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PLASTIC SURGERY IN REVIEW: Q&A

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CRANIOMAXILLOFACIAL — 1998

1

Which of the following arteries is the main vascular supply for the temporalis myofascial flap?

(A) Deep temporal
(B) Masseteric
(C) Occipital
(D) Superficial temporal

The correct response is Option A.

The temporalis myofascial flap, which is composed of the temporalis muscle and the deep temporal fascia, is primarily supplied by the myofascial branches of the deep temporal artery. This vessel is a branch of the external carotid artery. It runs posterior and medial to the mandibular ramus and inserts into the medial and inferior margin of the temporalis.

The temporalis myocutaneous flap is used in patients with chronic internal derangement of the temporomandibular joint who have continued pain and dysfunction following conservative therapy. Reconstruction of the articular disk using this flap is recommended for these patients.

The masseteric artery, a branch of the internal maxillary artery, inserts into the masseter muscle along its medial surface and supplies blood to that muscle.

The occipital artery is a branch of the external carotid artery. It provides the vascular supply for the occipital region of the skull.

The superficial temporal artery is the terminal branch of the external carotid artery. It supplies blood to the superficial temporal fascia, which is not harvested as part of the temporalis myocutaneous flap.

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2

In a patient with a hypoplastic mandible, which of the following cephalometric facial angles is most likely to be smaller (more acute) than normal?

(A) ANB
(B) SNA
(C) SNB
(D) SNO

The correct response is Option C.

In a patient with a hypoplastic mandible, the SNB angle is likely to be smaller, or more acute, than the SNB angle in a person with a normal mandible. Point B would be in a more posterior position in relation to the cranial base. In a patient with mandibular prognathism, point B would be in a more anterior position in relation to the cranial base, resulting in an SNB angle that would be more obtuse than normal.

The ANB angle measures the relationship of the maxilla to the mandible. A patient with a hypoplastic mandible and a normal maxilla would have an increased (more obtuse) ANB angle.

The SNA angle provides no information about the mandible because it relates the maxilla to the cranial base.

The SNO angle relates the orbit (orbitale) to the cranial base and has no relationship to the mandibular position.

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3

Plagiocephaly describes the shape of the skull that may result from fusion of which of the following sutures?

(A) Coronal
(B) Metopic
(C) Sagittal
(D) Squamosal

The correct response is Option A.

Plagiocephaly describes the shape of the skull that results from unilateral fusion of the coronal suture. The ipsilateral forehead is flattened and recessed, and the brow and superolateral orbit are elevated and retruded. Contralateral frontal bossing and orbital dystopia (inferior and anterior displacement of the supraorbital ridge) occur. The nasal root is deviated (constricted) toward the side of the fusion, and the tip of the nose is deviated to the contralateral side.

Radiographs shows the classic "harlequin" orbit resulting from elevation of the lesser wing of the sphenoid on the side of the fusion.

Trigonocephaly is a triangular-shaped deformity of the forehead. It results from synostosis of the metopic suture. Orbital hypotelorism is frequently associated.

Scaphocephaly describes the elongated, narrow skull resulting from synostosis of the sagittal suture.

Synostosis of the squamosal suture does not result in a characteristically described abnormal skull shape.

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4

A 12-year-old girl sustains a right subcondylar fracture and a left parasymphyseal fracture when she falls head first. Radiographs show that the right condylar head is displaced laterally out of the glenoid fossa, with medial rotation of the condylar neck; the left parasymphyseal fracture is nondisplaced.

Which of the following is the most appropriate management?

(A) Intermaxillary fixation for four weeks followed by passive/active physical therapy
(B) Closed reduction and intermaxillary fixation for two weeks and passive/active physical therapy
(C) Open reduction and internal fixation of the right subcondylar fracture followed by intermaxillary fixation for six weeks and passive/active physical therapy thereafter
(D) Open reduction and internal fixation of both the right subcondylar fracture and the left parasymphyseal fracture followed by intermaxillary fixation for two weeks and passive/active physical therapy thereafter

The correct response is Option D.

Open reduction of a fracture of the mandibular condyle is not commonly performed because the procedure may be complicated and closed reduction is usually sufficient. However, open reduction of the condyle is absolutely indicated in the following four situations:

1. Displacement into the middle cranial fossa
2. Impossibility of obtaining adequate dental occlusion by closed reduction
3. Lateral extracapsular displacement of the condyle
4. Invasion by a foreign body (e.g., a bullet from a gunshot wound)

Because the condylar head is displaced in this patient, open reduction and internal fixation of the right subcondylar fracture and the left parasymphyseal fracture must be performed. Intermaxillary fixation should be applied before

the procedure and remain in place for two weeks after the surgery. Subsequently, active and passive physical therapy of the mandible should be performed to work the mandible and remold the subcondylar union.

Closed reduction is contraindicated in this patient because of the displacement of the condylar head.

Intermaxillary fixation applied for an extended time period (greater than four weeks) may result in postoperative ankylosis.

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5

A newborn has a 2.5-cm area of absent skin at the vertex of the scalp. There is a palpable defect of the underlying skull. The most likely diagnosis is

(A) aplasia cutis congenita
(B) birth trauma
(C) congenital amniotic band
(D) pressure from the maternal pelvis
(E) Tessier 0 craniofacial cleft

The correct response is Option A.

The most likely diagnosis in this newborn is aplasia cutis congenita. This congenital disorder is characterized by a scalp defect most commonly in the midline of the vertex. It may be associated with a skull defect and/or exposure of the dura or brain. Most affected patients have defects less than 2 cm in diameter; spontaneous resolution frequently occurs, and only dressing changes are recommended to prevent infection and desiccation. Patients with larger defects, including exposed dura and missing bone, may require complex reconstruction using skin grafts, scalp flaps, or tissue expansion.

Although the etiology is unknown, some patients with aplasia cutis congenita exhibit trisomy D and familial inheritance. Arrested development secondary to vascular hypoplasia has been thought to be a contributing factor. Associated defects include hydrocephalus, myelomeningocele, cleft lip and palate, and abnormalities of the cranium, fingers, and trunk. Approximately 25% of patients with aplasia cutis congenita have at least two affected scalp areas. Exposure of the sagittal sinus or dura is associated with an increased risk for hemorrhage, meningitis, and other life-threatening complications.

Birth trauma results in infant molding of the head, fracture of the skull, facial trauma from obstetric forceps, or brachial plexus injury caused by traction on the upper extremity. Scalp defects are not associated with such trauma.

Congenital amniotic bands are thought to be a cause of plagiocephaly and constriction bands of the extremities but not of scalp defects.

Pressure from the maternal pelvis on the fetal skull during childbirth most likely causes deformational plagiocephaly, which is a condition not associated with defects in the scalp or skull.

A Tessier 0 craniofacial cleft occurs directly in the facial midline and extends superiorly from the nasal cavity. It would not cause an isolated skin defect at the vertex of the scalp.

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6

What is the earliest age at which the frontal sinus can be reliably viewed radiographically*?*

(A) 3 years
(B) 6 years
(C) 9 years
(D) 12 years
(E) 15 years

The correct response is Option B.

At birth, the frontal sinus cannot be distinguished from air cells within the anterior ethmoid. Growth is slow during the first year of life; the frontal sinus is difficult to locate during anatomical dissection in a 1-year-old child. It begins to invade the vertical portion of the frontal bone at 4 years of age, and at 6 years it is commonly noted on radiographs of the skull. Although a 12-year-old child has a large frontal sinus, growth is not complete until the late teenage years.

In an adult patient, the frontal sinus has an average height of 28 mm, a width of 24 mm, and an anteroposterior depth of 20 mm. However, the size and shape of the frontal sinus varies; asymmetry is not uncommon. It may be located in either the vertical, orbital, or both parts of the frontal bone. It may empty into either the anterior middle meatus or the anterior infundibulum.

The supraorbital and supratrochlear arteries rise from the ophthalmic artery to supply blood to the frontal sinus. The superior ophthalmic vein supplies drainage through the superior orbital fissure to the cavernous sinus. Sensory innervation is provided by the supraorbital and supratrochlear branches of the frontal nerve, which is a branch of the ophthalmic division of the trigeminal (V) nerve.

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7

The levator veli palatini muscle is primarily innervated by the

(A) V_2 branch of the trigeminal (V) nerve
(B) V_3 branch of the trigeminal (V) nerve
(C) facial (VII) nerve
(D) vagus (X) nerve
(E) hypoglossal (XII) nerve

The correct response is Option D.

The levator veli palatini muscle comprises a muscular sling in the posterior palate that is essential for effective palatal closure. It arises embryologically from the fourth pharyngeal arch and, therefore, is innervated by the pharyngeal plexus, a derivative of the vagus (X) nerve. This nerve also innervates several other muscles that figure prominently in speech development: the pharyngeal constrictors, the musculus uvulae, the palatoglossus, and palatopharyngeus.

The trigeminal (V) nerve has three separate divisions. The first branch, the ophthalmic division, is purely sensory, as is the second division. The second, or maxillary, division is intermediate in size between the first and third divisions. The mandibular branch of the trigeminal nerve, the third division, is the largest branch and contains both sensory and motor nerves. Developmentally, the third division is a nerve of the first branchial (or mandibular) arch and provides motor innervation to the muscular derivatives of this arch, including the temporal, masseter, pterygoids, mylohyoid, tensor tympani, and the anterior belly of the digastric.

The facial (VII) nerve provides motor innervation to the muscles of facial animation, including the buccinator.

The hypoglossal (XII) nerve provides motor innervation to the tongue.

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8

A 2-year-old child has recurrent discharge from a sinus in the left lower aspect of the neck at the anterior border of the sternocleidomastoid muscle, between the middle and lower third of the muscle. This condition has been present since birth. Which of the following nerves will be at greatest risk for injury during surgical excision of the lesion?

(A) Facial (VII)
(B) Spinal accessory (XI)
(C) Hypoglossal (XII)
(D) Lingual
(E) Recurrent laryngeal

The correct response is Option C.

The child most likely has a congenital branchial cleft sinus or fistula. This is a remnant of the cleft between the second and third branchial arches. The second branchial arch descends over the third, elongating the cleft between them and causing its external opening to emerge in the lower neck. The internal opening lies at the anterior aspect of the posterior pillar of the fauces, just behind the tonsil (the junction between the second and third branchial arches). The fistulae are bilateral in 30% of cases and, although mainly lined with stratified squamous epithelium, may also have some pseudostratified columnar ciliated epithelium in their walls. Keratin, hair follicles, sweat glands, and sebaceous glands may also be present. Complete excision is required to prevent recurrence.
Characteristically, the fistulae follow the carotid sheath upwards before crossing the hypoglossal (XII) nerve and passing between the internal and external carotid arteries to reach the tonsillar fossa. As a result, the hypoglossal nerve is at risk during surgery.

The facial (VII) nerve is not in the vicinity of the lesion. However, it is intimately related to first branchial arch sinuses and cysts. The spinal accessory (XI) nerve lies in the posterior triangle of the neck and should not be at risk during surgery to correct the lesion. The lingual nerve lies at a higher level and is comparatively safe. The left recurrent laryngeal nerve arises from the vagus (X) nerve low in the neck before hooking round the subclavian artery and passing medially behind the common carotid artery to reach the groove between the trachea and the esophagus; thus it, too, is out of harm's way.

The vagus (X) nerve lies in the carotid sheath behind, and somewhat between, the internal jugular vein and the common carotid artery. The fistula lies on the other side of the great vessels. At the carotid bifurcation, the vagus nerve is lateral to the fistulous tract and stands less chance of injury than does the hypoglossal nerve.

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9

A 6-month-old infant has rotation of the chin to the left, flattening of the left side of the forehead and right occiput, asymmetric positioning of the ears, and palpebral fissures. There is a palpable mass in the right lower anterior aspect of the neck. Which of the following muscles is the most likely cause of the chin deviation?

(A) Omohyoid
(B) Sternocleidomastoid
(C) Sternohyoid
(D) Sternothyroid
(E) Trapezius

The correct response is Option B.

This patient's clinical features are most likely associated with torticollis, a condition that results from shortening and fibrosis of the right sternocleidomastoid muscle. Infants with torticollis have deviation of the chin upward and contralateral to the affected muscle. On the affected side, the head is tilted and the shoulder is raised. Rotation of the head may be restricted; lateral flexion to the side opposite the deformity may also be difficult. Torticollis is associated with nonsynostotic, or deformational, plagiocephaly.

The most appropriate management of torticollis is physical therapy instituted during infancy. Surgical release, which involves division of both heads of the sternocleidomastoid muscle through a small transverse incision just superior to the clavicle, is rarely required with this treatment course.

Patients with torticollis may also have a pseudotumor that can be palpated within the sternocleidomastoid muscle. Spontaneous resolution of this mass occurs in most patients; surgical excision is not required. Pathologic examination of a biopsy specimen, when necessary, shows immature cellular tissue that contains dispersed remnants of muscle fiber.

The omohyoid, sternohyoid, and sternothyroid muscles are not involved in torticollis since these strap muscles play no role in head movement. However, patients who undergo surgical release of the sternocleidomastoid muscle may also require release of the scaleni, splenius capitis, and trapezius muscles, which may become secondarily tightened. These muscles are located deep to the sternocleidomastoid.

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10

A right unilateral cleft lip is most likely to result from incomplete union between which of the following prominences?

(A) The frontonasal prominence to the lateral nasal prominence
(B) The frontonasal prominence to the medial nasal prominence
(C) The lateral nasal prominence to the maxillary prominence
(D) The lateral nasal prominence to the medial nasal prominence
(E) The medial nasal prominence to the maxillary nasal prominence

The correct response is Option E.

Five facial prominences border the developing mouth. These include the bilateral mandibular prominences, the bilateral maxillary prominences, and the frontonasal prominence. The lateral nasal and medial nasal prominences are derived from the frontonasal prominence. A unilateral cleft lip results from incomplete union between the medial nasal prominence and the maxillary prominence on the affected side.

The lateral nasal and medial nasal prominences are derived from the frontonasal prominence. Clefting would not result from incomplete union of these structures.

The lateral nasal prominence unites with the maxillary prominence. A patient with a unilateral cleft lip will have continuity between the lateral alar base and the lateral segment of the upper lip.

The lateral nasal prominence does not normally unite with the medial nasal prominence. A lack of union between the lateral and medial nasal prominences will not result in a cleft lip.

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11

The mental nerve exits the mental foramen at which of the following sites?

(A) Below the canine halfway down the mandible
(B) Below the first premolar halfway down the mandible
(C) Below the first premolar, directed posteriorly
(D) Below the second premolar halfway down the mandible
(E) Below the lateral incisor

The correct response is Option D.

The mental nerve exits the mental foramen below the second premolar, halfway down the mandible.

The mental nerve is the terminal branch of the inferior alveolar nerve, a major branch of the third division of the trigeminal (V) nerve. It provides sensation to the lower lip and to the skin overlying the chin. As such, its location must be known before using local anesthetic block techniques in this region. Moreover, knowing the mental nerve's exact location can be of use in avoiding inadvertent injury during osseous genioplasty.

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12

A 50-year-old man has an ulcerated lesion of the hard palate. Biopsy of the lesion shows marked pleomorphic cells, frequent mitotic activity, and intercellular bridging. Which of the following is the most likely diagnosis?

(A) Adenocarcinoma
(B) Adenoid cystic carcinoma
(C) Mucoepidermoid carcinoma
(D) Necrotizing sialometaplasia
(E) Poorly differentiated squamous cell carcinoma

The correct response is Option E.

This patient most likely has a poorly differentiated squamous cell carcinoma, the most common malignant lesion of the oral cavity. A biopsy specimen typically shows desmosomes or intercellular bridging. Other histologic findings include frequent mitosis and pleomorphism. Keratin pearls are seen on biopsy of differentiated squamous cell carcinoma.

Adenocarcinoma rarely affects the palate. This tumor may resemble undifferentiated squamous cell carcinoma, but intercellular bridging is not seen on biopsy.

Adenoid cystic carcinoma is the most common malignant tumor of the minor salivary glands. Biopsy shows cylindric epithelial masses that contain basophilic and pale-staining cells.

Mucoepidermoid carcinoma is a rare malignant tumor of the minor salivary glands. Biopsy shows mucoid and squamous elements.

Necrotizing sialometaplasia is a benign, ulcerated lesion of the palate that resembles a malignant tumor. Biopsy of a lesion shows metaplastic squamous ductal cells.

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13

A 3-year-old boy has a dermoid cyst at the lateral aspect of the right eyebrow. Although he has no exophthalmos at rest, gentle palpation of the cyst shows indistinct margins and a decrease in size with accompanying proptosis. Which of the following is the most appropriate initial step in management?

(A) Observation with reevaluation in six months
(B) CT scan
(C) Needle aspiration
(D) Exophthalmometry
(E) Surgical excision

The correct response is Option B.

This child has a dermoid cyst of the orbital region. Most orbital dermoids manifest as solitary masses with distinct palpable margins and without intracranial extension; patients with these findings do not require preoperative evaluation to exclude the possibility of intracranial involvement. Simple excision of the cyst is appropriate at the time of diagnosis.

In infrequent cases, a dermoid cyst does not have distinct margins on palpation. The cyst may decrease in size with gentle pressure, and proptosis may occur. Patients with these findings may have extension of the dermoid cyst through the lateral orbital wall. CT scan should be performed to determine the extent of intraorbital involvement and assess the need for orbital reconstruction following surgical excision. Incomplete evaluation of these patients may lead to an incomplete excision of the dermoid. Inflammation, abscess, or sinus formation may occur.

In this patient, the axial CT scan on the previous page shows extension of the cyst through the right lateral orbital wall and the resulting orbital involvement. Although this finding is not common with dermoids of the lateral brow, it is more frequent in patients with delayed presentation of the orbital dermoid.

Observation is not recommended for management of dermoid cysts. These cysts should be appropriately managed with either surgical excision or further preoperative evaluation at the time of diagnosis. Delay of surgical management results in a higher risk for a symptomatic lesion.

Needle aspiration has not been shown to be effective for preoperative evaluation of a dermoid cyst.

Although Hertzel exophthalmometry is used for measurement of proptosis at rest, it would not be of value in this patient who has proptosis only on compression of the lesion.

Surgical excision would not be appropriate without initially evaluating the extent of tumor involvement.

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14

A 40-year-old woman is referred for evaluation of asymmetry of the cheek bones. Six months ago, she underwent open reduction and internal fixation of a left zygomatic fracture. Physical examination shows decreased projection over the body of the left zygoma with fullness of the ipsilateral nasolabial fold, when compared with the contralateral side. Palpation of the orbital rim shows a microplate with no evidence of an infraorbital step-off. A CT scan shows an anatomically reduced zygoma secured with mini- and microplates.

These findings are most consistent with

(A) early Romberg's disease
(B) fat atrophy of the overlying cheek
(C) malunion of the zygoma
(D) ptosis of the malar fat pad
(E) unrecognized contralateral zygomatic fracture

The correct response is Option D.

This patient who has previously undergone open reduction and internal fixation of a zygomatic fracture has developed facial asymmetry because of ptosis of the malar fat pad. This type of reduction of zygomatic fractures requires extensive subperiosteal exposure of bone in order to perform adequate anatomic reduction. Deformities that result from the need for extensive exposure include scleral show, lower lid ectropion, and deepening of the ipsilateral nasolabial fold, which occurs secondary to soft-tissue ptosis. Despite proper anatomic reduction, the overlying skin, fat, and muscle migrate downward to cover the zygomatic prominence. The projection of the cheekbone appears decreased because the thin skin of the lower eyelid drops over the zygomatic body. These associated deformities can be prevented by performing periosteal resuspension of the overlying soft tissue after reduction of the fracture.

Romberg's disease (progressive hemifacial atrophy) typically has its onset before age 20 years. It does not result from traumatic injury.

Fat atrophy that occurs secondary to trauma would manifest as a localized depression at the overlying cheek. Nasolabial fullness would not occur.

Because the postoperative CT scan showed proper anatomic reduction of the zygomatic bones, malunion of the ipsilateral side and contralateral fracture would be excluded as diagnoses.

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15

In a sagittal split osteotomy of the mandible, the neurovascular bundle should remain in which of the following segments of the mandible?

(A) Proximal segment
(B) Distal segment
(C) Lateral segment
(D) Superior segment
(E) Inferior segment

The correct response is Option B.

The mandibular (V_3) nerve is a branch of the trigeminal (V) nerve. It emerges from the base of the skull from the foramen ovale and enters the mandible at the lingula on the medial side of the mandibular ramus. Traveling through the mandibular canal, it innervates the mandibular dentition. A branch of the mandibular nerve emerges through the mental foramen, becoming the mental nerve, carrying sensation to the lower lips. During mandibular sagittal split osteotomy, the neurovascular bundle must remain in the distal segment of the mandible in order to maintain innervation of the lip and teeth.

Sagittal split osteotomy is especially suited to advancing the mandible (e.g., treating micrognathia) while continuing to maintain bone-to-bone contact without the need of grafting; the relationship of the condylar head in the glenoid fossa will also be maintained with this procedure.

The viability of the proximal bone segment is maintained by preserving soft-tissue attachments.

There are only two bony segments with a sagittal split osteotomy, the distal and proximal. There is no inferior or superior segment used to describe this operation. Whereas the lateral segment could be considered the proximal segment, it is not the segment in which the neurovascular bundle is maintained.

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16

A 28-year-old man sustains blunt trauma to the face. Examination shows enophthalmos, periorbital ecchymosis, subcutaneous emphysema, and ipsilateral epistaxis. These findings are most consistent with a fracture of the

(A) anterior wall of the maxillary sinus
(B) anterior wall of the frontal sinus
(C) medial wall of the orbit
(D) nasal bones
(E) zygomatic arch

The correct response is Option C.

Low-energy injuries result in fractures at the weakest points of the facial skeleton. The medial wall of the orbit fractures easily because of its thinness. Enophthalmos results from protrusion of orbital contents through the fractured medial wall. The lamina papyracea forms most of the medial wall and is also the lateral component of the ethmoid sinuses; when the medial wall is fractured, there is ipsilateral epistaxis. Subcutaneous emphysema occurs when the natural barriers between the air-filled cavities and the soft tissue are broken. Periorbital ecchymosis is caused by the tracking of blood along the orbital septum.

Fractures involving the anterior maxillary sinus, frontal sinus, or nasal bones do not cause enophthalmos, although the other symptoms may be present.

A fracture of the zygomatic arch would not cause the findings seen with a fracture of the medial wall of the orbit. Typically, an isolated zygomatic fracture will display a depressed arch and trismus.

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17

A 6-month-old infant has a smooth, firm, noncompressible lesion over the cephalad dorsum of the nose with discoloration of the overlying skin. The lesion does not transilluminate. Evaluation should include which of the following studies?

(A) Angiography
(B) CT scan of the head
(C) Nasoendoscopy
(D) Needle aspiration for culture and cytology
(E) Ultrasonography of the lesion

The correct response is Option B.

This 6-month-old infant with a mass on the dorsum of the nose most likely has an extranasal glioma. This congenital abnormality contains glial tissue but does not have nervous system or subarachnoid attachments. It appears as a smooth, firm, noncompressible lesion that does not transilluminate. Discoloration or telangiectasia of the overlying skin is a frequent finding. A CT scan of the head, including the base of the skull, is needed to rule out intracranial extension prior to removal of the lesion.

Splaying of the nasal bones on CT scan is seen with gliomas and other similar congenital masses. However, patients with intracranial involvement will also have defects in the foramen cecum and crista galli and significant dural attachment. These findings indicate the need for craniotomy for adequate exposure and resection of the lesion.

Angiography should only be used to rule out the presence of an angiofibroma, which is a rare associated finding.

Nasoendoscopy would show nasal obstruction but would not determine the extent of the lesion or the treatment course.

Needle aspiration is not useful in diagnosis of a mass of the nasal dorsum.

Ultrasonography would not determine the extent of the lesion.

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18

After undergoing laryngectomy for treatment of malignant carcinoma, patients are most likely to be concerned with their inability to control which of the following?

(A) Breathing
(B) Chewing
(C) Drooling
(D) Swallowing
(E) Taste

The correct response is Option D.

Any procedure that decreases the mobility of the tongue or alters the digestive pathway can interfere with the patient's ability to swallow. After laryngectomy, the tongue may be uncoordinated and the mucosa may lose sensation. Discontinuity of the digestive tract will require alternate methods of feeding. Because swallowing is essential for the patient's quality of life, loss of control of this function following laryngectomy may lead to significant social withdrawal. Reconstruction of the larynx is aimed toward preserving the basic functions, which include speech and swallowing.

Adequate control of breathing is ensured by performing tracheostomy at the time of surgery.

In patients who have difficulties with chewing, a diet of soft foods can be instituted.

Drooling commonly results from loss of lip sensibility, paralysis, or cicatricial retraction following obliteration of the gingivobuccal sinus. Surgical approaches that split the lower lip are a frequent cause. Although drooling is a concern, it is often unilateral and can be corrected with a secondary procedure.

Although loss of taste may be unpleasing or irritating, it will not interfere with social interaction.

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19

A 30-year-old woman has an opening click of the temporomandibular joint. Six months ago, she sustained blunt facial trauma in a motor vehicle accident. Which of the following is the most likely cause of the opening click?

(A) Air in the joint space
(B) Bony foreign bodies in the joint space
(C) Contact of the condylar head against the articular eminence
(D) Contact of the mandibular condyle against the glenoid fossa
(E) Subluxation of the articular disk

The correct response is Option E.

Patients who have a clicking sound of the temporomandibular joint (TMJ) on opening of the jaw commonly have subluxation of the articular disk. These clicks are caused by subluxation and relocation of the articular disk and retrodiskal tissue. Some patients also have a reciprocal click that occurs during jaw closure. These two findings are suggestive of internal derangement of the TMJ.

Although painless clicks are frequently left untreated, reciprocal clicks associated with pain require more aggressive management. Conservative treatment consisting of bite adjustment, administration of nonsteroidal anti-inflammatory drugs, and physical therapy are initial treatment options. Surgery is reserved for those patients who fail to improve with conservative therapy.

Patients with open fractures of the mandibular condyle or severe panfacial fractures may develop air within the joint space. However, these patients do not have clicking with function of the TMJ.

Bony foreign bodies located within the joint space may cause pain and decreased range of motion of the mandibular condyle but would not result in clicking.

A patient with degenerative disease affecting the articular disk may have direct contact between the condylar head and the articular eminence and glenoid fossa, because these bony structures are separated from the mandibular condyle by the disk. However, pain, especially with mandibular function, and decreased range of motion are the associated symptoms of this disease.

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20

A 45-year-old man has a 1.5-cm superficial ulcer of the midline of the lower lip. There is no lymphadenopathy on palpation of the neck. Biopsy shows well-differentiated squamous cell carcinoma. Which of the following is the most appropriate management?

(A) Irradiation
(B) Resection and bilateral modified neck dissection
(C) Vaporization with a CO_2 laser
(D) Vermilionectomy and mucosal advancement
(E) Wedge resection

The correct response is Option E.

This patient has a stage I squamous cell carcinoma of the lower lip. The regional lymphatic drainage of midline lesions is bilateral; however, clinical examination does not show lymphadenopathy. The risk for regional lymphatic drainage for this well-differentiated T1 lesion without palpable lymph nodes is less than 10%. Because of this, wedge resection should be performed to provide local control of the lesion with adequate function and cosmesis. Most early squamous cell carcinomas can be excised under local anesthesia. The adjacent premalignant tissue should also be removed.

Radiation therapy can be used in patients medically unable to undergo surgery. Patients who would have functional or cosmetic difficulties following surgery also benefit from radiation. Treatment may consist of external beam radiation, brachytherapy, or a combination of both methods, depending on the size and location of the tumor. However, wedge resection will result in a better cosmetic and functional result in this patient.

Bilateral modified neck dissection is not needed in a patient with a stage I lesion who has no evidence of lymphadenopathy on clinical examination or radiographs.

Vaporization with a CO_2 laser and vermilionectomy are both appropriate methods for management of actinic cheilitis or leukoplakia but would not be effective in a patient with invasive squamous cell carcinoma.

Defects of the vermilion can be closed with mucosal advancement. Primary closure of the defect using a V-lip or W-lip technique is appropriate when the excised area is less than one third of the total lip. Local flap reconstruction using an Abbe, Bernard, Estlander, or Karapandzic flap will effectively repair defects of one third to two thirds of the lip.

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21

A 25-year-old woman sustains a fracture of the frontal bone. A CT scan shows extensive comminution and displacement of the posterior wall and floor of the frontal sinus, as well as a frontal lobe contusion. Which of the following is the most appropriate management of the frontal sinus?

(A) Observation
(B) Reconstruction of the nasofrontal duct
(C) Open reduction of the posterior wall
(D) Cranialization of the frontal sinus
(E) Reidel procedure (resection of the anterior frontal sinus walls)

The correct response is Option D.

The most appropriate management of this patient who has a comminuted fracture of the posterior wall of the frontal sinus is cranialization, which will protect the frontal lobes and allow any associated edema to heal. Repair of the dura may be accomplished more easily following cranialization. In addition, the anterior wall remains intact, maintaining the aesthetics of the frontal bone. A galeal frontalis flap may also be transferred following cranialization to separate the brain from the respiratory cavity. An alternative treatment is to obliterate the frontal sinus after stripping off all the mucosa.

In cases of a comminuted fracture of the frontal bone, observation would be an inadequate management because of the possible development of meningitis and abscess formation when the respiratory cavity is allowed to remain in direct contact with the brain.

Reconstruction of the nasofrontal duct and open reduction of the posterior wall are not indicated in patients with comminuted fractures of the frontal sinus. Because the posterior wall and nasofrontal duct function together to provide drainage to the frontal sinus, a comminuted fracture of any portion of this area is best managed with cranialization or sinus obliteration. The duct otherwise tends to become stenosed and create the later problems of recurrent sinusitis and mucocele.

The Reidel procedure involves removal of the anterior wall and corresponding sinus mucosa, which allows retraction of the skin of the forehead against the posterior wall. This procedure has become obsolete because of its resultant cosmetic defects.

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22

A 15-year-old patient with cleft lip and palate will most likely require which of the following orthognathic procedures?

(A) Le Fort I maxillary advancement
(B) Le Fort I maxillary setback
(C) Le Fort III facial advancement
(D) Mandibular sagittal split osteotomy
(E) Mandibular subcondylar vertical ramus osteotomy

The correct response is Option A.

This 15-year-old patient with cleft lip and palate most likely has a hypoplastic maxilla and a class III malocclusion resulting from poor development of the maxilla. The most appropriate orthognathic procedure is Le Fort I osteotomy with maxillary advancement. This procedure will advance the entire lower midfacial region to re-establish the needed projection of the face and compensate for the retrusion of this region. It will also help re-establish more normal maxillary to mandibular dental relationships.

A Le Fort I setback procedure would worsen the retrusive appearance of this patient's face and therefore is not appropriate. Moving the maxilla posteriorly would also result in the soft tissue dropping posteriorly, worsening the dental relationship with the mandible.

A Le Fort III osteotomy would only correct the upper face and orbits, which is not necessary in a patient with cleft lip and palate.

Sagittal split and subcondylar vertical ramus osteotomies will only correct mandibular defects.

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23

A 50-year-old woman has undergone surgical ablation of a head and neck cancer. Postoperative radiation is indicated if her surgery fits which of the following categories?

(A) Excision of a melanoma of the buccal region
(B) Excision of a T2, N0 squamous cell carcinoma of the mobile tongue
(C) Parotidectomy for low-grade mucoepidermoid carcinoma
(D) Partial lower lip excision and reconstruction for squamous cell carcinoma
(E) Radical neck dissection for extracapsular nodal disease

The correct response is Option E.

Postoperative radiation may be used in patients with aggressive or advanced tumors. It is appropriate for patients with involvement of multiple nodes or a single node greater than 3 cm. A patient with extracapsular nodal disease who has undergone modified radical neck dissection should receive postoperative radiation.

Melanoma of the buccal region should be treated with excessive resection and nodal dissection. This malignancy is not sensitive to radiation therapy.

Parotidectomy alone is appropriate treatment of low-grade mucoepidermoid carcinoma.

Squamous cell carcinoma of the tongue or lip is best treated with excision alone. Radiation can be used in patients with associated adenopathy.

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24

During a LeFort I maxillary osteotomy, the tooth most likely to be injured by a low osteotomy line is the

(A) central incisor
(B) cuspid
(C) first bicuspid
(D) lateral incisor
(E) second bicuspid

The correct response is Option B.

The cuspids, or canine teeth, have the longest roots in both the maxilla and mandible. The average length of a cuspid tooth from the tip of the root to the tip of the crown is 27 mm. It is vital to know the length and position of the dental roots in order to avoid injuring the apices of the cuspid teeth during Le Fort I osteotomy and placement of internal fixation (interosseous miniplates or microplates and screws). The dentition may also be injured during stabilization of maxillary or mandibular fractures.

The bicuspid, central and lateral incisor, and molar teeth all have roots that are shorter than the roots of the cuspid teeth; the average length of a molar tooth from the tip of the root to the tip of the crown, for example, is 24 mm. Consequently, these teeth are much less likely to be injured during LeFort I osteotomy.

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25

A 62-year-old man undergoes resection of a tumor on the floor of the mouth that has invaded the mandible. He then undergoes reconstruction with a free osteocutaneous fibula flap. Although initially pink, the skin at the flap site is mottled and blue after 12 hours. Which of the following is the most appropriate management?

(A) Administration of a bolus of crystalloid fluid
(B) Intravenous administration of urokinase
(C) Transfusion of packed erythrocytes
(D) Application of leeches
(E) Immediate reexploration

The correct response is Option E.

This patient should undergo immediate reexploration of the vascular pedicle of the osteocutaneous fibula flap. Thrombosis of the vascular pedicle occurs in approximately 10% of patients after free flap transfer. Flap salvage can be accomplished by early recognition and aggressive reexploration. Hourly flap monitoring is performed for a minimum of 72 hours after transfer. This monitoring includes assessment of color, capillary refill, and Doppler pulse (if obtainable by the hand-held ultrasonic Doppler) or the use of devices such as the 20 MHz implantable Doppler or the laser Doppler. Any change in these indicators should be accompanied by emergent reexploration of the vascular pedicle. A swollen, blue, congested flap suggests venous thrombosis. Similar findings are also found with a hematoma occurring under the flap.

A common error in flap management is the assumption that a complication involves the perforating vessels between the main donor vessel and the skin portion of the composite flap. Although this may happen with osteocutaneous flaps, it should not be assumed, and surgical exploration of the vascular pedicle should be performed. If the main vascular pedicle is patent, then obstruction of the vessels that supply the skin paddle may be the cause. Obstruction may be the result of poor flap design, twisting of the skin paddle pedicle, or pressure on the skin paddle vessels caused by shaping of the flap. Appropriate measures may be taken depending on the cause.

Administration of a bolus of crystalloid fluid is not appropriate since there is no indication that this patient has hypovolemia.

Urokinase is not used for systemic management of free flaps. It is helpful in direct arterial infusion when it is known that there is no mechanical obstruction of the pedicle. In any event, exploration is required to rule out a mechanical cause of the thrombosis.

Although a hematocrit of 23% is lower than normal, it is not low enough to cause flap ischemia. Therefore, transfusion of packed erythrocytes is not effective management.

Application of leeches is appropriate in cases of venous congestion but would not correct thrombosis or mechanical kinking in the pedicle.

Early wound infection in patients who have undergone flap reconstruction would be accompanied by fever and significant tachycardia. Intravenous antibiotics would be appropriate treatment for such an infection.

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26

A 6-year-old boy has a submucous cleft palate, velopharyngeal insufficiency, learning disabilities, and cardiac anomalies. Examination shows a broad nose, malar flattening, epicanthal folds, retrognathia, and vertical maxillary excess. The most likely diagnosis is

(A) Down syndrome
(B) Pierre Robin sequence
(C) Stickler's syndrome
(D) Van der Woude's syndrome
(E) Velocardiofacial syndrome

The correct response is Option E.

This patient has velocardiofacial syndrome, an autosomal dominant condition caused by a deletion of the long arm of chromosome 22. Velocardiofacial syndrome is characterized by complete or submucous clefting of the palate, velopharyngeal insufficiency, and cardiac abnormalities. Abnormal facial features associated with this syndrome include a broad, prominent nose, malar flattening, epicanthal folds, retrognathia, and vertical maxillary excess.

Because anomalies of the internal carotid arteries are believed to be associated with velocardiofacial syndrome, nasoendoscopy has been recommended for affected patients to observe for pulsations on the posterior pharyngeal wall. However, it has recently been shown that magnetic resonance angiography is the diagnostic study of choice for detecting abnormalities of the carotid vasculature. Findings obtained from this study are helpful for planning operative correction of velopharyngeal insufficiency.

Down syndrome, or trisomy 21, is characterized by mental retardation, brachycephaly, congenital heart defects, auditory and visual abnormalities, and characteristic facies. It is not associated with cleft palate.

Patients with the Pierre Robin sequence may have cleft palate, but this is not a mandatory finding. Other associated abnormalities include microretrognathia, glossoptosis, and respiratory distress.

Stickler's syndrome, which may be associated with the Pierre Robin sequence, is an autosomal dominant mutation that results in myopia in infancy, retinal detachment, and progressive blindness. Cataracts may also occur.

Van der Woude's syndrome is an autosomal dominant disorder with variable penetrance. Patients with this condition have cleft lip and/or palate with lip pits. These pits represent accessory salivary glands.

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27

A 65-year-old woman has a 10-mm smooth pink nodule on the lower eyelid. Histologic analysis of a biopsy specimen confirms a diagnosis of Merkel cell carcinoma. Which of the following is the most appropriate next step in management?

(A) Excision with direct closure
(B) Excision with 2-mm margins and postoperative radiation therapy
(C) Radiation therapy only
(D) Radiation and chemotherapy
(E) Wide excision with subtotal or total lower eyelid reconstruction

The correct response is Option E.

This patient has Merkel cell carcinoma, a rare, highly malignant tumor that is found primarily on the head and neck. Management of Merkel cell carcinoma is wide local excision with dissection of the lymph nodes when appropriate. Because removal of the tumor would involve excision of most of the eyelid, subtotal or total reconstruction is necessary.

These carcinomas are composed of Merkel cells, which lie in the basal layer of the epidermis. Electron microscopy shows electron dense granules, strands of filaments, and desmosomes on the cell membranes. Merkel cells are thought to originate neuroectodermally. Although their precise function is unclear, it is believed that they are sensory receptors because they form intraepidermal complexes with free nerve endings. Merkel cell carcinoma occurs frequently in sun-exposed areas and appears as a firm, pink nodule on the dermis with a smooth, nonulcerated surface. It grows rapidly and metastasizes to the regional lymph nodes, liver, lungs, bones, and brain. The rate of mortality from this tumor is greater than 60%.

Total excision of this 10-mm tumor with appropriate margins would negate the possibility of direct closure; moreover, defects greater than one fourth of the total eyelid cannot be closed directly. The human eyelid is an average of 3 cm in diameter; making this patient's tumor involve one third of the eyelid.

Excision with a 2-mm margin would not sufficiently treat this tumor because the tumor characteristically has an indistinct border and a high rate of local recurrence unless a radical excision is performed.

Merkel cell carcinoma is resistant to radiation therapy, and there is no effective form of chemotherapy to treat this type of malignancy.

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28

A 28-year-old patient with an isolated parotid tumor undergoes superficial parotidectomy. Pathology confirms a low-grade acinic cell carcinoma with negative margins. Which of the following is the most appropriate next step in management?

(A) Observation
(B) Postoperative radiation therapy
(C) Completion parotidectomy
(D) Modified neck dissection
(E) Radical neck dissection

The correct response is Option A.

Superficial parotidectomy in this 28-year-old patient shows a low-grade acinic cell carcinoma with negative margins and no clinical evidence of neck metastasis. Consequently, the tumor has been adequately excised. The most appropriate management would be observation. A complete parotidectomy would not be necessary.

Clinical stage and histologic grade of malignant salivary gland tumors are significant predictors of survival. Studies have shown that 14% to 24% of patients with parotid carcinoma should have cervical lymphadenectomy because of clinical evidence of cervical node metastasis. Other predictors for occult cervical metastasis include facial (VII) nerve paralysis, age older than 50 years, perilymphatic invasion, and extraparotid tumor extension.

In a patient with parotid carcinoma with cervical metastasis, the best treatment results are achieved by combining adequate resection of the primary tumor with a parotidectomy and selective use of either postoperative radiation therapy or cervical lymphadenectomy.

When they are necessary, modified neck dissections are preferred to radical ones except in instances of extracapsular spread of the tumor, which would compromise such an approach. Radical neck dissection is reserved for those situations.

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29

Which of the following muscles can be used for reconstruction in a patient with facial paralysis?

(A) Buccinator
(B) Digastric, anterior belly
(C) Genioglossus
(D) Stylohyoid
(E) Zygomaticus major

The correct response is Option B.

The two bellies that comprise the digastric muscle receive sensory innervation from different sources. The anterior belly of the digastric muscle receives innervation from the inferior alveolar nerve, which rises from the mandibular division of the trigeminal (V) nerve. This muscle can be transferred and used during correction of paralysis involving the marginal mandibular branch of the facial (VII) nerve. Although the hypoglossal (XII) nerve can also be used in reconstruction in a patient with facial paralysis, altered tongue mobility is an adverse effect.

The buccinator, stylohyoid, and zygomaticus major muscles receive sensory innervation from the facial nerve, as does the posterior belly of the digastric muscle. These muscles would not be effective in ipsilateral reconstruction for facial paralysis.

The genioglossus muscle, supplied by the hypoglossal nerve, is located in the tongue. Tongue muscle cannot be transferred for reconstruction.

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30

A 42-year-old woman sustains fractures of the right orbit and zygoma in a motor vehicle accident. Which of the following is an indication for immediate ophthalmologic consultation?

(A) Corneal abrasion
(B) Diplopia
(C) Eyelid ptosis
(D) Hyphema
(E) Subconjunctival hemorrhage

The correct response is Option D.

If this patient has hyphema, or blood within the anterior chamber of the eye, she should undergo immediate evaluation by an ophthalmologist because of the urgent need for diagnosis and treatment. This condition is caused by tearing of the vessels within the iris during contusion. Fibrin and blood clots may impede filtration processes within the anterior chamber, leading to the development of glaucoma. Slit-lamp examination should be performed to determine the extent of hemorrhage and the presence of other injuries. Funduscopic examination and measurement of intraocular pressure are also recommended. Other indications for immediate consultation with an ophthalmologist include blindness or blurred vision, eye pain, rupture of the globe, or retrobulbar hematoma.

Consultation should be performed within 24 hours in patients with painful corneal abrasions, diplopia, or enophthalmos that is associated with normal vision and absence of pain. Patients with Le Fort II or III fractures should undergo measurement of globe pressure within 24 hours.

Patients with corneal abrasions typically have the sensation of a foreign body causing discomfort in the eye. The epithelial defects associated with corneal abrasions are caused by mechanical erosion of the cornea. Split-lamp examination and topical application of fluorescein will aid in diagnosis.

Diplopia, or double vision, may be present in one or several directions of gaze following blunt trauma to the face. Potential causes include edema of the extraocular muscles, entrapment of the muscles within the fracture lines, or paralysis of the oculomotor (III), trochlear (IV), or abducens (VI) nerves. A forced duction test will differentiate muscle from nerve involvement. Plain radiographs and CT scans are also helpful.

Posttraumatic ptosis of the eyelid results from edema of the lid, disruption of the levator aponeurosis, injury to the levator muscle or Müller's muscle, or palsy of the oculomotor nerve. This condition should be differentiated from pseudoptosis because of the possibility of exophthalmos. However, immediate ophthalmologic consultation is not necessary.

Subconjunctival hemorrhage stains the bulbar conjunctiva with blood from the nearby fracture site. This finding is seen on examination of the sclera. Evaluation of the fracture site is warranted, but it does not have to be immediate.

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31

Which of the following is the most appropriate management of a unicystic ameloblastoma of the mandible?

(A) Observation
(B) Enucleation and curettage
(C) Radical resection with at least a 1-cm margin
(D) Radiation therapy
(E) Segmental resection

The correct response is Option B.

The most appropriate management of a unicystic ameloblastoma of the mandible is enucleation and curettage, with frequent follow-up examinations. This type of tumor typically occurs in patients age 20 to 30 years and is found within the posterior mandible. It originates within the epithelial wall of a dentigerous cyst. Recurrence is uncommon.

Observation is inadequate management. If this type of tumor is left untreated, it continues to grow and is locally destructive.

Radical resection and/or hemimandibulectomy is recommended for patients with peripheral or extraosseous ameloblastoma. These aggressive tumors recur in 20% of affected patients. A biopsy specimen shows acanthomatous variety. Microscopic examination shows features similar to squamous cell carcinoma.

Radiation therapy is not necessary since unicystic ameloblastomas of the mandible are benign tumors.

A conventional or intraosseous ameloblastoma without tumor involvement of the margins is effectively treated with marginal (segmental) mandibular resection. Cortical spread of the tumor indicates the need for en-bloc resection with a 1-cm margin.

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32

A 25-year-old man is undergoing repair of a comminuted displaced fracture of the left zygoma. Which of the following landmarks will be most useful in restoring the zygoma to its anatomically correct position?

(A) Frontozygomatic suture
(B) Infraorbital rim
(C) Lateral orbital wall
(D) Lateral buttress
(E) Medial buttress

The correct response is Option C.

The most useful landmark in restoring the zygoma to its anatomically correct position is the lateral orbital wall, which is composed of the frontal process of the zygomatic bone and the greater wing of the sphenoid. Comminuted fractures of the lateral orbital wall are rare, even in patients with high-energy injuries to the zygoma. Intraoperative reconstitution of the three-dimensional lateral orbital wall will result in proper reduction of the fractured zygoma in all three planes. Inadequate reduction of the orbitozygomatic complex may manifest as loss of midface projection, increased facial width, and enophthalmos due to increased orbital volume.

Use of the frontozygomatic suture, infraorbital rim, lateral buttress, or medial buttress as a solitary anatomic landmark will result in accurate reduction of the zygoma only in two planes. Postoperative malposition of the bone may occur.

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33

Which of the following reconstructive techniques is most likely to provide optimal tongue function following hemiglossectomy?

(A) Free fibular flap
(B) Free radial forearm flap
(C) Pedicled tongue flap
(D) Sternocleidomastoid flap
(E) Split-thickness skin graft

The correct response is Option B.

In a patient who has undergone hemiglossectomy, a free radial forearm flap is most appropriate for reconstruction of the defect. This flap will provide a thin segment of tissue that will allow mobility of the reconstructed tongue. Resurfacing of the oral cavity is also possible with this flap.

The free fibular flap can be used for reconstruction of a segment of the mandible.

Use of a sternocleidomastoid flap is associated with a high incidence of flap failure.

A pedicled tongue flap or split-thickness skin graft would not provide sufficient tissue for reconstruction and would further limit tongue mobility.

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34

A 10-year-old boy has painless swelling of the mandible. A radiograph shows a radiolucent lesion with well-defined margins. Biopsy shows loose vascular stroma containing multinucleated cells. Which of the following is the most likely diagnosis?

(A) Ameloblastoma
(B) Dentigerous cyst
(C) Fibrous dysplasia
(D) Giant cell tumor
(E) Keratocyst

The correct response is Option D.

This child has a giant cell tumor of the mandible, the most frequent benign tumor of the facial skeleton in children. In comparison, giant cell tumors of long bones are usually malignant. Radiographs typically show a radiolucent lesion with well-defined margins. Histologically, giant cell tumors are indistinguishable from brown tumors of hyperparathyroidism. Therefore, all patients suspected of having a giant cell tumor should also be evaluated to exclude hyperparathyroidism.

Radiotherapy is not effective for giant cell tumors of the mandible. Small lesions may be treated by curettage. Larger lesions associated with bone destruction are most appropriately treated with excision and immediate skeletal reconstruction.

Microscopically, ameloblastomas show typically palisading, columnar, deep-staining cells (ameloblasts). Fibrous dysplasia shows disorganized connective tissue stroma and partially calcified osteoid. Dentigerous cysts are lined with epithelium, and keratocysts are lined with keratinized stratified squamous epithelium with a well-defined basal layer. Keratocysts may be locally aggressive and require more extensive treatment than enucleation.

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35

A 24-year-old man is brought to the emergency department following an automobile accident. He is alert. Examination shows a periorbital hematoma, ophthalmoplegia, ptosis of the upper eyelid, and a fixed dilated pupil on the left. Consensual light reflex is intact. Which of the following is the most likely diagnosis?

(A) Levator dehiscence
(B) Orbital apex syndrome
(C) Retrobulbar hematoma
(D) Superior orbital fissure syndrome
(E) Traumatic mydriasis

The correct response is Option D.

This patient most likely has superior orbital fissure syndrome. High-velocity fractures of the orbital roof may extend to involve the structures of the superior orbital fissure. The superior orbital fissure is formed by the greater and lesser wings of the sphenoid. Passing through this structure are the oculomotor (III) nerve, trochlear (IV) nerve, and abducens (VI) nerve, and the ophthalmic division of the trigeminal (V) nerve. Injury to the two divisions of oculomotor (III) nerve produces paralysis of the levator, superior rectus, inferior rectus, and inferior oblique muscles. Loss of trochlear (IV) nerve causes paralysis of the superior oblique muscle. Damage to abducens (VI) nerve produces paralysis of the lateral rectus muscle. Loss of the ophthalmic division of the trigeminal(V) nerve causes anesthesia of the brow, upper lid, and forehead.

Levator dehiscence results in upper eyelid ptosis, without sensory or motor paralysis of the extraocular musculature.

When a fracture extends into the optic canal, the optic (II) nerve is injured as well, resulting in blindness. This condition is known as orbital apex syndrome.

Retrobulbar hematoma is associated with elevated intraocular pressure, proptosis, and, occasionally, blindness. Extraocular paralysis is not a feature of this condition.

Traumatic mydriasis results in a fixed dilated pupil. However, it is not associated with ophthalmoplegia.

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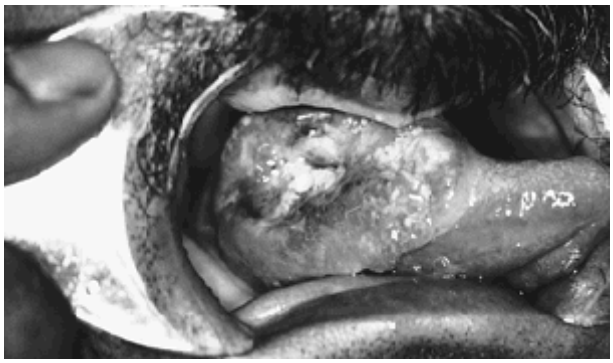
36



A 51-year-old man has had an enlarging mass of the tongue for three months. Examination shows a 4.5 × 2.5-cm lesion extending to the midline. There are no palpable lymph nodes. Biopsy shows squamous cell carcinoma. A photograph is shown above. Which of the following is the most appropriate management?

(A) Brachytherapy only
(B) External beam radiation followed by brachytherapy
(C) External beam radiation followed by chemotherapy
(D) Surgical excision only
(E) Surgical excision followed by adjuvant radiation therapy

The correct response is Option E.

The most appropriate management of this patient's condition is surgical excision of the mass followed by radiation therapy. Combined therapy is indicated for lesions greater than 3 cm to gain local control of the tumor and to decrease the dosage of radiation needed, thereby reducing the risk for adverse effects.

Brachytherapy is less effective for large tumors than for small tumors and is associated with a high morbidity to the oral cavity, including decreased salivary flow, decreased taste sensation, and muscle fibrosis.

Radiation therapy followed by brachytherapy or chemotherapy requires larger curative doses and is associated with high morbidity.

Surgical excision alone would not be adequate for local tumor control.

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37

A 65-year-old man is brought to the emergency department after striking his face on the steering wheel of his car in a motor vehicle accident. Physical examination shows traumatic telecanthus and loss of nasal bony support. Maxillary occlusion is intact and stable. Remaining facial examination shows no abnormalities.

Which of the following is the most appropriate management?

(A) Halo traction of the midface
(B) Closed reduction with transcanthal plates and nasal splinting
(C) Open reduction and fixation with plates and screws
(D) Open reduction, fixation with plates and screws, and bone grafting using a cantilever graft
(E) Open reduction and interfragmentary wiring of the fracture fragments

The correct response is Option D.

This patient most likely has a naso-orbito-ethmoid (NOE) fracture, which commonly occurs with severe, blunt trauma to the root of the nose. Patients with NOE fractures have extensive comminution of the medial orbital walls, ethmoid sinus, and bony and cartilaginous structure of the nose. Fractures of the zygoma, orbital floors, and maxilla may also be associated. Appropriate management of NOE fracture involves open reduction and internal fixation with plates and screws through a coronal approach. This procedure will effectively restore the width and projection of the middle third of the face. In addition, a cantilever bone graft should also be used during primary reconstruction to prevent the potential loss of support associated with collapse and scarring of the overlying soft tissues. Secondary reconstruction will be unsatisfactory because of the scarring that occurs with the delay in treatment.

Because traumatic telecanthus is a frequent finding, any tendinous fibers that attach the medial canthal tendon to the large fracture fragments should not be disrupted during reconstruction. The fragments should be anatomically reduced and fixed rigidly. Use of interfragmentary wire fixation will not provide the three-dimensional stability that is expected with miniplate or microplate fixation. Complete avulsion of the tendon from the bone is best managed with open transnasal canthoplasty.

Halo traction of the midface is cumbersome and requires frequent readjustment of the traction device.

Closed reduction of the fracture followed by splinting frequently leads to a saddle deformity of the nose. Application of cutaneous transcanthal lead plates is an outdated treatment method. Residual deformities are common following their use because the canthus is not placed in the appropriate superior and posterior position in the orbit.

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38

A 2-year-old boy has a bifid uvula and notching of the posterior nasal spine. Which of the following additional physical findings is likely?

(A) Absent anterior nasal spine
(B) Alveolar cleft
(C) Choanal atresia
(D) Cleft lip
(E) Zona pellucida

The correct response is Option E.

This child has a submucous cleft palate, which is generally associated with a bifid uvula and notching or absence of the posterior nasal spine. In this condition, the levator muscle is frequently oriented more longitudinally and often inserts abnormally on the posterior edge of the palatal bone along the bony cleft margin. It appears as a convergent ridge on each side of the soft palate. The mucosa between the two abnormally positioned muscles is thinned and is referred to as the zona pellucida.

Although the posterior nasal spine is frequently absent or notched in association with a submucous cleft palate, the anterior nasal spine is unaffected. The anterior nasal spine would be absent in Binder's syndrome.

An alveolar cleft is associated with an incomplete or complete cleft of the primary palate. It is not associated with a submucous cleft palate.

In patients with choanal atresia, the posterior nasal spine and the bone and soft tissue surrounding the deformity are often accentuated, not hypoplastic or separated.

Bifid uvula may occur in 2% of the normal population and is not an accurate predictor of a submucous cleft palate. Bifid uvula and absence of the posterior nasal spine are generally not associated with cleft lip.

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39

A 60-year-old man has a T4 squamous cell carcinoma of the base of the tongue. A relative indication for removal of the larynx is direct extension of the tumor into which of the following sites?

(A) Hypopharynx
(B) Mobile tongue
(C) Neck
(D) Soft palate
(E) Tonsil

The correct response is Option A.

This patient has a T4 squamous cell carcinoma of the base of the tongue that involves invasion of the tumor into adjacent structures. Invasion of the tumor into the endolarynx or hypopharynx (pyriform sinus or posterior pharyngeal wall) is an indication for removal of the larynx. Failure to remove the larynx will result in incomplete tumor removal. This patient will also be at increased risk for aspiration and secondary pulmonary complications.

Extension of a T4 squamous cell carcinoma into the mobile tongue, soft palate, or tonsil does not require treatment with laryngectomy. The tumor can be ablated from these areas and the larynx preserved; the resulting laryngeal function should be adequate. In some cases, it may be necessary to suspend the larynx to control aspiration.

Neck dissection is appropriate management for extension of tumor into the neck.

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40

A 4-month-old infant is being evaluated because of an enlargement of the lip. Examination shows desiccation and clear or hemorrhagic vesicles on the tip of the tongue. Which of the following is the most likely diagnosis?

(A) Basal cell carcinoma
(B) Hemangioma
(C) Infantile myofibromatosis
(D) Lymphangioma
(E) Teratoma

The correct response is Option D.

The most likely diagnosis in this 4-month-old infant is a lymphangioma, a congenital malformation that is characterized by enlargement of the lip (macrocheilia), ear, or tongue. In patients with tongue enlargement, clear vesicles ("salmon eggs") or hemorrhagic vesicles ("caviar spots") are often associated. The tongue may protrude through the lips, resulting in desiccation, ulceration, and necrosis. Multiple vesicles and papules may also be present on the buccal mucosa, with resultant drainage. Other associated abnormalities include enlarged teeth, bone hypertrophy, and skeletal overgrowth.

Basal cell carcinomas are extremely rare in children. These tumors are characterized by raised pearly edges with telangiectasias and central ulcerations.

Hemangiomas are also associated with macrocheilia and tongue protrusion, but vesicles do not appear.

Infantile myofibromatosis most commonly manifests as a solitary lesion. This condition almost always occurs in children younger than age 2 years.

Teratomas are rare congenital tumors that contain elements derived from multiple germ cell layers. Although most lesions are found within the pelvic region, the thyroid gland, orbits, sinuses, and midline of the nose may also be affected. The lip and tongue are not involved.

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41

A 52-year-old man has had progressive bilateral enlargement of the parotid glands over the past year. Examination shows bilateral 3 cm masses located in the tail of the parotid gland. There is no associated pain or weakness of the face. Which of the following is the most likely diagnosis?

(A) Adenocarcinoma
(B) Adenocystic carcinoma
(C) Mucoepidermoid carcinoma
(D) Pleomorphic adenoma
(E) Warthin tumor

The correct response is Option E.

This patient most likely has a Warthin tumor. Salivary gland tumors frequently occur within the parotid gland, and 75% of parotid tumors are benign. Warthin tumor is the most common neoplasm of the parotid gland, accounting for 10% of parotid tumors. These masses are painless and slow growing, often of several years' duration. They are common in older men and are frequently bilateral. Warthin tumors are usually treated with superficial parotidectomy. Recurrence is common.

Adenocarcinomas comprise 10% of malignant parotid gland tumors. These tumors vary according to grade and histologic appearance. They most frequently occur after the fifth decade of life and commonly involve the minor salivary glands. In the parotid gland, they manifest as fixed masses characterized by occasional pain or facial palsy.

Adenocystic carcinoma, or cylindroma, is infrequent in the parotid gland (7%) but quite common in the minor salivary glands (35%). It is a slowly growing mass, often associated with pain and facial palsy. These tumors are aggressive, with one third to one half of affected patients developing metastatic disease. The survival rate for patients with adenocystic carcinoma is 70% at 5 years but drops to 13% at 20 years, indicating slowly progressing spread of tumor.

Mucoepidermoid carcinoma is the most common malignancy of the parotid gland. It is rarely bilateral. It may be low or high grade. Low-grade tumors are slow growing and indolent; high-grade tumors are much more aggressive. The recurrence rate of high-grade tumors is increased, and the facial nerve is frequently affected.

Pleomorphic adenomas, or benign mixed tumors, are the most common salivary gland neoplasms, comprising about 60% of all salivary gland tumors and 80% of benign tumors. They occur as painless salivary masses that are firm and well circumscribed. Facial weakness is not found. Bilateral tumors are rare.

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42

Composite resection is planned for a 65-year-old man who has a 4-cm tumor fixed to the mentum in the anterior floor of the mouth. For which of the following reasons should a reconstruction plate NOT be used to replace the anterior mandible, despite his poor prognosis?

(A) Interference with postoperative radiotherapy
(B) Poor cosmetic appearance
(C) Poor volume replacement
(D) Prevention of osseointegration
(E) Unacceptably high failure rate

The correct response is Option E.

A reconstruction plate is used following excision of a mandibular tumor in a patient who has a poor prognosis (i.e., stage IV tumor) and/or a lateral defect. However, use of a reconstruction plate in patients like this one who have an anterior defect is associated with an unacceptably high failure rate of 35%.

According to recent studies, postoperative radiation in a patient with a reconstruction plate is still safe and effective, despite a slight increase in radiation uptake around the screws.

Restoration of contour and overall cosmetic appearance is excellent in most patients with a reconstruction plate because the plate is prefitted to the shape of the mandible and the screw holes are drilled prior to surgery. Only patients undergoing extensive soft-tissue resection will have poor cosmetic results.

Volume replacement will be poor in a patient with a high-volume defect repaired with a plate and a low-volume flap. However, most defects are of low volume and can be adequately covered with a reconstruction plate. Despite the presence of a reconstruction plate, osseointegrated implants can be placed in the bilateral remnants of the mandible.

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43

A 76-year-old woman develops progressively severe ptosis of the upper eyelids that interferes with her ability to drive, read, and watch television. The condition does not worsen as the day progresses and is not associated with any injury, tumor, or neurologic disease. Which of the following surgical procedure is NOT likely to provide any benefit?

(A) Frontalis suspension
(B) Horizontal resection of the orbicularis
(C) Horizontal resection of the tarsal plate
(D) Levator plication
(E) Transconjunctival plication of Müller's muscle

The correct response is Option B.

This patient has the common involutional or "aponeurotic" type of ptosis, which is distinct from myogenic, neurogenic, and mechanical ptosis. Surgical treatment of ptosis is largely governed by the degree of levator function. Zero to 5 mm (poor function) usually requires frontal suspension. Moderate function (6 to 10 mm) indicates that levator resection will be necessary, while good function (10 mm+) is easily handled by some form of aponeurotic surgery. An example of the latter is the Fasanella-Servat operation. Here the lid is everted and two fine artery forceps are used to grasp the upper border of the tarsus from both its medial and lateral sides. This facilitates the transconjunctival resection of a horizontal strip of tarsal plate together with attached conjunctiva and some of the underlying levator aponeurosis. In patients with good levator function and a positive phenylephrine test (ptosis that resolves following the instillation of 10% phenylephrine into the conjunctival sac), a similar procedure is carried out except that it spares the tarsus. In this plication procedure, Müller's muscle is shortened. Many surgeons have now abandoned these techniques in favor of the anterior approach which allows plication or resection of the levator under direct vision. Fine adjustment is possible, pathological anatomy is more easily visualized, the tarsal plate is not damaged, and a wider variety of ptosis may be tackled.

Horizontal resection of a strip of orbicularis muscle is employed as a cosmetic adjunct in blepharoplasty. Although it may be used for access in ptosis correction, it plays no functional part in the surgical relief of this condition.

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CRANIOMAXILLOFACIAL — 1999

44

A 20-year-old woman is undergoing CT evaluation after sustaining a frontal sinus fracture in a motor vehicle accident. Which of the following is the most important determinant for urgent surgical intervention?

(A) Air-fluid level in the frontal sinus
(B) Degree of comminution of the anterior table of the frontal sinus
(C) Fracture of the posterior table of the frontal sinus
(D) Presence of an open fracture

The correct response is Option C.

Before developing an appropriate treatment plan for this patient, the most important step is to determine whether she has a fracture of the posterior table of the frontal sinus. The presence of this type of fracture may indicate a possible dural laceration and underlying central nervous system injury. A patient with a fracture of the posterior table should undergo immediate neurosurgical consultation followed by operative repair.

An air-fluid level is not an absolute indicator of disruption of the nasofrontal duct. The degree of comminution of the anterior table is important when performing reconstruction because bone grafting may be required; however, it is not as critical as a posterior table fracture. The presence of an open fracture of the frontal sinus is less significant because some degree of contamination occurs with all frontal sinus fractures.

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45

In a patient with a unilateral cleft lip and palate, eruption of which of the following teeth is most likely to be impaired?

(A) Canine, cleft side
(B) Canine, noncleft side
(C) Central incisor, cleft side
(D) Lateral incisor, cleft side

The correct response is Option A.

In a patient with a unilateral cleft lip and palate, eruption of the canine tooth that adjoins the cleft is most likely to be impaired, resulting in crossbite. The clefted palate typically interferes with the positioning of the developing tooth bud. Performing repair by moving the cleft segment medially will also disrupt tooth development.

Absence of the permanent lateral incisor is the second most common cause of crossbite; 10% to 40% of patients with unilateral cleft lip and palate are affected. If the lateral incisor is present, it often erupts within the line of the cleft.

The central incisor may be small or have deformities involving the crown, but it is not malpositioned.

Although the canine tooth on the noncleft side is not malpositioned, involvement of its tooth buds within the cleft may inhibit tooth formation.

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46

In patients with craniofacial microsomia, which of the following cranial nerves is most frequently involved?

(A) Optic
(B) Trigeminal
(C) Facial
(D) Acoustic
(E) Spinal accessory

The correct response is Option C.

The incidence of craniofacial microsomia has been reported to be 1 in 5600 births. Genetic analysis shows no pattern of inheritance, but a possible genetic link has been mapped to chromosome 8q13. Males are more frequently affected, and most patients with craniofacial microsomia have involvement of the right side of the face.

In 10% to 45% of patients, facial nerve palsy occurs. Other associated findings include mandibular hypoplasia (89% to 100%), hypoplasia of the soft tissues of the face, including the muscles of mastication (85% to 95%), microtia (66% to 99%), and macrostomia (17% to 62%). Associated craniofacial anomalies include velopharyngeal insufficiency, orbital dystopia, epibulbar dermoids, cleft lip and/or palate, and plagiocephaly.

Involvement of the other cranial nerves is not seen in craniofacial microsomia.

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47

An edentulous 40-year-old man sustains a displaced Le Fort II fracture in a motor vehicle accident. Which of the following can be used to best determine the maxillomandibular relationship prior to the application of rigid fixation?

(A) Analysis with a face-bow
(B) CT scans of the face
(C) Plain radiographs
(D) Pretraumatic photographs
(E) Use of the patient's dentures

The correct response is Option E.

Management of maxillomandibular fractures involves determination of the anatomic relationship of the maxilla and mandible to each other, as well as to the cranial base. Human teeth are typically used to establish the orientation of the jaws. In the edentulous patient, this is not possible. Custom-made intraoral splints or dentures can instead be rigidly fixed to the maxilla and mandible using wire or screws. The maxilla and mandible can then be brought into occlusion and fixed together.

A face-bow is used to determine the relationship of the maxilla and the midface to the cranial base; the mandible is not assessed. Plain radiographs and CT scans of the face are also helpful in determining the extent of the patient's injuries and in planning surgery, but not to establish skeletal orientation. Pretraumatic photographs will only show soft-tissue relationships, not bony dental relationships.

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48

An 18-year-old woman has severe microgenia, effacing of the labiomental fold, and increased height of the lower anterior face. Which of the following is the most appropriate operative management?

(A) Jumping genioplasty
(B) Sliding genioplasty with horizontal osteotomy to move the chin straight forward
(C) Sliding genioplasty with oblique osteotomy to move the chin forward and downward
(D) Vertical reduction genioplasty
(E) Use of an alloplastic chin implant to effect sagittal augmentation

The correct response is Option A.

The most appropriate operative procedure in this patient who has a retruded chin and a long lower face is a jumping genioplasty. This procedure requires displacement of the inferior bone segment to the anterior border of the residual mandible. A jumping genioplasty will advance the lower face horizontally to compensate for the sagittal deficiency, decrease the height of the lower anterior face, and deepen the labiomental fold. It will also help shorten the chin.

Although a sliding genioplasty with horizontal osteotomy would improve the sagittal relationship and establish a deeper labiomental fold, it requires bony contact along the posterior portion of the osteotomy to move the chin significantly. Patients with severe microgenia would not benefit. In addition, the height of the lower anterior face would not be decreased.

Sliding genioplasty combined with oblique osteotomy would move the chin forward to reduce a portion of the sagittal deficiency, but would also move the chin downward, increasing the lower anterior facial height and the effacement of the labiomental fold.

Vertical reduction genioplasty would not repair this patient's sagittal deficiency. Alloplastic chin implantation is appropriate for patients with mild sagittal deficiencies.

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49

A 5-year-old girl has velopharyngeal incompetence that has not responded to speech therapy. She underwent repair of a cleft palate in infancy. Based on the results of videofluoroscopy and nasoendoscopy, sphincter pharyngoplasty is scheduled. Which of the following muscles should be incorporated in the flaps used to create the sphincter?

(A) Levator palatini
(B) Palatoglossus
(C) Palatopharyngeus
(D) Tensor palatini
(E) Uvular

The correct response is Option C.

In this child who is scheduled to undergo sphincter pharyngoplasty, the palatopharyngeus muscle should be incorporated within the flap. The technique of sphincter pharyngoplasty originally involved the bilateral transposition of salpingopharyngeus muscle flaps from the lateral pharyngeal walls. This process has been further developed to incorporate palatopharyngeal myomucosal flaps with intact neurovascular supply. These flaps are elevated from the posterior tonsillar pillar and inset into the posterior wall of the nasopharynx where it joins the palate, creating a smaller dynamic velopharyngeal sphincter. This newly developed procedure decreases the risk for reduction of the nasal airway, which may result in hyponasality and sleep apnea.

The levator veli palatini muscles arise from the eustachian tube and sphenoid bone and insert into each other in the midline of the soft palate. These muscles elevate and posteriorly displace the soft palate against the posterior nasal wall during speech. This action closes the velopharyngeal port and opens the eustachian tube.

The palatoglossus muscles form the anterior tonsillar pillars, which elevate the base of the tongue.

The tensor veli palatini muscles arise from the medial pterygoid plate and eustachian tube, pass around the hamulus, and insert into each other in the midline of the soft palate. During swallowing, these muscles tense the soft palate, opening the eustachian tube and allowing the tongue to push the food bolus posteriorly.

The uvular muscles arise from the palatine aponeurosis and the posterior nasal spine and insert into the uvula. These muscles are longitudinally oriented, cylindrical, paired structures located on the nasal side of the soft palate. Contraction during speech results in bulging of the soft palate with velopharyngeal closure. The uvula is lifted and bent backward.

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50

A 3-month-old girl has a port-wine stain of the left forehead, periorbital region, and cheek that has not changed significantly since birth. She is otherwise healthy. Which of the following is most likely to be anticipated in this patient?

(A) Bony overgrowth of the maxilla
(B) Development of seizures
(C) Malignant degeneration
(D) Rapid growth phase
(E) Spontaneous involution

The correct response is Option B.

This 3-month-old infant has a port-wine stain of the face, which is a capillary vascular malformation that corresponds frequently with the distribution of the trigeminal nerve. Patients with port-wine stains involving the first two divisions of the trigeminal nerve (V_1 and V_2) are at increased risk for Sturge-Weber syndrome; other findings associated with this syndrome include mental retardation and leptomeningeal venous malformations. These patients are also at increased risk for the development of focal motor seizures, hemiparesis, and visual abnormalities, including buphthalmos and glaucoma.

Although port-wine stains are most frequently found on the face, other areas of the body may be affected. These lesions are present at birth and do not spontaneously involute; a rapid growth phase does not occur. Most patients have a unilateral lesion involving more than one dermatome.

Bony overgrowth of the maxilla is characteristic of lymphatic vascular malformations.

Port-wine stains are not associated with malignant degeneration.

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51

A 36-year-old man is brought to the emergency department after being struck in the face with a baseball bat. CT scan shows a displaced fracture of the zygomaticomaxillary complex. Which of the following is most likely to cause late posttraumatic enophthalmos in this patient?

(A) Extraocular muscle atrophy
(B) Fat atrophy
(C) Increased bony intraorbital volume
(D) Loss of ligamentous support of the globe
(E) Scar contracture

The correct response is Option C.

Approximately 15% to 22% of patients with orbital fractures develop enophthalmos due to increased bony intraorbital volume. This is most frequently associated with a zygomatic fracture that has not been reduced adequately. Increases in bony volume of as little as 5% may cause changes in the size, shape, and positioning of the orbital soft tissue. Less common causes of enophthalmos include fat atrophy, extraocular muscle atrophy, scar contracture, and loss of support of the globe by the surrounding ligamentous structures.

Patients with acute fractures typically do not require bone grafting if the fracture is adequately reduced. Mild to moderate enophthalmos can be corrected with bone grafting of the orbit through small incisions. Patients with more severe enophthalmos should undergo repositioning of the zygoma, which will result in a reduction of orbital volume. In this procedure, the orbit is degloved and the masseter muscle is detached from the zygoma. Bone grafting of the zygoma is performed, and the positioning of the zygoma is overcorrected to compensate for the loss of soft-tissue volume and postoperative drift.

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52

A 50-year-old man has metastatic squamous cell carcinoma of the cervical lymph nodes. Which of the following is the most likely primary site of the occult tumor?

(A) Esophagus
(B) Floor of the mouth
(C) Larynx
(D) Nasopharynx
(E) Thyroid

The correct response is Option D.

Approximately 90% of patients older than 50 years with a neck tumor have a carcinoma. Cervical node malignancies without a known primary site occur most frequently in men between ages 50 and 60 years. Involvement of the oropharynx or the laryngopharynx occurs in 40% of these patients, while 10% have thyroid involvement. Fine-needle aspiration biopsy of the node should be performed in patients with unknown primary tumors; histologic evaluation frequently shows squamous cell carcinoma. A biopsy specimen of the nasopharynx and structures of Waldeyer's ring obtained through direct endoscopy may reveal a hidden tumor. Carcinoma of the nasopharynx frequently metastasizes to the bilateral upper jugular nodes. The posterior cervical nodes may also be affected.

Primary tumors located below the clavicular area commonly originate in the lungs or gastrointestinal tract. The prognosis for patients in whom a primary tumor is eventually found is worse than for those in whom a primary tumor cannot be located.

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53

The cervical branch of the facial nerve is transected during parotidectomy. Which of the following functions is most likely to be affected?

(A) Forward flexion of the neck
(B) Lateral flexion of the neck
(C) Pursing the lips
(D) Retraction and depression of the angle of the mouth
(E) Upward and downward movement of the hyoid bone

The correct response is Option D.

Transection of the cervical branch of the facial nerve would result in loss of function of the platysma muscle, which acts to retract and depress the mandible. This muscle lies in a superficial position within the anterior neck and attaches to the superficial fascia of the pectoralis major and deltoid muscles as well as to the mandible and the skin and subcutaneous tissue of the lower face. With these multiple attachments, it acts in a synchronous motion with the other muscles of the lower lip to draw the oral commissure and lower lip downward.

The marginal mandibular branch of the facial nerve innervates the lip depressor muscle. Because the lip depressor muscle compensates for the loss of function of the platysma muscle, weakened depression of the lower lip would only be a temporary finding.

Forward flexion of the neck involves relaxation of the posterior muscles of the neck with the patient in the upright position or action of the sternocleidomastoid muscles bilaterally with the patient in the supine position.

Muscles that contribute to lateral neck flexion include the sternocleidomastoid, splenius, and inferior obliquus capitis.

Upward movement of the hyoid bone is accomplished through the action of the digastric, stylohyoid, mylohyoid, and geniohyoid muscles; the sternohyoid, sternothyroid, thyrohyoid, and omohyoid muscles are used for downward movement.

Pursing the lips is a function of the orbicularis oris muscle.

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54

Which of the following glandular structures receives innervation from the auriculotemporal nerve?

(A) Lacrimal
(B) Meibomian
(C) Parotid
(D) Sublingual
(E) Submandibular

The correct response is Option C.

The parotid gland receives its innervation from the auriculotemporal nerve, which is a branch of the glossopharyngeal nerve that communicates with the trigeminal and facial nerves. Because of its relationship with the parotid gland, the auriculotemporal nerve has been shown to be a cause of Frey's syndrome (gustatory sweating) occurring after parotidectomy; division of the nerve has been recommended as a potential treatment option. The sympathetic plexus of the external carotid artery, the facial nerve, and the great auricular nerve also supply innervation to the parotid gland.

The meibomian and lacrimal glands receive innervation from the lacrimal nerve, which is a branch of the ophthalmic division of the trigeminal nerve (V_1). The sublingual gland is innervated by the lingual nerve, which is a branch of the mandibular division of the trigeminal nerve (V_3). The submandibular gland is innervated by multiple sources, including the chorda tympani, which is a component of the facial nerve, the submandibular ganglion, which is a branch of the lingual nerve, and the mylohyoid branch of the inferior alveolar nerve. Each of these structures is derived from the trigeminal nerve.

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55

A 30-year-old man is brought to the emergency department with a naso-orbito-ethmoid fracture after being struck in the face with a baseball bat. Examination shows the presence of telecanthus and a saddle-nose deformity. Which of the following is the most appropriate management of the telecanthus?

(A) Bone grafting of the nasal dorsum
(B) Delayed treatment until the swelling resolves
(C) Detachment and transnasal wiring of the medial canthal tendon
(D) Reduction of the central (canthal bearing) fragment and plate fixation
(E) Reduction of the nasomaxillary buttresses and plate fixation

The correct response is Option D.

In this 30-year-old patient who has developed telecanthus following naso-orbito-ethmoid (NOE) fracture, the most appropriate management of the telecanthus is reduction of the central (canthal bearing) fragment and plate fixation. Telecanthus indicates the presence of a NOE fracture. This complication occurs secondary to the fracture and causes lateral displacement of the medial canthus due to displacement of the portion of the medial orbital wall that contains the medial canthus. The presence of telecanthus is the strongest indication for operative treatment of a NOE fracture. In this patient, surgical correction should be performed as soon as possible.

NOE fractures can be classified into three types based on the central segment that bears the medial canthal tendon. In type I, there is a simple fracture of the central segment. Type II involves comminution of the central segment. Patients with avulsion of the attachment of the medial canthal tendon have a type III injury. Appropriate reduction of the central segment will best treat this patient's telecanthus.

In addition, all fractures should be meticulously reduced and fixed with wire, and bone grafting of all nasal and orbital deformities should be performed.

Delayed treatment may result in the development of other complications, including enophthalmos, saddle-nose deformity, and skeletal abnormalities.

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56

A 30-year-old woman has increasing dryness, itchiness, and excessive tearing of the right eye 10 months after sustaining a comminuted fracture of the orbital rim and floor in a motor vehicle accident. At the time of injury, she underwent surgical exploration and wire fixation of the fracture performed through a subciliary incision. Current examination shows a reddened sclera, epiphora, 10 mm of scleral show with ectropion, and scarring of the lower eyelid to the infraorbital rim. A photograph is shown above.

Which of the following is the most appropriate management?

(A) Injection of corticosteroids into the lower eyelid scar
(B) Marginal tarsorrhaphy
(C) Massage and closure of the lower eyelid with tape sutures
(D) Surgical exploration of the orbital floor and removal of the wire fixation
(E) Scar release, grafting, and tightening of the lower eyelid

The correct response is Option E.

The most appropriate management in this 30-year-old woman who has adverse sequelae following fixation of a fracture of the orbital rim and floor is release of the scar deformity, grafting, and tightening of the lower eyelid. Increased scleral show underneath the inferior limbus is frequently seen following this type of fixation; it has been suggested that the use of a subciliary incision plays a role in its development. Scar contracture and the positioning

of the orbital rim are also associated with this deformity. In patients with comminuted fractures of the orbital rim and floor, the fracture segments may be displaced inferiorly and posteriorly in the absence of rigid fixation; this results in a downward stretching of the septum and lower eyelid.

Surgery is recommended to treat postoperative ectropion that does not respond to conservative management. Releasing the scarred attachment of the septum orbitale from the orbital rim and restoring eyelid position are critical. Osteotomy and rigid fixation can be used to properly position the orbital rim. Following release of the scar contracture, the eyelid margin should be repositioned at the inferior limbus of the sclera. Horizontal tightening or fascial suspension will stabilize the eyelid position. Repositioning of the malar fat pad may also be beneficial. Full-thickness skin grafting should be considered in patients with severe deformities who require replacement of one of the layers of the lower eyelid.

Marginal tarsorrhaphy may be used in combination with other techniques but will not be effective alone.

Massage therapy, injection of corticosteroids, and closure using tape sutures are not recommended for management of severe ectropion.

Surgical exploration of the orbital floor and removal of the wire fixation will not correct this patient's eyelid position.

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57

A neonate has unilateral microtia of the right ear. Examination shows complete absence of all normal external auricular structures except for a rotated lobule. Which of the following is the most appropriate management?

(A) Autologous ear reconstruction at age 3 months
(B) Excision of all abnormal external ear structures by age 1 year
(C) Creation of an ear canal to provide improved hearing by age 1 year
(D) Autologous ear reconstruction at age 7 years
(E) Implantation of silicone framework at age 7 years

The correct response is Option D.

This neonate with microtia should undergo autologous ear reconstruction at age 7 years. The normal ear is almost completely developed by this age, although the width of the ear and its distance from the scalp will continue to change slightly until the child reaches 10 years of age. In addition, at age 7 there is usually sufficient costal cartilage for this reconstruction.

Surgical management is not considered a reasonable option in infants. At age 3 months, the ipsilateral ear is not appropriately sized; therefore, a proper match cannot be constructed.

In patients with unilateral microtia, creation of an ear canal should be delayed until the patient is 13 to 19 years of age. Creation of the canal before age 13 years will result in localized scarring and may potentially interfere with external auricular reconstruction. In order to improve hearing in an affected patient, bone-conduction hearing aids may be implanted at age 6 to 12 months.

Implantation of silicone or porous polyethylene framework should be performed when the contralateral ear has reached adult size. Because younger children may lose or damage the prosthesis, this procedure is reserved for older children or adults.

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58

Which of the following structures drains into the inferior meatus beneath the inferior concha?

(A) Auditory tube
(B) Nasofrontal duct
(C) Nasolacrimal duct
(D) Maxillary sinus
(E) Sphenoid sinus

The correct response is Option C.

The nasolacrimal duct, which maintains the drainage of the nasolacrimal system, drains into the inferior meatus beneath the inferior concha.

The auditory tube opens into the nasopharynx just posterior to the inferior concha. The nasofrontal duct, maxillary sinus, and anterior ethmoid air cells drain into the middle meatus. The sphenoid sinus drains into the sphenoethmoid recess, which lies superior and posterior to the superior concha.

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59

A 54-year-old man has increased swelling and progressive ptosis of the right upper eyelid, mild proptosis of the right globe, and diplopia 10 hours after undergoing open reduction and internal fixation of naso-orbito-ethmoid fractures that he sustained in a fall. On examination, he has mydriasis and tenderness and mild pain of the right eye.

These findings are most consistent with

(A) Horner's syndrome
(B) Marcus Gunn pupil
(C) orbital apex syndrome
(D) retrobulbar hematoma
(E) superior orbital fissure syndrome

The correct response is Option E.

This patient's findings are most consistent with superior orbital fissure syndrome. In patients with fractures of the orbital roof, increased edema caused by inflammation or bleeding may produce progressive cranial nerve palsies, leading to the development of this syndrome. Patients with superior orbital fissure syndrome have paralysis of the oculomotor, trochlear, and abducens nerves and the ophthalmic division of the trigeminal nerve (V_1). Associated findings include ptosis of the upper eyelid, mydriasis, and proptosis of the globe.

A patient with suspected superior orbital fissure syndrome should undergo CT scan to appropriately diagnose and treat the injuries. Displaced supraorbital fractures should be managed with open reduction, surgical repair, and evacuation of any hematomas.

Horner's syndrome is characterized by the unilateral findings of ptosis, miosis, enophthalmos, and facial anhidrosis. This condition occurs due to compromise of the superior cervical sympathetic nerve fibers, often resulting from a brain stem lesion.

Testing of a suspected Marcus Gunn pupil should be performed in a darkened room with the eyes fixed on a distant object. In a patient with positive findings, both pupils constrict symmetrically when a light is shined in one eye; when the light is quickly moved to the contralateral eye, both pupils dilate. This is caused by deficits of the optic nerve.

In orbital apex syndrome, there is extension of the orbital fracture into the optic canal and damage to the optic nerve, resulting in blindness. Appropriate management includes administration of corticosteroids and surgical decompression of the optic canal. Although this type of surgery had been debated in the past, it is now recognized as the treatment of choice for injuries to the optic canal.

Patients with retrobulbar hematoma have increased intraocular pressure and proptosis of the globe. Blindness may be associated. Diplopia is not a feature of this condition.

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60

A neonate with cleft palate has micrognathia, glossoptosis, and respiratory distress. Which of the following is the most appropriate initial management?

(A) Cleft palate repair
(B) Intubation
(C) Prone positioning
(D) Tongue-lip adhesion
(E) Tracheotomy

The correct response is Option C.

The most likely diagnosis in this neonate is Pierre Robin sequence, which is classically associated with micrognathia or retrognathia, glossoptosis, respiratory distress, and cleft palate. Genetic transmission is not believed to be a factor in Pierre Robin sequence.

If untreated, death may result from the tongue falling back into the airway, causing obstruction. The most appropriate initial management is to place the neonate in the prone position, which allows the tongue to fall forward, clear the airway, and improve breathing.

Intubation may be necessary if prone positioning does not open the airway. Tongue-lip adhesion should be performed if the neonate does not show signs of improvement (including gains in weight and strength) after seven days or if intubation for three days is not successful. Tracheotomy may be used for severe, life-threatening complications.

Cleft palate repair is inappropriate as initial management, but may be performed at a later date.

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61

A 35-year-old man has an ulcerative lesion in the right retromolar trigone. A biopsy specimen shows squamous cell carcinoma. Which of the following nodal groups in the neck is most likely involved?

(A) Submandibular (level I)
(B) Jugular digastric (level II)
(C) Midjugular (level III)
(D) Lower jugular (level IV)
(E) Posterior cervical triangle (level V)

The correct response is Option B.

This 35-year-old man with squamous cell carcinoma of the retromolar trigone is most likely to have involvement of the jugular digastric (level II) nodes in the neck. Because the retromolar trigone is located in an isolated area within the posterior floor of the mouth, malignant tumors are not often discovered initially, and may have progressed to T2 or T3 lesions. The probability of lymph node metastases increases greatly with each increase in the size of the primary tumor. Approximately 10% to 15% of patients with T1 lesions have nodal involvement, compared with 40% for T2 lesions, 50% for T3 lesions, and 70% for T4 lesions. Distant metastases are found in 15% to 20% of patients.

Tumors of the retromolar trigone drain directly into the jugular digastric nodes, then to the midjugular nodes (level III) and the lower jugular nodes (level IV). Lymphatic drainage from the posterior gingiva, tonsil, and tongue occurs in a similar pattern. Tumors of the anterior floor of the mouth, lip, and cheek drain into the submandibular and submental nodes (level I). Lymphatic drainage to the posterior cervical triangle (level V) is rarely seen with lesions in the mouth.

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62

The above photograph is of a 16-year-old boy who is being evaluated for correction of a hypoplastic chin. Examination shows an Angle class II malocclusion and 5 mm of overjet. Following cephalometric analysis and orthodontic therapy, which of the following is the most appropriate management?

(A) Advancement genioplasty
(B) Le Fort I maxillary setback
(C) Le Fort I maxillary advancement and sagittal split mandibular advancement
(D) Sagittal split mandibular advancement and advancement genioplasty
(E) Augmentation with a porous polyethylene chin implant

The correct response is Option D.

This 16-year-old boy who has an Angle class II malocclusion and 5 mm of overjet should undergo sagittal split mandibular advancement and advancement genioplasty. Initial evaluation of this patient should consist of cephalometric analysis using life-sized photographs to identify the position of the maxilla, mandible, and mentum in relation to each other and to the cranial base. Dental models are obtained during the oral examination to determine the occlusal relationships. Following initial evaluation, mandibular advancement through a sagittal split approach should be performed to correct the Angle class II malocclusion. Advancement genioplasty will correct the hypoplastic chin.

In some patients with chin hypoplasia, maxillary impaction via a Le Fort I osteotomy may also be considered depending on the relationship between the maxilla and mandible and the amount of mandibular advancement required.

Advancement genioplasty alone or augmentation of the chin with an implant would not address this patient's malocclusion. Combining a sagittal split mandibular advancement with a Le Fort I maxillary advancement would result in persistent malocclusion. A Le Fort I maxillary setback would not correct the malocclusion or the chin hypoplasia.

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63

A 40-year-old man sustains a severely displaced fracture of the mandibular body when he is involved in an automobile accident. On examination, he has numbness of the lower lip and chin on the side of the fracture. Which of the following nerves is most likely injured?

(A) Buccal
(B) Inferior alveolar
(C) Labial
(D) Lingual
(E) Marginal mandibular

The correct response is Option B.

This 40-year-old man who has numbness of the lower lip and chin on the same side as the mandibular body fracture is most likely to have injured the inferior alveolar nerve. In patients with displaced mandibular fractures, the likelihood of occurrence of an associated nerve injury ranges from 11% to 59%, with the inferior alveolar nerve being affected most frequently. Patients commonly develop neurapraxia secondary to stretching or compression of the nerve. Other causes of injury include extraction of third molars or placement of bicortical screws through the mandibular canal.

The buccal, labial, and lingual nerves provide sensation to the gingivae, buccal mucosa, lips, floor of the mouth, and tongue. These nerves are not located within the bony canal of the mandible and therefore would not be affected by a fracture.

The marginal mandibular nerve is a motor, not a sensory, nerve.

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64

A 32-year-old man sustains an injury to the left cheek in a motor vehicle accident in which his head hit the dashboard. CT scan shows an isolated fracture of the zygomatic arch; reduction is planned using the temporal (Gillies) approach. During this procedure, an elevating device should be inserted between the

(A) skin and the superficial temporal fascia
(B) superficial and deep temporal fascia
(C) superficial and deep layers of the deep temporal fascia
(D) deep temporal fascia and the temporalis muscle
(E) temporalis muscle and the pericranium

The correct response is Option D.

In this patient with an isolated fracture of the zygomatic arch necessitating fracture reduction using a temporal (Gillies) approach, an elevating device must be inserted between the deep temporal fascia and the temporalis muscle. This device will then follow the temporalis muscle to descend beneath the malar eminence, allowing appropriate surgical access to the fracture site.

If the elevating device is placed at a level superficial to the deep temporal fascia, it will not descend to its desired position beneath the malar eminence and the zygomatic arch, and injury to the frontal branch of the facial nerve may result. If it is placed deep to the temporalis muscle, it will lead into the temporal fossa, denying the surgeon access to the malar eminence and zygomatic arch.

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65

A 19-year-old man sustains multiple facial fractures when he falls down three flights of stairs. A CT scan is shown above. Which of the following is the most appropriate method for repair of the frontal sinus fracture?

(A) Ablation of the entire sinus (Reidel procedure)
(B) Cranialization of the sinus
(C) Exenteration of the sinus mucosa
(D) Nasalization of the nasofrontal ducts
(E) Obliteration with fat grafts

The correct response is Option B.

This patient who has a comminuted fracture of the frontal sinus should undergo cranialization. In this procedure, the posterior wall and sinus mucosa are removed, allowing access to the nasofrontal duct. The ductal mucosa is then inverted and obstructed with cranial bone, pericranium, or fascia. Following surgery, the intracranial contents (dura and brain) gradually expand to fill the space left within the cranium. This procedure is often recommended for patients with severe comminution of the posterior wall of the frontal sinus to resolve any cerebrospinal fluid leakage.

Fractures associated with dural tears and cerebrospinal fluid leaks are best managed with repair of the tears and cranialization to stabilize the posterior wall. A craniotomy approach will allow the surgeon to explore the dural tears and then repair them, which will resolve any cerebrospinal fluid leak. The frontal sinus ducts can then be obliterated.

Normal contouring of the anterior wall of the frontal sinus will prevent the development of significant contour deformity.

Ablation of the entire sinus (Reidel procedure) involves total excision of the anterior and posterior walls of the frontal sinus. This method would treat the patient's injury by allowing retraction of the skin of the forehead against the posterior wall, but is not often used due to its resultant cosmetic defects.

Exenteration is performed in patients with polypoid disease of the sinus tract to remove diseased mucosa and preserve the confines of the sinus.

Nasalization involves removal of the frontal bone, which allows the floor of the sinus to open into the nose and restore sinus aeration and drainage. This procedure is typically used in patients with frontal basilar fractures involving the nasofrontal duct or floor of the frontal sinus.

Removal of the sinus mucosa and obliteration of the frontal duct is also an option in patients with fractures of the frontal wall of the posterior sinus. Osteogenesis, autogenous grafting of fat, fascia, or muscle, or bone grafting can then be used for reconstruction. This method would prevent regrowth of the mucosa and result in full obliteration of the sinus by fibrosis. In addition, it has not been shown to be inferior to cranialization in patients with posterior wall fractures. However, any method that involves reconstruction would be impractical in this patient due to the severe comminution of the posterior wall.

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66

Which of the following is the most common malignancy of the parotid gland?

(A) Adenoid cystic carcinoma
(B) Malignant mixed tumor
(C) Mucoepidermoid carcinoma
(D) Squamous cell carcinoma
(E) Undifferentiated carcinoma

The correct response is Option C.

Mucoepidermoid carcinomas are the most common malignancies of the parotid gland, with 16% to 17% of parotid malignancies being mucoepidermoid carcinomas. Approximately 8% of parotid malignancies are squamous cell carcinomas; 4% to 5% are malignant mixed tumors (also called carcinoma ex-pleomorphic adenoma) and 2% are adenoid cystic carcinomas. Undifferentiated carcinomas are rare, comprising less than 1% of malignant parotid tumors.

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67

A 22-year-old man who underwent cleft palate repair in infancy has an Angle class III malocclusion, malar hypoplasia, no tooth show with the lips in repose, and a prognathic appearance. Cephalometric analysis shows an SNA angle of 77 degrees, an SNB angle of 83 degrees, a flat mandibular plane, and an acute gonial angle. (Normal cephalometric values: SNA, 82 ± 4 degrees; SNB, 80 ± 4 degrees.)

Which of the following is the most appropriate operative management?

(A) Le Fort I maxillary osteotomy with impaction and advancement
(B) Le Fort I maxillary osteotomy with advancement and vertical lengthening
(C) Sagittal split mandibular ramus osteotomies with setback only
(D) Le Fort II nasomaxillary osteotomy with advancement and sagittal split mandibular ramus osteotomies with setback

(E) Setback genioplasty with onlay bone grafting to the malar eminences

The correct response is Option B.

This patient who has an Angle class III malocclusion with malar hypoplasia should undergo Le Fort I maxillary osteotomy with advancement and vertical lengthening. Following cleft palate repair, measurement of the SNA angle (relationship of the maxilla to the cranial base) shows maxillary hypoplasia with sagittal and vertical deficiencies (short-face syndrome). There is minimal incisor exposure with the lips in repose. Overrotation of the mandible results in a pseudoprognathic appearance, caused by vertical deficiency of the maxilla in combination with a flat mandibular plane and an acute gonial angle.

A Le Fort I maxillary osteotomy with impaction and advancement would result in increased vertical maxillary deficiency, increased overrotation of the mandible, and a further decrease in tooth show.

Nasomaxillary osteotomy is not indicated for correction of this patient's deformity.

Sagittal split mandibular ramus osteotomies with setback will not correct this patient's maxillary hypoplasia or mandibular overrotation.

Setback genioplasty with onlay bone grafting to the malar eminences would only mask this patient's malar hypoplasia and would not correct the underlying maxillary deficiency or address any of this patient's other deformities.

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68

A 30-year-old man has a raised nasal mass that was present at birth and has gradually enlarged during his lifetime. Examination shows a soft mass with a central pit at the nasal radix; the overlying skin appears normal. Which of the following is the most likely diagnosis?

(A) Dermoid cyst
(B) Encephalocele
(C) Glioma
(D) Hemangioma
(E) Venous malformation

The correct response is Option A.

This 30-year-old man has findings consistent with a dermoid cyst. These congenital lesions develop along embryonic cleft lines in the head and neck and are most likely to be found in the lateral eyebrow, midline nasal root, and the neck. The nasal pit is a characteristic finding. Patients with suspected dermoid cysts should undergo CT evaluation to determine if the lesion demonstrates intracranial extension. If findings on CT scan are positive, surgical resection using a combined intracranial-extracranial approach should be performed.

An encephalocele involves herniation of brain tissue through a skull defect. Affected patients experience enlargement of the mass with crying (Furstenberg's sign). Other congenital defects may be associated. Gliomas are smooth, firm, noncompressible masses composed of neuroglial tissue. Discoloration or telangiectasia of the overlying skin is a frequent finding. CT scan will show splaying of the nasal bones. Hemangiomas are raised lesions that consist of a proliferation of endothelial cells. Most appear shortly after birth and involute spontaneously after a period of rapid growth. There is often discoloration of the overlying skin; skin pits are not associated. Venous malformations are large, deep, compressible lesions with bluish discoloration that frequently fill with blood.

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69

An 18-year-old man sustains an injury to the right malar region in a fistfight. On examination, he has periorbital ecchymosis and edema; there are signs of subconjunctival hemorrhage. He has diplopia with upward gaze. Findings on forced duction testing are negative. Which of the following is the most likely cause of the diplopia?

(A) Edema
(B) Entrapment
(C) Hematoma
(D) Muscle contusion
(E) Neurapraxia

The correct response is Option A.

This patient most likely has an orbital blowout fracture, and his diplopia should be seen as a sign of edema, which is the most likely nonmechanical cause of diplopia in patients with this type of fracture. Nonmechanical causes are less frequently associated with diplopia than entrapment of the orbital contents. Hematoma, extraocular muscle contusion, and neurapraxia involving one or more extraocular nerves may also cause diplopia.

Forced duction testing will confirm the cause of the diplopia. In this test, the lower lid is everted and the lower rectus muscle is grasped at its insertion with the forceps and pulled. Positive findings on this test are associated with entrapment of the orbital contents within the fracture. If the findings are negative, the patient's diplopia is most likely caused by edema.

Entrapment is associated with restricted ocular movement, especially upward gaze. Structures that may be entrapped include the inferior oblique or inferior rectus muscles, Lockwood's ligament, Tenon's capsule, intermuscular membrane, or periorbital fat.

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70

In patients who have sustained trauma to the mandible and temporomandibular joint, which of the following symptoms is the most commonly reported and suggests internal derangement of the joint?

(A) Clicking
(B) Decreased range of motion of the mandible
(C) Deviation of the mandible with function
(D) Pain
(E) Tinnitus

The correct response is Option D.

In patients with internal derangement of the temporomandibular joint (TMJ), the most commonly reported symptom is pain. In addition, affected patients may have clicking sounds or other noises within the joint, limited range of motion, tinnitus, and deviation of the mandible to one side.

The primary causes of internal derangement of the TMJ are trauma, abnormal functional loading, and degenerative joint disease. Although trauma involving the mandible and joint is most frequently associated, other potential causes include trauma to the head and neck, endotracheal intubation, cervical traction, and iatrogenic stretching of the mouth during dental treatment.

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71

A 7-year-old boy who underwent bilateral repair of cleft lip and palate has transverse collapse of the maxillary arch. On examination, there is an anterior palatal fistula that measures 2 mm in width and a mobile premaxilla. Which of the following is the most appropriate initial step in management?

(A) Application of orthodontics only
(B) Palatal fistula closure only
(C) Primary segmental osteotomies only
(D) Bone grafting
(E) Primary segmental osteotomies and palatal fistula closure followed by application of orthodontics

The correct response is Option A.

In patients with similar findings, treatment is best begun during the stage of transitional dentition, which occurs prior to the eruption of the permanent canine teeth but after orthodontic alignment of the lateral segments and the premaxilla. This commonly occurs before age 6 years. Beginning orthodontic therapy at this age is advantageous because the permanent canine teeth can be guided to erupt in the appropriate location; it is also possible that the lateral incisor teeth adjacent to the cleft site have not yet erupted. In these patients, orthodontics can be applied to form a symmetric arch.

This patient, however, is being seen at the stage of mixed dentition. This is defined as that age range in which there are both deciduous (primary) and permanent (secondary) teeth erupted in the oral cavity simultaneously. With a normal pattern of eruption, the permanent mandibular first molar erupts first in a position posterior to the deciduous second molar. This usually occurs at age 6 to 7 years. Although application of orthodontics is still the appropriate

initial treatment for this patient, he may later require osteotomy to align the premaxilla to the lateral segments because his permanent teeth have already begun to erupt.

Palatal fistula closure and bone grafting can be performed after orthodontic therapy has been completed. Use of bone grafting decreases the incidence of fistula recurrence. The grafted bone acts as a support for erupting teeth and stabilizes the premaxilla. If palatal fistula closure and bone grafting are unsuccessful in a patient in the mixed dentition stage, segmental osteotomies may be considered during the teenage years after eruption of the permanent teeth is complete.

Performing fistula closure before the maxilla is allowed to expand completely will result in recurrence of the fistula with expansion of the palate.

Primary segmental osteotomies should not be performed in patients during the stage of mixed dentition because the procedure interferes with the developing tooth buds within the maxillary bone.

Attempting fistula closure and bone grafting prior to the application of orthodontics will result in persistent maxillary collapse due to fixation of the maxilla in an anteriorly locked position.

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72

A 35-year-old baseball player is being evaluated in the emergency department after being hit in the glabellar region with a baseball. CT scans show a depressed fracture of the frontal sinus involving the anterior table with extension and bony displacement that blocks the nasofrontal ducts. The posterior table is intact.

Which of the following is the most appropriate management?

(A) Observation and serial plain radiographs
(B) Observation, serial plain radiographs, and prophylactic administration of antibiotics
(C) Surgical elevation of the fracture of the anterior table with rigid fixation
(D) Surgical removal of all sinus mucosa, plugging of the nasofrontal ducts with bone grafts, and elevation of the fracture of the anterior table with rigid fixation
(E) Surgical removal of all sinus mucosa, plugging of the nasofrontal ducts with bone grafts, cranialization of the sinus, and elevation of the fracture of the anterior table with rigid fixation

The correct response is Option D.

The most appropriate management of this patient who has a depressed fracture of the frontal sinus involving the anterior table only is removal of the sinus mucosa, bone grafting of the nasofrontal ducts, and elevation and rigid

fixation of the anterior table. Although this patient has no obvious deformity on initial physical examination, his injuries are masked by swelling. CT scan will show displacement of the fracture, indicating nasofrontal duct injury, and a concomitant air-fluid level. Surgical reduction of the fracture and fixation of the contour deformity are required.

Observation, serial plain radiographs, and administration of antibiotics are inappropriate in a patient who requires open reduction of the fracture.

Simple anatomic reduction does not address the nasofrontal duct injury and may result in the development of abscess, infection, or mucocele.

Cranialization of the sinus is not appropriate in patients without involvement of the posterior table or breach of the cranial cavity.

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73

A 38-year-old woman has tenderness of the left cheek after being involved in a motor vehicle accident. Examination shows tenderness and swelling of the left malar region. Occlusion is normal. She has no visual abnormalities. CT scan of the head shows a fracture of the left zygoma without displacement.

Which of the following is the most appropriate management?

(A) Observation
(B) Maxillomandibular fixation
(C) Reduction through a temporal (Gillies) approach
(D) Open reduction and internal fixation with direct wire fixation
(E) Open reduction and internal fixation with miniplate fixation

The correct response is Option A.

Patients with nondisplaced zygomatic fractures should not be initially managed surgically. Instead, the malar eminence should be protected and the patient should be instructed to eat soft foods. Routine follow-up for six weeks is essential to rule out an undiagnosed fracture of the orbital floor or potential displacement of the fracture fragments, in which case surgery would be necessary.

Appropriate management of displaced zygomatic fractures should include wide exposure of the fracture fragments, reduction of all fractures, rigid fixation across the zygomaticofrontal and zygomaticomaxillary buttresses, primary bone grafting if indicated, and periosteal suspension and redraping of the soft tissues.

Maxillomandibular fixation is used to stabilize fractures involving the midface or mandible.

The temporal (Gillies) approach is appropriate for patients with isolated fractures of the zygomatic arch. This approach uses the temporalis muscle and fascia to splint the arch and prevent its displacement by the forces of the masseter muscle. Patients with comminuted fractures of the zygomatic arch should undergo open reduction and internal fixation through a coronal approach.

Direct wire fixation may be used in the management of a displaced zygomatic fracture, but this technique provides less stability than rigid fixation using miniplates.

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74

The photograph shown above is of a 16-year-old boy who has enlargement of the left side of the jaw. Panoramic radiographs show a 7-cm multilocular cystic lesion. Which of the following is the most likely additional associated finding?

(A) Neurofibromas
(B) Palmar pits
(C) Polyps of the colon
(D) Submucosal cleft palate
(E) Telangiectasias of the lips

The correct response is Option B.

This patient has Gorlin syndrome (nevoid basal cell carcinoma syndrome), an autosomal dominant disorder with mixed penetrance and variable expressivity. In patients with this condition, multiple basal cell carcinomas may appear early in adolescence in association with multiple odontogenic keratocysts, skeletal anomalies, calcification of the falx cerebri, nasal deformities, and palmar and plantar pits. The odontogenic keratocysts may be bilateral; the maxilla and mandible are often affected equally.

Neurofibromas are a clinical manifestation of von Recklinghausen syndrome.

Colonic polyps are a feature of Gardner syndrome, an inherited disorder that is also associated with desmoid tumors and osteomas of the skull and mandible.

Submucosal cleft palate is associated with various craniofacial syndromes.

Patients with Osler-Weber-Rendu disease (hereditary hemorrhagic telangiectasia) typically have telangiectasias of the lips.

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75

Which of the following is most likely to maximize the success of secondary bone grafting of alveolar clefts?

(A) Adequate drainage of the recipient site
(B) Age of the patient at the time of grafting
(C) Embryologic origin of the bone graft
(D) Rigid fixation of the bone graft
(E) Use of calvarial bone

The correct response is Option B.

The success of secondary bone grafting of the alveolar cleft depends most on the age of the patient at the time of grafting. Optimal results will be attained if grafting is performed during the age of mixed dentition. This is defined as that age range in which there are both deciduous (primary) and permanent (secondary) teeth erupted in the oral cavity simultaneously; it commonly occurs between age 8 and 10 years. Because maxillary growth is nearly complete, grafting at this time will not be disruptive; instead, the permanent teeth will erupt normally through the grafted alveolus.

Drainage of the recipient site is discouraged because tight closure is most appropriate. The embryologic origin of the bone used for grafting has no effect on graft take, and both calvarial and iliac bone can be used for grafting. Rigid fixation is not necessary because the graft fragments are typically packed into the cleft.

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76

A 38-year-old man sustains trauma to the nose in a diving accident. Examination shows marked ecchymosis and edema of the nose, slight deviation of the external nose to the right, and step-off at the left frontal process of the maxilla. There is bilateral fullness of the septal mucosa.

Which of the following is the most appropriate initial management?

(A) Prophylactic administration of antibiotics and monitoring of the patient until facial swelling resolves
(B) Closed reduction of the nasal bone fracture
(C) Placement of bilateral septal splints and internasal packing
(D) Incision and drainage of the septum
(E) Open reduction and internal fixation of the frontal process of the maxillary fracture

The correct response is Option D.

This patient who has sustained nasal trauma may have developed a septal hematoma; ruling out this type of injury is emergent because a saddle-nose deformity may develop due to loss of septal support. Therefore, observation without intervention is not appropriate. A clinical examination that includes external palpation of the nasal bones and internal inspection via direct vision or endoscopy should be performed initially to determine the extent of the injury. Incision into the septal cartilage and perpendicular plate of the ethmoid and vomer should then be performed, with drainage of all hematomas and direct repair of any septal fractures. Support with septal splints and internasal packing may be indicated following surgical exploration.

Closed reduction of the nasal fracture should be performed but is not the first step in the management of this patient. It is preferable to wait for the edema to decrease before performing fracture reduction.

Open reduction of the fracture may improve the final result but is typically performed only in patients with external lacerations or in those who require additional procedures.

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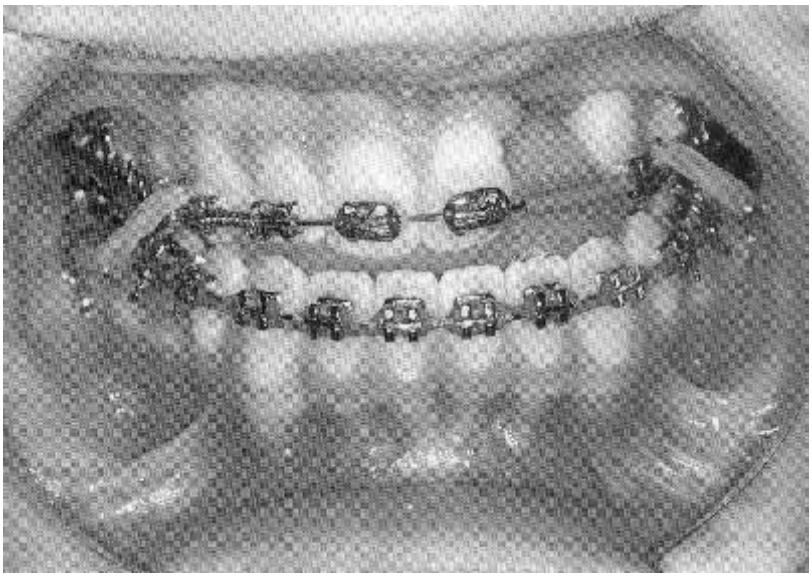
77



The above photograph is of a 16-year-old girl who underwent unilateral left-sided repair of cleft lip and palate in infancy. Mandibular projection is normal. Cephalometric analysis is most likely to show which of the following occlusal relationships?

(A) ANB angle greater than zero
(B) ANB angle equal to zero
(C) SNA angle greater than SNB angle
(D) SNA angle equal to SNB angle
(E) SNA angle less than SNB angle

The correct response is Option E.

This patient who underwent unilateral repair of a left-sided cleft lip and palate in infancy is most likely to have maxillary hypoplasia; therefore, cephalometric analysis is most likely to subsequently show that the SNA (sella-nasion-point A) angle is smaller than the SNB (sella-nasion-point B) angle. The SNA angle measures the relationship of the cranial base (SN) to the maxilla (point A), while the SNB angle measures its relationship to the mandible (point B). In a patient with maxillary hypoplasia, point A would lie posterior to point B.

The ANB angle measures the relationship of the maxilla to the mandible. A patient with maxillary hypoplasia would also have an ANB angle less than zero because the maxillary denture base would be positioned posterior to the mandibular denture base.

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78

A 43-year-old woman is unable to close the mandible after yawning. She recently underwent a bilateral mastectomy and immediate reconstruction with a bilateral transverse rectus abdominis myocutaneous (TRAM) flap during general anesthesia. At that time, she had a difficult intubation because of an anatomically short neck.

Which of the following is the most appropriate initial step in management?

(A) Alloplastic replacement of the condylar head
(B) Augmentation of the articular eminence
(C) Gap arthroplasty using the temporalis muscle
(D) Maxillomandibular fixation in centric occlusion
(E) Reduction while the patient is sedated

The correct response is Option E.

This patient who recently underwent a surgical procedure complicated by a difficult intubation has hypermobility of the temporomandibular joint (TMJ) due to dislocation of the condylar head as it extends beyond the articular eminence. This condition may be caused by trauma, opening the mouth widely, especially during yawning, or forced opening of the mouth during general anesthesia or prolonged dental procedures. Although the dislocated joint frequently repositions itself, some patients may require manual reduction during intravenous sedation.

When performing manual reduction, the surgeon should place the thumbs into the mucosal sulcus adjacent to the mandibular bicuspids and the fingers under the mandible. Firm downward pressure applied first anteriorly and then posteriorly will resist the action of the spastic elevator muscles and force the condyle into the glenoid fossa.

Patients with chronic joint dislocations should undergo maxillomandibular fixation followed by augmentation of the articular eminence.

Alloplastic replacement of the condylar head and gap arthroplasty are recommended for patients with degenerative changes associated with ankylosis of the TMJ.

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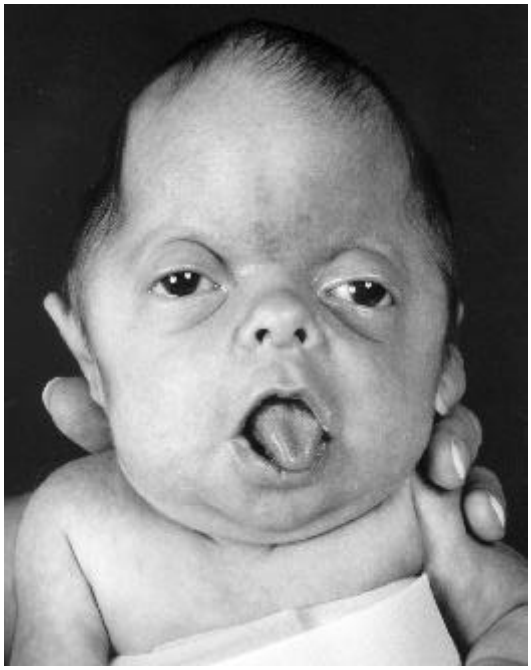

A 2-month-old boy has the deformities shown in the photograph and CT scan above. Which of the following is the most likely diagnosis?

(A) Anterior plagiocephaly
(B) Brachycephaly
(C) Posterior plagiocephaly
(D) Scaphocephaly
(E) Trigonocephaly

The correct response is Option B.

This 2-year-old boy has brachycephaly, which is caused by fusion of both coronal sutures extending into the cranial base. Brachycephaly is characterized by an excessively wide and retruded anterior cranial vault.

Plagiocephaly is a cranial asymmetry caused by unilateral premature fusion of the coronal (anterior plagiocephaly) or lambdoid (posterior plagiocephaly) suture. It is characterized by flattening of the forehead and upper orbit or of the occipitoparietal regions, respectively. Patients with scaphocephaly have a boat-shaped skull due to fusion of the sagittal suture. There is elongation and narrowing of the cranial vault. Trigonocephaly is characterized by a triangle shape of the skull and upper orbits caused by fusion of the midline forehead suture (metopic synostosis). Orbital hypotelorism is associated with trigonocephaly.

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80

A 24-year-old man has an anterior open bite after sustaining blunt trauma to the midface. On examination, there appears to be no mandibular injury. Which of the following findings best supports the diagnosis of a Le Fort I fracture in this patient?

(A) Anesthesia of the cheek
(B) Movement at the lateral orbital rim
(C) Movement at the lower portion of the maxilla
(D) Movement at the nasal root
(E) Step deformity at the infraorbital rim

The correct response is Option C.

This patient who has an anterior open bite following blunt trauma to the midface should undergo immediate physical examination to determine the extent of his injuries. During physical examination, the surgeon places one hand on the anterior portion of the maxilla and the other hand on the nasal root to prevent scalp motion, which may be confused with upward facial movement. Movement at the lower portion of the maxilla, but not at the nasal root, suggests the presence of a Le Fort I fracture. This characteristic "floating palate" results from disconnection of the dental alveolar portion of the maxilla from its upper portion.

Anesthesia of the cheek is most frequently associated with Le Fort II maxillary or zygomatic fractures. Patients with Le Fort II maxillary fractures also have movement at the nasal root and a step deformity at the infraorbital rim. Associated findings on physical examination include bilateral circumorbital and subconjunctival ecchymosis, lengthening of the face, and malocclusion.

In a Le Fort III fracture, the facial bone complex is disconnected from the cranium. Movement at the lateral orbital rim is associated.

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81

Two months after sustaining blunt trauma to the mandible, a 40-year-old man has pain in the temporomandibular joint (TMJ), decreased range of motion of the mandible, and deviation of the chin point to the affected side with chewing. Initial radiographs showed no fracture. Current examination shows a maximum vertical dimension of opening of 2 cm. CT scans show a nondisplaced fracture of the intracapsular condylar head.

Which of the following is the most likely cause of the decreased range of motion of the mandible?

(A) Adhesions of the temporalis muscle
(B) Bony ankylosis of the TMJ
(C) Degenerative joint disease
(D) Fibrous ankylosis of the TMJ
(E) Myofascial pain dysfunction

The correct response is Option D.

This patient who has a fracture of the intracapsular condylar head not previously diagnosed on radiographs has developed fibrous ankylosis of the temporomandibular joint (TMJ). Ankylosis may result from localized inflammation, development of a hematoma, or scarring. It may be classified as bony or fibrous and as complete or incomplete.

Patients with complete ankylosis have a maximum incisal opening of less than 5 mm. Pain is a common symptom. Difficulties with speaking and maintaining oral hygiene are also associated.

The temporalis muscle would not contribute to scarring and adhesions occurring within the joint space. Bony ankylosis is associated with long-term restriction of movement and degeneration of the joint space. Degenerative joint disease and myofascial pain dysfunction are long-term complications of trauma that would not be seen as soon as two months after injury.

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82

A 9-year-old boy has turribrachycephaly, midface hypoplasia, facial acne, and a high-arched palate with a submucosal cleft. Which of the following is the most likely diagnosis?

(A) Apert syndrome
(B) Crouzon syndrome
(C) Pfeiffer syndrome
(D) Saethre-Chotzen syndrome
(E) Van der Woude syndrome

The correct response is Option A.

The 9-year-old boy has Apert syndrome, an autosomal dominant disorder characterized by turribrachycephaly, midface hypoplasia, and severe syndactyly and coalition of the digits. Cleft palate may be associated. Acne is seen in patients of all age groups.

Patients with Crouzon syndrome (an autosomal dominant disorder) typically have craniosynostosis involving the coronal, sagittal, and lambdoid sutures, as well as turribrachycephaly. Other findings include midface hypoplasia, exorbitism, and proptosis. The extremities are normal.

Pfeiffer syndrome is an autosomal dominant disorder with craniofacial findings similar to Apert and Crouzon syndromes; it is distinguished by the presence of enlarged, bulbous thumbs and halluces.

Patients with Saethre-Chotzen syndrome, an autosomal dominant disorder, have craniosynostosis, a low hairline, and brachydactyly. There is mild variable involvement of the midface.

Van der Woude syndrome is an autosomal recessive disorder characterized by cleft lip and palate and lip pits. There are no craniofacial abnormalities.

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83

A 4-year-old boy has a tender, palpable, fluctuant mass over the left parietal skull and signs of left orbital and facial cellulitis 36 hours after undergoing primary repair of a scalp laceration that he sustained when he was bitten by a dog. Temperature is 39EC (102.2EF).

In this patient, the abscessed cavity is most likely located within which of the following layers of the scalp?

(A) Galea aponeurotica
(B) Pericranium
(C) Skin
(D) Subaponeurotic tissue
(E) Subcutaneous tissue

The correct response is Option D.

This child with a contaminated bite wound of the scalp most likely has an abscessed cavity within the subaponeurotic tissue. This tissue is loose and scanty to permit unencumbered movement of the overlying skin, subcutaneous tissue, and galea aponeurotica together as a single unit.

A laceration of the scalp is less likely to result in damage to the pericranium, and development of a significant hematoma or infection of the soft tissues of the face is less frequent than with a laceration of the subaponeurotic tissue.

Primary closure should not be attempted in patients with extensive or contaminated wounds.

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84

In a 3-year-old child with a hemangioma, surgical intervention is indicated for each of the following EXCEPT

(A) airway obstruction
(B) bleeding and ulceration
(C) distortion of the upper lip
(D) Kasabach-Merritt syndrome
(E) visual obstruction

The correct response is Option C.

Children with hemangiomas often do not require surgery. Observation is appropriate in most cases because hemangiomas typically undergo spontaneous involution.

Surgery should be performed in patients with specific complications; these include obstruction of the airway or visual axis, bleeding and ulceration, and involvement of the nasal tip. If involution is not complete by age 5 years, surgery should be considered. Potentially lethal complications that indicate the need for operative management include the development of high-output cardiac failure and localized consumptive coagulopathy associated with Kasabach-Merritt syndrome.

Distortion of the upper lip is not an indication for surgical removal of a hemangioma.

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CRANIOMAXILLOFACIAL — 2000

85

A 57-year-old man has severe pain and swelling of the left cheek and an unpleasant taste in his mouth three weeks after undergoing open reduction and internal fixation of a fracture of the left zygoma. On examination, there is a fluctuant mass over the left cheek.

Which of the following is the most appropriate next step in management?

(A) Oral administration of antibiotics and follow-up examination in 48 hours
(B) Intravenous administration of antibiotics and plain radiographs
(C) Intravenous administration of antibiotics and drainage of the abscess
(D) Intravenous administration of antibiotics, drainage of the abscess, and removal of the hardware

The correct response is Option C.

In this patient who has a wound abscess following operative fixation of a zygomatic fracture, the most appropriate next step in management is intravenous administration of antibiotics and surgical drainage of the abscess. This patient is experiencing an unpleasant taste in the mouth because the abscess is draining into the oral cavity.

Oral administration of antibiotics and follow-up examination will only delay treatment of the abscess.

In patients with maxillary sinusitis, plain facial radiographs should be obtained to illustrate air fluid levels within the maxillary sinus; these patients also should be treated with intravenous administration of antibiotics.

Removal of the hardware is not indicated in a patient who underwent surgery only three weeks earlier because there is an increased risk for bony malunion. Any loose hardware at the site of the abscess should be removed.

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86

In order to perform bone grafting of an alveolar cleft, which of the following is the most appropriate incision to elevate and advance the gingiva?

(A) Elevation of the gingiva within the gingival sulcus in adult dentition and above the attached gingiva in deciduous dentition
(B) Elevation of the gingiva within the gingival sulcus in deciduous dentition and above the attached gingiva in adult dentition
(C) Elevation of the gingiva within the gingival sulcus in adult and deciduous dentition
(D) Elevation above the attached gingiva in adult and deciduous dentition

The correct response is Option B.

In order to elevate and advance the gingiva medially in a patient undergoing bone grafting of an alveolar cleft, the gingiva should be elevated within the gingival sulcus in patients with deciduous dentition and above the attached gingiva in patients with adult dentition. The attached gingiva, which is a layer of keratinized squamous epithelium, is located along and above the tooth margin. Subgingival connective tissue fibers within this layer attach the teeth to the surrounding periodontal membrane, providing a mechanical and biologic barrier to protect the cervical portion of the teeth.

Several authors have studied the benefits of using either buccal mucosal or mucogingival incisions for grafting of the alveolar cleft. In patients with deciduous dentition, mucogingival flaps should be developed along the tooth margin to provide a larger portion of attached gingiva for greater periodontal support during the eruption of the canine teeth. As the permanent dentition erupts, the periodontal membrane and subgingival connective tissue fibers will form to provide support. Another option for alveolar grafting involves the application of split palatal grafts just prior to tooth eruption. However, buccal mucosal flaps should not be used because they can impede the eruption of the canine teeth. This may occur because the buccal mucosa above the attached gingiva is mobile and does not attach to the teeth.

In adult dentition, the flaps should be developed above the attached gingiva. Elevation of the attached gingiva in an adult patient would result in permanent damage to the periodontal membrane and subgingival connective tissue fibers.

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87

In adults, the normal range of vertical mandibular opening is from

(A) 20 to 30 mm
(B) 30 to 40 mm
(C) 40 to 50 mm
(D) 50 to 60 mm

The correct response is Option C.

In adults, vertical mandibular opening measured from maxillary incisal edge to mandibular incisal edge (interincisal distance) typically ranges from 40 to 50 mm. In addition, normal range of motion of the mandible includes lateral jaw excursion (measured at the midline incisor) to 10 mm on each side.

Decreased mandibular opening may indicate dysfunction of the temporomandibular joint (TMJ) or surrounding soft tissues. Patients who may potentially have internal derangement of the TMJ may also experience painless clicking during attempted opening of the mandible.

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88

Which of the following is a characteristic finding in patients with Binder syndrome?

(A) Absence of the posterior nasal spine
(B) Angle class II malocclusion
(C) Flattened nasal bridge
(D) Positive overjet
(E) Vertical maxillary excess

The correct response is Option C.

A patient with Binder syndrome typically has a retruded nose with a flattened nasal bridge resulting from hypoplasia of the nasomaxillary complex. The nasal tip is low-set and flat, with crescent-shaped nostrils and a short, retracted columella with an absent triangular base. Affected patients have pathognomonic absence of the anterior nasal spine. Angle class III malocclusion is also associated.

Angle class II malocclusion and positive overjet are typically seen in combination, but are not associated with Binder syndrome. The posterior nasal spine is not affected, and the maxilla is hypoplastic, not excessively long.

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89

Which of the following is the second most common type of facial fracture in children?

(A) Frontal bone
(B) Mandibular
(C) Maxillary
(D) Nasal
(E) Zygomatic

The correct response is Option B.

Whereas nasal fractures are the most common type of facial fracture in children, mandibular fractures are the second most common type, comprising 38% of all facial fractures in this age group. Because the facial bones are relatively pliable and elastic and are primarily composed of cancellous bone, fractures of the face occur infrequently in children younger than age 10 years. The paranasal bones are less prone to fracture because the sinuses have not yet developed. In addition, the greater proportion of the skull within the craniofacial skeleton in children results in many more skull fractures than facial bone fractures.
Motor vehicle accidents are the most common cause of facial fractures in children. The subcondylar region and alveolar processes are most frequently involved, and there is an increased risk for growth disturbances following fracture in these areas.

Approximately 35% of pediatric facial fractures occur in the fronto-nasoethmoid region, 17% occur in the midface, and 10% at the orbit.

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90

A 43-year-old man sustains a "through and through" laceration of the right cheek when he is stabbed with a knife. A photograph is shown on the previous page. Parotid duct injury is suspected. Within the oral cavity, the parotid duct is located in the region of which of the following teeth?

(A) Mandibular first molar
(B) Mandibular second molar
(C) Maxillary first molar
(D) Maxillary second molar
(E) Maxillary second premolar

The correct response is Option D.

In a patient who has a suspected injury of the parotid duct, also known as Stensen's duct, the surgeon should be aware of the duct's location; it originates on the anteromedial side of the parotid gland, where it courses obliquely and medially around the anterior edge of the masseter muscle and inserts into the buccal mucosa opposite the maxillary second molar. Because the parotid duct typically travels with the buccal branch of the facial nerve, these structures are often injured concomitantly. The course of the parotid duct can be visualized by drawing a line from the middle of the tragus to the midportion of the upper lip.

Parotid duct injury should be suspected in a patient who has a laceration of the lateral cheek in the ductal region. In order to confirm this diagnosis, a 22-gauge catheter is used to cannulate the distal duct within the oral cavity adjacent to the maxillary second molar. The duct is then irrigated with saline or methylene blue to demonstrate the presence of a laceration. Repair involves placement of a small silicone stent during magnification, followed by suturing of the laceration. A parotid gland injury that occurs without concomitant ductal injury is best treated with adequate drainage; suturing is not required.

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91

A 23-year-old woman who sustained blunt trauma to the cheek in a motor vehicle accident has inferior displacement of the cheekbone. This finding is most likely caused by the action of which of the following muscles?

(A) Digastric
(B) Lateral pterygoid
(C) Masseter
(D) Medial pterygoid
(E) Temporalis

The correct response is Option C.

The finding of inferior displacement of the cheekbone in this 23-year-old woman is most likely caused by the chronic active traction of the masseter muscle, which in patients with zygomatic fractures exacerbates displacement of the zygoma. Because the masseter muscle extends from the medial and lateral surfaces and lower border of the zygomatic arch to the anterolateral surface of the mandibular ramus, it exerts powerful forces of elevation on the mandible. This muscle is necessary for chewing but can contribute to the displacement of fracture fragments in patients with zygomatic fractures. In a patient who has already undergone reduction of the zygomatic fracture, performing two-point wire fixation of the zygoma at the orbital rim will not diminish the forces of the masseter muscle and will instead create an axis around which the zygoma can rotate. Although the zygomaticus major muscle originates from the body of the zygoma and may be thought to contribute to this patient's displaced cheekbone, in reality it is not involved in the displacement.

The anterior belly of the digastric muscle originates from the inside lower border of the symphysis and attaches to the lateral corner of the hyoid bone. This muscle is part of the suprahyoid musculature, which in a patient with a mandibular fracture would pull the anterior mandibular fragments posteroinferiorly.

The lateral pterygoid muscle arises from the lateral pterygoid plate of the sphenoid bone and extends posteriorly and horizontally to insert on the neck of the condyle and into the anterior margin of the articular disk of the temporomandibular joint. As the condyle is moved forward, the lateral pterygoid acts to protrude the jaw, then slides down the articular eminence, opening the mouth. In patients with subcondylar fractures, the muscle pulls the condylar head in an anteromedial direction, whereas in patients with unilateral fractures the contralateral pterygoid continues to protrude, resulting in deviation of the mandible to the side of the fracture.

The medial pterygoid muscle arises inferiorly, laterally, and posteriorly from the medial surface of the pterygoid plate and inserts on the medial ramus and mandibular angle. During contraction, it pulls the mandible medially, elevating the lower jaw. A patient who sustains a fracture medial to the mandibular angle will have displacement of the mandibular ramus medially and cephalad because of the action of this muscle.

The temporalis muscle arises within the infratemporal fossa and inserts on the coronoid process of the mandible. This muscle does not attach to the zygoma.

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92

The above photograph is of a 64-year-old man who has had progressive enlargement of the end of his nose. Which of the following is the most likely to produce the best outcome?

(A) Proper skin hygiene
(B) Oral administration of isotretinoin
(C) Oral administration of tetracycline
(D) Tangential excision
(E) Rhinectomy and total nasal reconstruction

The correct response is Option D.

In this 64-year-old man who has advanced, disfiguring rhinophyma, the most appropriate management is tangential excision of the skin and hypertrophic appendages. Rhinophyma, or sebaceous hyperplasia of the nasal skin, is thought to be a severe form of acne rosacea affecting the epidermis, skin appendages, and dermis. It typically occurs in men older than age 60 years and is not associated with alcohol use. Affected patients have bulbous enlargement of the nose, gross hyperplasia of the sebaceous glands, and skin erythema. Superficial infection of the sebaceous plugs is characteristic; a foul odor is often emitted from the plugs. Histologic examination will show hypertrophy and hyperplasia of the sebaceous glands, fibrovascular proliferation of the dermis, and acanthosis of the epithelium with sparing of the nasal cartilages and lining. Malignant degeneration to basal cell carcinoma occurs infrequently. Tangential excision is recommended for management of severe rhinophyma, as in this patient. Following excision, the wound is covered with a moist bacteriostatic dressing until spontaneous re-epithelialization occurs.

Patients with a less advanced form of rhinophyma should be treated nonsurgically; appropriate skin hygiene is initially used for local control. Oral isotretinoin and tetracycline are also prescribed for some patients.

Rhinectomy and total nasal reconstruction are unnecessary in a patient with rhinophyma because the underlying nasal architecture is unaffected.

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93

The optic nerve passes through which of the following bones of the orbit?

(A) Ethmoid
(B) Frontal
(C) Lacrimal
(D) Maxilla
(E) Sphenoid

The correct response is Option E.

The optic nerve passes through the lesser wing of the sphenoid bone, which along with the greater wing of the sphenoid is one of seven bones that comprise the orbit. Others include the frontal bone, the maxilla, the zygoma, the ethmoid, the lacrimal, and the palatine bones. The lesser wing of the sphenoid forms the posterior aspect of the roof of the orbit; the optic nerve and ophthalmic artery travel through this region and into the optic canal.

The frontal bone, maxilla, zygoma, and ethmoid bones are all included in the outer rim of the orbit, which is a firm structure that protects the fragile bones of the interior orbit. The greater wing of the sphenoid contains the superior orbital fissure, which transmits the abducens (VI), frontal, lacrimal, nasociliary, and trochlear (IV) nerves, as well as the superior and inferior branches of the oculomotor (III) nerve.

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94

A 54-year-old woman has a 4-cm squamous cell carcinoma at the apex of the posterior triangle of the right side of the neck. She underwent radiation therapy two years ago for treatment of squamous cell carcinoma of the nasopharynx. Which of the following is the most appropriate type of neck dissection?

(A) Bilateral
(B) Modified radical
(C) Posterior
(D) Radical
(E) Supraomohyoid

The correct response is Option D.

This patient who has a squamous cell carcinoma in the posterior triangle of the neck should undergo radical neck dissection, which involves removal of the cervical lymph nodes, sternocleidomastoid muscle, internal jugular vein, and

spinal accessory nerve. Radical neck dissection is indicated in patients who have large, bulky neck tumors or involvement of the spinal accessory nerve or sternocleidomastoid muscle, or in patients who have undergone unsuccessful radiation therapy. Because this patient's tumor involves the posterior triangle of the neck, which contains the spinal accessory nerve, radical neck dissection should be performed.

Bilateral neck dissection is appropriate for patients with bilateral tumors or a primary tumor that crosses the midline.

Modified radical neck dissection differs from radical neck dissection in that it spares the spinal accessory nerve. This technique is appropriate for patients with tumors classified as N0 or N1, or in some patients with N2 tumors. Posterior neck dissection preserves the spinal accessory nerve while removing nodes in the posterior aspect of the neck. It is performed in patients who have tumor spread to the suboccipital or retroauricular lymph nodes; this finding is typically seen in patients with cutaneous lesions, such as melanomas. Neither dissection is appropriate in a patient who has a tumor involving the spinal accessory nerve.

Selective neck dissection is appropriate for patients with early (N0 or some N1) disease and may be performed prophylactically in patients with aggressive, high risk tumors, including T2 lesions of the floor of the mouth, tongue, tonsils, supraglottic larynx, and alveolar ridge. Supraomohyoid neck dissection is included in this procedure.

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95

A 50-year-old man has a 4.1-cm squamous cell carcinoma of the floor of the mouth and a palpable mass in the ipsilateral neck. He undergoes wide excision of the tumor with adequate margins and cervical lymphadenectomy. The lymph nodes are inflammatory but are not involved with the malignancy.

Which of the following is the most appropriate next step in management?

(A) Routine follow-up examination in three months
(B) Postoperative radiation therapy
(C) Postoperative chemotherapy
(D) Immunotherapy
(E) Re-excision of the primary tumor

The correct response is Option B.

In a patient with a T3 or T4 tumor of the oral cavity and a nodal status of N1 or N2 who has undergone complete surgical ablation of the tumor with neck dissection, the most appropriate next step in management is postoperative radiation therapy. Surgery followed by radiation therapy is required for patients with carcinoma classified as either stage III or stage IV, as in this patient. In contrast, patients with stage I or stage II carcinoma may be treated with either radiation therapy only or surgical resection only; both types of treatment are equally effective. Neck dissection is recommended for stage II carcinoma because of the potential for occult metastasis.

Routine follow-up is inadequate treatment of stage III or stage IV carcinoma because advanced disease is poorly controlled with one treatment modality alone. Postoperative chemotherapy may be beneficial for patients with recurrent or metastatic carcinomas; its use in the treatment of large tumors is still being evaluated. Although the effects of immunotherapy are still being studied, it is being used in patients with aggressive tumors that have not responded to standard forms of treatment. Excision with 1-cm to 2-cm margins is recommended for tumors of the oral cavity; if a tumor is excised with a more narrow margin of tissue, re-excision should be performed or the patient should undergo radiation therapy for adequate tumor control.

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96

A 50-year-old man has a biopsy-proven malignant melanoma of the central scalp that has a thickness of 1.9 mm. There are no palpable lymph nodes. Which of the following is the most appropriate management?

(A) Mohs' micrographic excision of the lesion followed by direct primary closure
(B) Re-excision of the lesion with a 1-cm margin followed by split-thickness skin grafting over the pericranium
(C) Re-excision of the lesion with a 1-cm margin followed by repair with a scalp rotation flap
(D) Re-excision of the lesion with a 2-cm margin, repair with a scalp rotation flap, and sentinel node biopsy followed by regional lymphadenectomy if findings on the biopsy specimen are positive
(E) Re-excision of the lesion with a 3-cm margin, repair with a scalp rotation flap, and bilateral cervical lymphadenectomy

The correct response is Option D.

In this patient who has a malignant melanoma of the scalp and no clinically positive lymph nodes in the neck, the surgeon should re-excise the tumor with a 2-cm margin and repair the resultant defect using a scalp rotation flap. At the same time, sentinel node biopsy should be performed; if histologic examination of the biopsy specimen shows findings consistent with tumor spread, regional lymphadenectomy should then be done.

This patient has a malignant melanoma with "intermediate" (1.1 mm to 3.9 mm) thickness as defined by Breslow's classification, which correlates tumor thickness with risks for regional metastases and survival rates. In patients who have tumors of intermediate thickness, management is still somewhat controversial. However, melanomas of the scalp are typically aggressive and associated with a poor prognosis; therefore, wide excision is indicated. The recommended margin for excision of a malignant melanoma is as follows:

Thickness	Recommended margin of excision
Less than 1 mm	1 cm
1 mm to 4 mm	2 cm
More than 4 mm	3 cm

The method used to repair the defect is less critical than the margin of excision; therefore, either a skin graft or flap could be used.

Because the potential for microsatellitosis exists in patients with melanomas of intermediate thickness who have clinically negative lymph nodes, some surgeons will advocate the use of elective lymph node dissection, which has been shown to result in a slight improvement in survival rates. However, among those who underwent elective nodal dissection, only 25% were found to have micrometastases; therefore, lymphadenectomy was unnecessarily performed in 75% of these patients. One study of patients who had confirmed micrometastases reported a five-year survival rate of 96% in those who underwent elective nodal dissection, compared with an 84% survival rate in those who did not undergo additional surgery. Lymphoscintigraphy and sentinel node biopsy are recommended for determining micrometastatic lymphatic spread of tumor. Patients with clinically positive lymph nodes should then undergo therapeutic nodal dissection.

Mohs' micrographic excision is more appropriate for lesions at other sites, such as the face. Tumor excision with margins that are narrow enough to allow for primary closure of the defect has been associated with a recurrence rate of 42%. Excision with a larger margin (ie, 3 cm) is not necessarily recommended because several studies have shown no difference in survival rates when the margin of excision is excessively wide. For example, one study of patients who had melanomas of intermediate thickness on the trunk and extremities showed no difference in survival rates when the tumors were excised with either 2-cm or 4-cm margins.

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97

A 4-year-old boy has pain and swelling of the face after tripping and falling on his chin. This patient most likely has a fracture of the mandible at which of the following sites?

(A) Angle
(B) Body
(C) Condyle
(D) Ramus
(E) Symphysis

The correct response is Option C.

This 4-year-old boy most likely has a fracture of the mandibular condyle; approximately 66% of mandibular fractures in children younger than age 10 years involve the mandibular condyle. In contrast, in children ages 11 to 15 years there is only a 40% incidence of condylar involvement seen with mandibular fractures.

The high incidence of pediatric injury to the mandibular condyle is associated with its relatively small cross-sectional diameter. The pediatric condyle can be distinguished from the same structure in adult mandibles by its thin cortical bone, dense vascularity, and high osteogenic potential. Children who sustain this type of injury are at increased risk for growth disturbance.

Appropriate management of this patient's fracture is closed reduction at the fracture site, followed by active mobilization of the mandible in one week.

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98

Which of the following disorders is classified as autosomal recessive?

(A) Apert syndrome
(B) Carpenter syndrome
(C) Crouzon syndrome
(D) Jackson-Weiss syndrome
(E) Pfeiffer syndrome

The correct response is Option B.

Carpenter syndrome is an autosomal recessive disorder characterized by craniosynostosis and brachydactyly. Affected patients typically have mental retardation.

Apert, Crouzon, and Pfeiffer syndromes are all autosomal dominant disorders with craniosynostosis, exorbitism, and midface retrusion; however, each is distinguished by its associated extremity findings. Patients with Apert syndrome have severe syndactyly of the middle three digits of the hands and feet, often with a common nail. Pfeiffer syndrome is characterized by broad thumbs and halluces and mild cutaneous syndactyly. In Crouzon syndrome, the extremities are normal.

Jackson-Weiss syndrome is associated with craniosynostosis and broad halluces with fusion of the tarsal and metatarsal bones. This disorder is inherited as an autosomal dominant trait.

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99

Which of the following is the primary advantage of using plates and screws instead of intermaxillary wire fixation in the treatment of midface fractures?

(A) Decreased cost
(B) Decreased risk for infection
(C) Decreased risk for nonunion
(D) Maintenance of facial height
(E) Maintenance of occlusion

The correct response is Option D.
In a patient with a midface fracture, plates and screws can be used during internal fixation to effectively maintain the patient's facial height. Although fixation with intermaxillary wires can be expected to result in maintenance of occlusion, a collapse of the midface that results in diminished midface height is often associated. In patients who undergo internal fixation using plates and screws, postoperative intermaxillary fixation may also be significantly truncated or completely unnecessary.

The use of plates and screws for fracture fixation does not decrease overall cost or affect the patient's risk for postoperative infection or nonunion.

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100

A 1-year-old girl has an enlarging mass over the right lateral brow. A photograph is shown on the previous page. Which of the following is the most appropriate next step in management?

(A) Observation
(B) CT scan of the face
(C) Arteriogram
(D) Incision and drainage of the lesion
(E) Surgical excision of the lesion

The correct response is Option E.

In this 1-year-old child who has a dermoid cyst of the lateral eyebrow, the most appropriate management is surgical excision of the cyst. Dermoid cysts involving the lateral brow are typically 1-cm to 2-cm firm, noncompressible, mobile lesions not attached to the overlying skin. They develop in infancy and most commonly involve the supraorbital region at the outermost third of the brow. Because these lesions do not spontaneously involute, surgical excision is recommended.

Dermoid cysts of the lateral brow are seldom attached to any deep structure other than the periosteum; therefore, a preoperative CT scan of the face would not be necessary. CT scan is appropriate for preoperative work-up in a patient who has a rare dermoid cyst of the midline because this cyst may extend into the nasal septum, sinuses, and underlying meninges and brain. Arteriography would not be useful because these cysts are not highly vascular. Incision and drainage is appropriate for management of an abscess.

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101

A 16-year-old boy is brought to the emergency department after sustaining blunt trauma to the mandible in a motor vehicle accident. Radiographs show a displaced fracture of the mandibular body with the teeth in the line of the fracture. Which of the following is an indication for extraction of the involved teeth?

(A) Fractures of the teeth
(B) Loose teeth
(C) Mixed dentition
(D) Molar or premolar teeth
(E) Teeth with restorations (fillings)

The correct response is Option A.

Indications for extraction of teeth in the line of a fracture include:

- displaced or comminuted fracture containing a tooth
- fracture of the tooth or root structure
- periodontal disease of the supporting structures
- functionless tooth in the absence of opposing teeth

Retention of an affected tooth may increase the patient's risk for development of osteomyelitis because of the creation of an open conduit with a high bacterial count.

Extraction of teeth is typically performed prior to the application of maxillomandibular and/or rigid fixation. Extraction should only be delayed until fixation has been completed if the presence of the tooth results in added stability at the fracture site or greater ease of application of fixation, or if extraction will result in further displacement at the fracture site.

Because most teeth involved in the line of fracture are loose, this is not necessarily an indication for extraction. Patients in the stage of mixed dentition have both deciduous (primary) and permanent (secondary) teeth in the oral cavity at the same time; this has no bearing on the decision to extract or retain teeth. The type of tooth and presence of restoration are not indications for extraction.

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102

A 19-year-old man who has Angle class II malocclusion and a dentofacial deformity is scheduled to undergo advancement genioplasty. Which of the following is the primary blood supply to the bony genioplasty segment?

(A) Anterior mucosal attachments
(B) Facial artery
(C) Inferior alveolar artery
(D) Lingual artery
(E) Posterior muscle attachments

The correct response is Option E.

Prior to performing advancement genioplasty in this 19-year-old man with a chin deformity, the surgeon should be aware that the primary blood supply to the bony genioplasty segment is from the posterior muscle attachments. Because these structures provide a vascularized pedicle to the bony segment, they should not be excessively dissected given the risk for damage in this region.

In this patient, advancement genioplasty can be used to attain greater anterior projection of the chin. This is accomplished by performing an osteotomy from the region of the chin that lies inferior to the mental foramen on each side of the face. The soft-tissue attachments are moved anteriorly to the inferior border of the mandible.

The anterior mucosal attachments are dissected away from the mandible prior to performing the osteotomy. The facial, inferior alveolar, and lingual arteries do not supply blood directly to the osteotomy segment.

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103

A 4-year-old girl is brought for evaluation of an uneven upper lip. She underwent rotation advancement repair of a unilateral complete cleft lip in infancy. On examination, there is a deficiency in the vertical height of the medial lip. A photograph is shown above. Which of the following is the most appropriate next step in management?

(A) Observation
(B) Z-plasty
(C) Conversion to a triangular flap repair
(D) Re-rotation lip repair
(E) Reconstruction using an Abbe flap

The correct response is Option D.

This 5-year-old girl who has an uneven upper lip should undergo re-rotation lip repair. The patient's findings are consistent with a lack of vertical height, which is a common complication seen following rotation advancement lip repair. It results from inadequate rotation of the lip during the initial surgery. The medial component of the lip is especially affected. Because the lip will not relax any further five years after the original surgery, revision lip repair is recommended.

Observation is not appropriate because this problem will no longer correct itself over time.

If re-rotation does not provide adequate vertical height, Z-plasty may be performed close to the nostril sill; however, it would be ineffective if performed alone.

Conversion to a triangular flap repair would produce an inferior aesthetic result.

Reconstruction using an Abbe flap is recommended for patients who have tightness of the upper lip following repair of a bilateral cleft lip; this technique is employed to create a functional philtrum in affected patients.

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104

A neonate has unilateral microtia. On examination, there is superior displacement of the lobular component and atresia of the external ear canal. These findings are most consistent with abnormal development of which of the following structures?

(A) First and second branchial arches
(B) Second and third branchial arches
(C) Fourth, fifth, and sixth branchial arches
(D) First and second branchial grooves
(E) Second and third branchial grooves

The correct response is Option A.

Development of the six branchial arches occurs within the walls of the anterior foregut during the fourth week of gestation, as neural crest cells migrate into the future head and neck region, and alternating ridges and depressions develop. Each branchial arch is composed of endoderm, ectoderm, and mesoderm. During development, a series of clefts forms to create the branchial grooves externally and the pharyngeal pouches internally. The branchial grooves are lined with surface ectoderm and the pharyngeal pouches are lined with foregut endoderm.

The auricle arises from the first (mandibular) and second (hyoid) branchial arches and is further defined by the development of hillocks, which appear on these arches during the sixth week of gestation. The anterior hillocks give rise to the tragus, root of the helix, and superior helix, while the posterior hillocks give rise to the antihelix, antitragus, and lobule. Patients with complete microtia have partial or complete absence of the external ear structures resulting from abnormal embryologic development of portions of the first and second branchial arches and pharyngeal pouches. The lack of mesenchymal proliferation that occurs during development results in abnormal development of the auricular helix.

The first (mandibular) branchial arch also gives rise to Meckel's cartilage, Reichert's cartilage, the malleus, the incus, the mandible, and the sphenomandibular ligament. The stapes, styloid process, stylohyoid ligament, lesser cornu of the hyoid, and upper part of the hyoid body are also derived from the second (hyoid) branchial arch. The third branchial arch gives rise to the greater cornu of the hyoid and lower part of the hyoid body. The thyroid, arytenoid, corniculate, and cuneiform cartilages are derived from the fourth, fifth, and sixth branchial arches.

Most of the branchial grooves are obliterated during the later stages of embryonic development; the dorsal end of the first branchial groove is not. The second, third, and fourth branchial grooves contribute to the cervical sinus, which then progresses to become the cervical vesicle. This structure is obliterated before birth.

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105

A 20-year-old man has epistaxis and pain, swelling, and tenderness of the nose after being struck in the face during a fistfight. Which of the following is the most appropriate next step in evaluation of this patient's injuries?

(A) Assessment of occlusion
(B) Intranasal inspection using a nasal speculum
(C) Use of a nasolacrimal probe
(D) Radiographs of the nasal bones
(E) CT scan of the face

The correct response is Option B.

This patient who has symptoms involving the nasal structure only most likely has an isolated nasal fracture. Any patient with a nasal fracture, regardless of severity, should undergo intranasal inspection with a nasal speculum to exclude the presence of a septal hematoma. Ruling out this type of injury is critical because a saddle-nose deformity may develop due to loss of septal support; therefore, all hematomas seen on intranasal inspection should be drained immediately.

Assessment of occlusion is not necessary because the fracture only involves the nose. Use of a nasolacrimal probe is only indicated for evaluation of the presence or absence of lacrimal duct injury. Radiographs and CT scans of the nose are excessive and unnecessary when the diagnosis can be made on clinical examination.

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106

A 40-year-old man has dryness, itching, and excessive tearing of the right eye one month after undergoing exploration and repair of an orbital floor blowout fracture through a subciliary incision. Current examination shows ectropion of the lower eyelid with increased scleral show on the affected side.

Which of the following is the most appropriate initial step in management?

(A) Lubrication of the ocular globe and massage of the eyelid
(B) Injection of corticosteroids into the eyelid scar
(C) Excision of the eyelid scar followed by skin grafting
(D) Marginal tarsorrhaphy
(E) Surgical release of scar tissue with lateral canthoplasty

The correct response is Option A.

In this patient who has developed ectropion of the lower eyelid after undergoing repair of an orbital blowout fracture, the most appropriate initial management is lubrication of the ocular globe and massage of the eyelid. Increased scleral show beneath the inferior limbus on the involved side is a frequent temporary finding following lower eyelid surgery and is thought to be particularly associated with the use of a subciliary incision. It occurs as a result of contracture of the surgical scar as it relates to the positioning of the infraorbital rim.

Because most patients with ectropion experience spontaneous resolution of the problem, initial management should focus on preventing desiccation of the ocular globe; artificial tears or other means of lubrication can be used. Other appropriate measures include gentle massage therapy, exercises involving the orbicularis muscle, taping of the eyelid, and patient reassurance.

Injection of corticosteroids into the scar is not appropriate because corticosteroids should not be injected into the lower eyelid. In a patient who has long-term symptomatic ectropion that has not spontaneously resolved, appropriate techniques include excision of the scar with skin grafting, tarsorrhaphy, and surgical release of the scar tissue.

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107

A 40-year-old woman develops Frey syndrome after undergoing parotidectomy. The most likely cause is injury to branches of which of the following nerves?

(A) Auriculotemporal
(B) Facial (VII)
(C) Great auricular
(D) Posterior auricular
(E) Vagus (X)

The correct response is Option A.

This 40-year-old woman has Frey syndrome, which occurs as a result of peripheral autonomic dysfunction due to surgical injury. In patients who develop Frey syndrome following parotidectomy, the most likely cause is injury to branches of the auriculotemporal nerve, which is a branch of the mandibular division of the trigeminal nerve. The auriculotemporal nerve links the parasympathetic secretory fibers to the parotid gland. The preganglionic parasympathetic fibers course down the tympanic branch of the glossopharyngeal nerve and the lesser petrosal nerve to the otic ganglion; from there, the postganglionic fibers travel via the auriculotemporal nerve to the parotid gland. Following parotidectomy, the dermal sweat glands may be reinnervated abnormally by the parasympathetic fibers, resulting in innervation of the skin in the preauricular or temporal area. Patients with this abnormal innervation may have localized erythema and diaphoresis instead of saliva production from the parotid gland. Appropriate management for patients who develop this condition includes re-elevating the skin flap and using interposition grafts and flaps.

Frey syndrome does not develop following injury to motor nerves. Therefore, the facial (VII) nerve, which provides motor innervation for most of the facial muscles, cannot be injured in this patient.

The great auricular nerve arises from the second and third cervical nerves and emerges from the posterior border of the sternocleidomastoid muscle, then travels anterosuperiorly between the sternocleidomastoid and platysma muscles and divides into auricular, facial, and mastoid branches. The auricular branch provides sensation to the earlobe and posterior two-thirds of the ear and is prone to injury during surgery of the upper lateral neck.

The posterior auricular nerve arises from the facial nerve at the stylomastoid foramen, receives a contribution from the auricular branch of the vagus nerve, and supplies two nerve branches, one of which joins with the mastoid branch of the great auricular nerve and another that joins with the lesser occipital nerve. Both branches provide sensibility to the posterior side of the pinna and the concha. The posterior auricular nerve supplies motor innervation to the posterior auricular and occipitalis muscles.

The auricular branch of the vagus (X) nerve, also known as Arnold's nerve, arises from the superior ganglion, receives a contribution from the glossopharyngeal nerve, and travels along the temporal bone, emerging through the auricular fissure between the mastoid process and external auditory meatus. It supplies sensation to the posterior aspect of the ear and external auditory meatus.

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108

Patients with which of the following conditions are predisposed to development of temporomandibular joint (TMJ) disorders?

(A) Angle class I occlusion
(B) Anterior tooth loss
(C) Microgenia
(D) Prognathism
(E) Short-face syndrome

The correct response is Option D.

Patients with prognathism are predisposed to development of TMJ disorders. There is an increased incidence of TMJ dysfunction in patients who have posterior movement of the mandibular condyles during occlusion or function. Other conditions that are predisposing factors to the development of TMJ disorders include Angle class II, division 2 malocclusion, absence of posterior teeth, apertognathia, or long-face syndrome. Affected patients who have TMJ symptoms such as pain, clicking sounds within the joint, tinnitus, decreased range of motion of the mandible, or deviation of the mandible to the affected side should undergo a complete dental and occlusal examination.

The presence of isolated microgenia is not associated with a greater risk for development of TMJ disorders.

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109

A 6-year-old girl with velocardiofacial syndrome is referred for evaluation by a speech therapist because she has hypernasal speech. When planning surgical management of this patient's hypernasality, the surgeon should be most concerned about which of the following anatomic anomalies?

(A) Displacement of the carotid vessels
(B) Mandibular retrognathia
(C) Microcephaly
(D) Submucous cleft palate
(E) Vertical maxillary excess

The correct response is Option A.

Velocardiofacial syndrome, or Shprintzen syndrome, is an autosomal dominant disorder with variable expressivity. Patients characteristically have occult or submucous cleft palate, developmental delay, and facial abnormalities, including narrow palpebral fissures, vertical maxillary excess, malar flattening, mandibular retrognathia, and a prominent nose with a square nasal root and narrow alar base. Microcephaly occurs in 40% to 50% of affected patients. Hypernasal speech may result from a combination of cleft palate and occult velar paresis.

However, the associated cardiac anomalies, which occur in more than 80% of patients, are of greatest concern to the surgeon. In particular, the carotid arteries may be ectopic and may be positioned superficially within the posterior pharyngeal wall. Nasoendoscopy should be performed before any surgery because of the increased risk for arterial bleeding during pharyngeal flap repair, which is commonly performed for treatment of hypernasality. If pharyngoplasty is carried out in a patient with unrecognized medial displacement of the carotid vessels, severe hemorrhage and death may result.

If pulsatile vessels are seen in the posterior pharynx during endoscopy, MR angiography is then used to detect anomalous carotid or vertebral arteries near or at the flap donor site.

Mandibular retrognathia, microcephaly, submucous cleft palate, and vertical maxillary excess are all associated with velocardiofacial syndrome; however, none of these abnormalities would result in the development of life-threatening complications during pharyngeal flap reconstruction.

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110

A 58-year-old man has a squamous cell carcinoma of the anterior third of the tongue. Which of the following nodal groups is most likely involved in metastasis?

(A) Jugular digastric
(B) Postcervical
(C) Preparotid
(D) Submental
(E) Superior cervical

The correct response is Option D.

This 58-year-old man who has a squamous cell carcinoma of the anterior third of the tongue will most likely have metastasis to the submental nodes. This portion of the tongue drains into the submental nodes, then to the middle cervical and lower cervical nodes of the jugular chain. The submental nodes also receive lymphatic drainage from the nasal vestibule, lips, and anterior skin of the chin.

The jugular digastric nodes receive lymphatic drainage from the posterior third of the tongue, which may then drain into the remainder of the cervical jugular nodal chain. The posterior half of the scalp drains directly into the postcervical nodes, while the ear and neck drain into the occipital nodes first, then into the postcervical nodes. The preparotid nodes receive lymphatic drainage from the anterior scalp, forehead, midface, and parotid gland. The lateral and middle portions of the tongue drain into the submandibular nodes and then into the superior cervical nodes.

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111

A 3-year-old boy has craniosynostosis, midmaxillary hypoplasia, a low hairline, and brachydactyly. Which of the following is the most likely diagnosis?

(A) Apert syndrome
(B) Crouzon syndrome
(C) Pfeiffer syndrome
(D) Saethre-Chotzen syndrome
(E) van der Woude syndrome

The correct response is Option D.

This 3-year-old boy has findings consistent with Saethre-Chotzen syndrome. Patients with this autosomal dominant disorder have craniosynostosis, a low hairline, and brachydactyly. There is mild variable involvement of the midface.

Apert syndrome is an autosomal dominant disorder characterized by turribrachycephaly, midface hypoplasia, and severe syndactyly and coalition of the digits. Cleft palate may be associated. Acne is seen in patients of all age groups.

Patients with Crouzon syndrome, an autosomal dominant disorder, typically have craniosynostosis involving the coronal, sagittal, and lambdoid sutures, as well as turribrachycephaly. Other findings include midface hypoplasia, exorbitism, and proptosis. The extremities are normal.

Pfeiffer syndrome is an autosomal dominant disorder with craniofacial findings similar to Apert and Crouzon syndromes; it is distinguished by the presence of enlarged, bulbous thumbs and halluces.

van der Woude syndrome is an autosomal recessive disorder characterized by cleft lip and palate and lip pits. There are no craniofacial abnormalities.

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112

In an 8-year-old boy who underwent repair of a unilateral cleft lip and palate in infancy, which of the following materials is most effective for grafting of the alveolar cleft?

(A) Cancellous iliac graft
(B) Cortical cancellous rib graft
(C) Cortical cranial graft
(D) Hydroxyapatite with osteogen
(E) Lyophilized bone

The correct response is Option A.

This 8-year-old boy who has a repaired unilateral cleft lip and palate should undergo alveolar grafting using cancellous iliac bone graft. Particulate cancellous bone is used for grafting in most patients because it promotes the formation of new bone at the recipient site. Viable cells are transplanted with the cancellous graft; therefore, rapid revascularization (within weeks) is likely, and the grafted material is easily incorporated into alveolar bone. The graft is less likely to be disrupted by migration and orthodontic movement of teeth. In young children such as this patient, cancellous bone from either an iliac or cranial site can be used because subsequent tooth eruption through either type of graft will be comparable. However, large amounts of cancellous bone cannot be harvested from sites such as the pelvis or calvaria in young children because the pelvis is comprised mainly of cartilage, and the diploic space in the calvaria is relatively thin.

Use of cortical bone for grafting involves slow ingrowth of vessels and replacement of the graft by host tissue over a long period of time by a method known as "creeping substitution." Because of this, cortical bone is not preferred for alveolar grafting. In addition, studies have shown unpredictable tooth eruption through alveolar grafts using cortical bone.

Grafting using cortical cancellous bone is also not the first choice because the graft is primarily composed of cortical bone.

Studies have shown that grafting with allogenic materials, such as crystalline hydroxyapatite and lyophilized bone, is associated with suboptimal results. Use of a new form of fast-setting hydroxyapatite for bone grafting is currently being studied.

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113

A 15-year-old boy comes for evaluation because he has facial asymmetry. On examination, he has a firm prominence of the right maxilla, distal right femur, and proximal anterior tibia. There are three 1-cm to 3-cm pigmented macular lesions on the trunk.

This patient's findings are most consistent with

(A) Albright syndrome
(B) juvenile fibromatosis
(C) metastatic fibrosarcoma
(D) Ollier disease
(E) von Recklinghausen disease

The correct response is Option A.

This 15-year-old boy most likely has Albright syndrome, also known as Albright-McCune-Sternberg syndrome. This condition typically occurs before age 20 years and manifests as polyostotic fibrous dysplasia and pigmented cutaneous lesions. Female patients also have sexual precocity. Other findings may include premature closure of the epiphyses, rudimentary kidneys, coarctation of the aorta, and endocrine abnormalities.

Fibrous dysplasia is an abnormal, benign proliferation of bone-forming mesenchyme characterized by uniform thickening of the bone. Deformity and displacement of adjacent structures typically result. Approximately 20% of patients with fibrous dysplasia have the polyostotic variant, which affects multiple areas within the same bone and/or multiple bones on one side of the body. The most frequently involved bones are the maxilla above the first molar in the face, as well as the femur and tibia extrafacially. In patients who have dysplastic bone within the face, the management plan includes preventing sinus dysfunction while performing burring and limited resection to restore symmetric bone contour.

Cutaneous examination of patients with Albright syndrome will typically show fewer than six large (greater than 1 cm) lesions with irregular borders.

Juvenile fibromatosis is initially seen during childhood. Affected patients have multiple fibromas of the trunk and extremities that progressively enlarge. Lesions of the head and neck are relatively rare.

Fibrosarcoma is a well-differentiated tumor that typically occurs during middle age and is rare in the head and neck but may be seen in the nose or paranasal sinuses.

Patients with Ollier disease characteristically have vascular malformations (venous or lymphatic) and multiple enchondromas in the hands and long bones. Sarcomatous degeneration may be associated.

von Recklinghausen disease, or neurofibromatosis type I, involves multiple soft, palpable neural sheath tumors of the cranium, spinal canal, or skin. Craniofacial manifestations may include osteolytic lesions in the mandible or skull. Examination of an affected patient will show multiple (more than five) pigmented cutaneous macules larger than 0.6 cm with regular borders; 5% to 15% of patients will subsequently develop neurofibrosarcoma.

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114

A 65-year-old man who has smoked cigarettes for the past 40 years has an ulcerated 3-cm biopsy-proved squamous cell carcinoma of the lateral aspect of the lower lip that is not fixed to the underlying mandible. A 3-cm lymph node can be palpated in the left submandibular region; there is no associated metastasis.

According to TNM classification, which of the following is the correct clinical classification of this tumor?

(A) T1 N1 M0
(B) T2 N1 M0
(C) T1 N2 M0
(D) T2 N2 M0
(E) T3 N1 M0

The correct response is Option B.

In this patient who has a 3-cm squamous cell carcinoma of the lip with one palpable lymph node but no evidence of distant metastases, the tumor is correctly classified as T2 N1 M0. The staging of squamous cell carcinomas of the lip involves three descriptors: T, N, and M. The T descriptor is based on the diameter or surface area of the tumor. The N descriptor describes nodal status. The M descriptor indicates distance of metastasis beyond the neck. This staging criteria allows physicians to predict patient outcomes and choose appropriate therapy based on comparisons with patients in large studies.

A TNM classification table is shown below.

<u>Status of Tumor (T)</u>

TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor 2 cm or less in greatest dimension
T2	Tumor more than 2 cm but not more than 4 cm in greatest dimension
T3	Tumor more than 4 cm in greatest dimension
T4 (lip)	Tumor invades adjacent structures (eg, through cortical bone, inferior alveolar nerve, floor of mouth, skin of face)
T4 (oral cavity)	Tumor invades adjacent structures (eg, through cortical bone, into deep [extrinsic] muscle of tongue, maxillary sinus, skin; superficial erosion alone of bone/tooth socket by gingival primary is not sufficient to classify as T4)

Stages of Lymph Nodes (N)

NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension
N2	Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension; or in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension; or in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension
N2a	Metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension
N2b	Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension
N2c	Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension

Status of Metastasis (M)

MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

Stage Grouping

Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage II	T2	N0	M0
Stage III	T3	N0	M0
	T1	N1	M0
	T2	N1	M0
	T3	N1	M0
Stage IVA	T4	N0	M0
	T4	N1	M0
	Any T	N2	M0
Stage IVB	Any T	N3	M0
Stage IVC	Any T	Any N	M1

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115

A 17-year-old girl who underwent repair of a left-sided cleft lip and palate in infancy has Angle class III malocclusion. Which of the following best describes this patient's malocclusion?

(A) The mesiobuccal cusp of the upper first molar lies in the buccal groove of the lower first molar
(B) The mesiobuccal cusp of the upper first molar lies in the buccal groove of the lower second premolar
(C) The mesiobuccal cusp of the upper first molar lies in the buccal groove of the lower second molar
(D) The maxillary canine cusp lies anterior to the mandibular cusp
(E) The maxillary canine cusp lies anterior to the second mandibular incisor

The correct response is Option C.

Occlusion describes the relationship between the upper and lower teeth and is critical for planning reconstructive surgery of the jaws. The Angle classification of occlusion is based on the relationship of the mesiobuccal cusp of the maxillary first molar to the mandibular first molar when viewed in the sagittal plane. In class III malocclusion, the mesiobuccal cusp of the maxillary first molar lies posterior to the buccal groove of the mandibular first molar and instead is located in the buccal groove of the lower second molar. Causes of Angle class III malocclusion include maxillary retrognathia or hypoplasia (commonly seen in patients with cleft palate) and mandibular prognathia.

In patients with class I (normal) occlusion, the mesiobuccal cusp of the maxillary first molar lies in the buccal groove of the mandibular first molar. Class II malocclusion is defined as the mesiobuccal cusp of the maxillary first molar being located anterior to the buccal groove of the mandibular first molar.

The occlusive relationships of the maxillary canine cusp are not included in Angle's classification.

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116

Which of the following sites contains the primary blood supply of the tongue?

(A) Dorsal third of the tongue
(B) Median septum of the tongue body
(C) Middle third of the tongue
(D) Multiple segments of the tongue
(E) Ventral third of the tongue

The correct response is Option E.

Blood to the tongue is primarily supplied by the ipsilateral lingual artery within the ventral third of the tongue. The lingual arteries penetrate the tongue near its deep base and course toward the tip within the ventral portion. A smaller dorsal lingual branch emerges from each artery and travels parallel to its artery of origin toward the tip of the tongue. Some vascularity may also be supplied by the facial and ascending pharyngeal arteries.

Transverse vessels that cross the midline of the tongue are present only at the tip between the lingual arteries and dorsal lingual branches. In addition, several vessels may be found at the base of the tongue; otherwise, the median septum of the tongue body is avascular.

Knowledge of the vascular anatomy of the tongue is essential for designing tongue flaps, which can be used for oral reconstruction. Longitudinal flaps can be based on the dorsal or ventral sides of the tongue and extended proximally or distally. Tip flaps can be used for repair of vermillion defects; they may be unipedicled or bipedicled and can extend transversely.

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117

Which of the following is characteristic of Romberg disease?

(A) Autosomal dominant inheritance pattern
(B) Bilateral progressive atrophy of the facial soft tissues and bones
(C) Hair deficiency in mild forms
(D) Initial presentation at birth with spontaneous resolution during childhood
(E) Involvement of the ipsilateral neck, trunk, or extremities

The correct response is Option E.

Romberg disease is a type of hemifacial atrophy that may extend to affect a limited area of the ipsilateral neck, trunk, and/or extremities. Affected patients have progressive atrophy of skin, muscle, bone, and cartilage typically limited to one side of the face. The disorder usually manifests in childhood and spontaneously resolves as the patient reaches early adulthood.

Romberg disease has no known etiology or inheritance pattern. Decreased muscle bulk, atrophy of the tongue and subcutaneous tissue, hypoplasia of bone and cartilage, and hair deficiencies are only seen in patients with severe forms of the disease.

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118

The helical root arises from which of the following external ear structures?

(A) Antihelix
(B) Concha
(C) Inferior crus
(D) Scaphoid fossa
(E) Triangular fossa

The correct response is Option B.

Accurate identification of external ear structures is essential for recognition of malformation or injury and subsequent reconstructive surgery. The helical root arises from the concha and then divides the concha into the cymba superiorly and the cavum inferiorly.

The antihelix is a curved prominence that lies parallel to the helix medially. The cephalic portion of the antihelix divides into superior and inferior crura. The inferior crus is bordered by the triangular fossa superiorly and the cymba inferiorly. The scaphoid fossa is the groove between the helix and antihelix, and the triangular fossa is defined as the concave area between the superior and inferior crura.

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119

Which of the following is the most common site of squamous cell carcinoma of the oral cavity?

(A) Buccal mucosa
(B) Floor of the mouth
(C) Mandibular gingivae
(D) Palate
(E) Tongue

The correct response is Option E.

The tongue is the most common site of squamous cell carcinoma of the oral cavity. Tongue carcinoma occurs most often in elderly persons but has been seen in adolescents and young adults. Excess alcohol and tobacco use are thought to be associated. Approximately 36% of all squamous cell carcinomas of the oral cavity affect the tongue. In contrast, 30% of all oral squamous cell carcinomas involve the floor of the mouth, 16% involve the mandibular gingivae, and 10% involve the buccal mucosa, while only 3% involve the palate.

Sites most likely to be affected by tongue carcinomas include the anterior two-thirds, lateral borders, and ventral surface of the tongue; lesions affecting the midline or dorsal surface are rare. Approximately 33% of these tumors arise behind the circumvallate papilla.

Because tongue carcinomas are typically painless, affected persons often do not seek treatment until the tumor becomes advanced and begins to ulcerate and/or cause pain or difficulties with speech or swallowing. Tumor progression correlates directly with the size and extent of invasion of the tumor into the tongue muscles. Patients with extensive muscle infiltration typically have restricted tongue movement.

Approximately 30% of patients with tongue carcinomas have lymph node metastases at initial presentation. The midjugular, subdigastric, and submandibular lymph nodes are most likely to be affected, while the lower jugular, submental, and posterior cervical triangle nodes are rarely involved.

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120

Which of the following chin deformities does NOT result from an abnormality in facial bone development?

(A) Asymmetric chin deformity
(B) Macrogenia
(C) Microgenia
(D) Pseudomicrogenia
(E) Witch's chin

The correct response is Option E.

Patients with the witch's chin deformity have an aesthetically undesirable appearance of the chin caused by soft-tissue ptosis. This condition results from abnormal development of the soft-tissue attachments to the mandible. The maxilla and mandible are not involved.

Asymmetric chin deformities, macrogenia, microgenia, and pseudomicrogenia occur as a result of underlying developmental deformities of the maxilla and/or mandible.

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121

Mandibular fractures most frequently occur at which of the following sites?

(A) Angle
(B) Condyle
(C) Coronoid process
(D) Ramus
(E) Symphysis

The correct response is Option A.

Mandibular fractures are most likely to occur at the angle because it is the thinnest portion of the mandible and is therefore most susceptible to traumatic forces. Approximately 35% of all mandibular fractures occur at the angle. The parasymphysis is only slightly less vulnerable, with approximately 24% of all mandibular fractures occurring here. This is thought to result from the presence of the mental foramen and the cuspid roots in this region.

Approximately 18% of mandibular fractures occur at the mandibular body, 17% occur at the condylar process, and 4% occur at the coronoid process. Only 2% of these fractures affect the ramus.

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122

A 42-year-old man has painless swelling in the parotid region. Examination shows a firm, rubbery 3 × 3-cm parotid mass that is not fixed to the underlying facial skeleton. Facial nerve function is normal. Fine-needle aspiration biopsy is nondiagnostic. Which of the following is the most appropriate next step in management?

(A) Incisional biopsy of the lesion
(B) Enucleation of the lesion
(C) Superficial parotidectomy
(D) Total parotidectomy with sacrifice of the facial nerve
(E) Total parotidectomy with prophylactic ipsilateral supraomohyoid neck dissection

The correct response is Option C.

This patient has a pleomorphic adenoma, or benign mixed tumor of the parotid gland. Pleomorphic adenomas, which are the most common parotid tumors, are discrete, firm, benign masses that enlarge slowly. Pain and facial paralysis are rare findings. Histologic examination of a biopsy specimen will show a mix of mucoid and cellular elements with occasional pseudocartilaginous changes. Superficial parotidectomy should be performed in patients who have lesions confined to the superficial lobe; conservative total parotidectomy is recommended for deeper lesions. The recurrence rate reported following adequate tumor excision is 1% to 5%.

Incisional biopsy is inadequate treatment of pleomorphic adenoma. Enucleation has been associated with local tumor recurrence because the masses are often not encapsulated. Total parotidectomy with sacrifice of the facial nerve or prophylactic supraomohyoid lymph node dissection is excessive and unnecessary for management of a benign tumor.

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123

Scaphocephaly is associated with which of the following suture synostoses?

(A) Bilateral coronal
(B) Lambdoid
(C) Metopic
(D) Sagittal
(E) Unilateral coronal

The correct response is Option D.

Scaphocephaly is just one form of craniosynostosis, or varying deformities of the cranial vault resulting from restrictions in development. Detectable craniosynostotic abnormalities occur in one of approximately 1800 neonates. The coronal, lambdoid, metopic, and sagittal sutures are primarily involved; minor sutures can include the frontonasal, frontosphenoidal, and temporosquamosal. Mental retardation is often seen in patients with multiple synostotic sutures; this occurs as a result of prolonged restriction of brain growth and cranial vault development secondary to fusion of the overlying sutures.

Scaphocephaly is associated with synostosis of the sagittal suture. Affected patients have an elongated, narrow cranial vault. In contrast, patients with bilateral coronal synostosis have brachycephaly, in which the frontal portion of the skull is wide and flat and the cranium is shortened anteroposteriorly. Lambdoid suture synostosis is also known as occipital or posterior plagiocephaly. This condition, characterized by an oblique posterior flattening, is rarely seen congenitally and more often results from childbirth or prolonged head positioning, such as during sleep. Infants with

metopic suture synostosis, or trigonocephaly, have a triangularly shaped forehead with decreased bitemporal distance. Unilateral coronal synostosis, or frontal plagiocephaly, involves oblique frontal flattening of the skull.

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124

In a 30-year-old woman who is undergoing evaluation prior to orthognathic surgery, cephalometric analysis shows a decreased SNB angle and a normal SNA angle. These findings are most consistent with

(A) mandibular protrusion
(B) mandibular pseudoprognathism
(C) mandibular retrusion
(D) maxillary protrusion
(E) maxillary protrusion and mandibular retrusion

The correct response is Option C.

This patient's findings are most consistent with mandibular retrusion, which is defined as a normal SNA (sella-nasion-point A) angle combined with a decreased SNB (sella-nasion-point B) angle on cephalometric analysis. The SNA angle measures the position of point A (anterior maxilla) relative to the anterior cranial base (SN); a normal SNA angle is defined as 82 degrees ± 3 degrees. Patients with maxillary protrusion have an increased SNA angle, while patients with maxillary retrusion have a decreased SNA angle. In contrast, the SNB angle measures the position of point B (anterior mandible) relative to the anterior cranial base (SN); a normal SNB angle is defined as 80 degrees ± 3 degrees. It is increased in patients with mandibular protrusion and decreased in patients with mandibular retrusion.

The Landes angle, which is formed by the Frankfort horizontal line and the nasion to point A (N-A) plane, is sometimes used instead of the SNA angle because of its greater reliability. A normal Landes angle is measured at 88 degrees ± 3 degrees.

The ANB angle measures the position of point A to point B relative to the anterior cranial base; the angle is positive when point A lies anterior to point B. Patients with maxillary protrusion, mandibular protrusion, or a combination of both will have a markedly increased ANB angle. A decreased ANB angle can be seen in patients who have maxillary retrusion, mandibular protrusion, or a combination of both. In patients with mandibular pseudoprognathism, the ANB angle is normal.

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A 10-year-old boy has had a firm painless mass of the left fronto-orbital region that has progressively enlarged over the past several years. There is no history of trauma; the mass was not present at birth. He reports diplopia with upward gaze and mild vertical orbital dystopia. These findings are most consistent with

(A) encephalocele
(B) fibrous dysplasia
(C) mucocele
(D) neurofibromatosis
(E) teratoma

The correct response is Option B.

This 10-year-old boy has findings consistent with fibrous dysplasia, a rare benign condition of bone that occurs as a result of a defect in the activity of the bone-forming mesenchyme. Fibrous dysplasia may either be monostotic, with single bone involvement, or polyostotic, involving multiple sites. Polyostotic fibrous dysplasia associated with abnormal pigmentation, hyperthyroidism, and sexual precocity is known as Albright's syndrome. In patients who have craniofacial fibrous dysplasia, symptoms are primarily related to tumor enlargement and eventual displacement of the orbit and globe; these may include diplopia, proptosis, and encroachment on the optic canal, which can result in blindness. Management of fibrous dysplasia should include observation with conservative bone excision, orbital decompression, and bone graft reconstruction as needed.

Congenital encephaloceles are typically present at birth, while acquired encephaloceles are associated with a history of trauma. Mucoceles, which develop following inflammation or recurrent infection of the ethmoid sinuses, are found medially. Neurofibromas are soft-tissue lesions, while teratomas are present at birth and are more common in the neck and nasopharyngeal regions.

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A 19-year-old man has midface hypoplasia, maxillary retrusion, and the appearance of mandibular prognathism. On examination, he has Angle class III malocclusion and a negative overjet of 15 mm. Which of the following is the most appropriate management?

(A) Anterior mandibular subapical osteotomy
(B) Genioplasty
(C) Le Fort I osteotomy
(D) Sagittal split osteotomy
(E) Combined Le Fort I osteotomy and sagittal split osteotomy

The correct response is Option E.

In this patient who has maxillary hypoplasia and mandibular hyperplasia, resulting in midface retrusion and the appearance of mandibular prognathism, the most appropriate management is combined Le Fort I and sagittal split osteotomies. There are several indications for combined surgery in this patient, including correction of the 15 mm of negative overjet and rotation of the maxillary midline. Maxillomandibular correction can be beneficial in patients who have more than 10 mm of either positive or negative overjet.

Anterior mandibular subapical osteotomy can be used to level the occlusal plane, correct asymmetry, or change the anterior positioning and/or axial angulation of the anterior mandibular teeth. Genioplasty alone will not correct this patient's Angle class III malocclusion. If performed as a single procedure, neither Le Fort I osteotomy nor sagittal split osteotomy will correct both of this patient's deformities.

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127

Which of the following is the most common cause of posttraumatic enophthalmos?

(A) Fat atrophy
(B) Increased volume of the bony orbit
(C) Ligament disruption
(D) Orbital roof defect
(E) Soft-tissue contracture

The correct response is Option B.

Enophthalmos, or posterior displacement of the globe within the bony orbit, is most frequently caused by an increase in bony orbital volume. Because the positioning of the globe is determined by the bony orbit, ligamentous system, and orbital fat, changes in any of these contributing factors occurring as a result of trauma can lead to a change in globe position. However, volumetric studies have pointed to enlargement of orbital volume as the predominant cause of enophthalmos. As such, surgical correction of facial fractures should always include the confirmation and/or re-establishment of normal bony orbital volume. This involves confirmation of the correct positioning of the medial and lateral orbital floors.

Disruption of the orbital ligaments can also result in posttraumatic enophthalmos, especially in relation to increased bony orbital volume. In certain patients who have increased orbital volume, intact ligaments can function to maintain the globe in its normal position. However, if the ligaments are disrupted, the soft tissues can contract, resulting in a

change in both orbital shape and volume. If this is not corrected, the globe will be positioned abnormally following healing, and the enophthalmos will then be difficult to correct.

Defects in the orbital roof are not commonly cited as a cause of enophthalmos because superior displacement of the globe into the anterior cranial fossa is rare.

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128

Which of the following structures are spared during functional neck dissection as compared with radical neck dissection?

(A) External carotid artery, sternocleidomastoid muscle, and great auricular nerve
(B) External jugular vein, digastric muscle, and spinal accessory nerve
(C) Internal carotid artery, digastric muscle, and vagus nerve
(D) Internal jugular vein, sternocleidomastoid muscle, and spinal accessory nerve
(E) Internal jugular vein, sternocleidomastoid muscle, and vagus nerve

The correct response is Option D.

Because radical neck dissection has been associated with a high incidence of morbidity, a modified version of the procedure was devised to continue to treat metastases to the lymph node basin of the lateral neck while sparing vital structures. In the modification of the radical neck dissection, the internal jugular vein, sternocleidomastoid muscle, and spinal accessory nerve are spared. The internal jugular vein provides a crucial venous outlet for the head and neck, while the sternocleidomastoid muscle provides support, strength, and balance. Dissection of the spinal accessory nerve has been associated with painful shoulder drop.

The modified radical neck dissection is now performed in most patients; however, some indications for the use of the original neck dissection remain. The procedure should still be performed in those patients who have metastases to more than one lymph node in the neck following surgery or radiation therapy, patients with carcinomas classified as N2 or N3, and patients who have a fixed neck mass that has not yet been removed, a recurrent tumor, or extranodal extension involving the internal jugular vein or spinal accessory nerve. A surgeon who does not have extensive experience with the modified technique may also wish to perform a radical neck dissection.

It is important to note that patients who have bilateral metastases, classified as N2c, should undergo careful evaluation because of the increased risk for facial and cerebral edema that is associated with ligation of both internal jugular veins.

The external jugular vein, digastric muscle, and submaxillary gland are always removed, while the external carotid artery and vagus nerve remain intact with both the radical and modified versions of the procedure.

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129

In a patient undergoing surgical management of a Le Fort I fracture, rigid fixation is applied using metal plates and screws. When maxillomandibular fixation is removed to confirm the occlusal relationship, a unilateral posterior open bite is noted. Which of the following is the most appropriate next step in management?

(A) Fixation with elastic banding on the side of the open bite for four weeks
(B) Re-establishment of maxillomandibular fixation for six weeks
(C) Removal of all rigid fixation and disimpaction of the maxillary fracture
(D) Removal of all rigid fixation followed by wire fixation of the fracture sites
(E) Replacement of the metal plates with absorbable (Lactasorb) plates on the side of the open bite

The correct response is Option C.

The most important management principal in this patient who has a Le Fort I fracture involves re-establishing the pretraumatic maxillomandibular orientation. Erich arch bars can be used to re-establish occlusion in patients with functional dentition, while intraoral splints can be created for use in edentulous patients. When this has been completed, the fracture site can be exposed and rigid fixation can be applied.

If the maxilla has been impacted into the pterygoid plates, the occlusion will be angled superiorly toward the side of impaction. Therefore, if rigid fixation is applied before the fracture site is disimpacted, the patient will have an open bite on removal of maxillomandibular fixation. In order to prevent this, the impacted segments should be mobilized prior to the application of rigid maxillomandibular fixation, and an even plane should be established to correct the open bite.

Wires, elastic bands, and absorbable plates (Lactasorb) can be used to re-establish maxillomandibular fixation but will not correct the open bite.

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130

The photograph shown above is of an 11-year-old girl who is undergoing evaluation because of the appearance of her nose. Examination shows a short, flattened nasal bridge and midface hypoplasia. The anterior nasal spine is absent on radiographs. Which of the following is the most likely diagnosis?

(A) Binder's syndrome
(B) Goldenhar's syndrome
(C) Nager's syndrome
(D) Treacher Collins syndrome
(E) Velocardiofacial syndrome

The correct response is Option A.

This 11-year-old girl has Binder's syndrome, which is characterized by localized nasomaxillary hypoplasia resulting in a flat nasal bridge and a short, retracted columella. The columella and upper lip are depressed into the floor of the nose, and the anterior nasal spine is absent. Angle class III malocclusion is usually present.

Goldenhar's syndrome, or oculoauriculovertebral dysplasia, involves asymmetry of the hard and soft tissues of the face. This condition is most often unilateral but may be seen bilaterally in some patients. Manifestations of this syndrome include hypoplasia involving the mandible and underlying soft tissues of the face, epibulbar dermoids, and varied degrees of microtia on the affected side. Most patients have associated vertebral abnormalities.

Nager's syndrome, or acrofacial dysostosis, is an autosomal recessive disorder characterized by craniofacial and upper extremity abnormalities. Patients with Nager syndrome have hypoplasia of the orbits, zygoma, maxilla, mandible, and soft palate. Auricular defects may also be present. Hypoplasia or agenesis occurs in the radius, thumbs, and metacarpals. Some patients may have radioulnar synostosis and elbow joint deformities.

Patients with Treacher Collins syndrome, or mandibular dysostosis, have hypoplasia of the zygoma, maxilla, and mandible, downward slanting of the palpebral fissures, colobomas of the lower eyelids, absence of eyelashes, and auricular defects.

Velocardiofacial syndrome is characterized by overt or submucous clefting of the palate and cardiac abnormalities. Most patients have abnormal facial features, including narrow palpebral fissures and a prominent nose with a square nasal root and narrow alar base. The anterior nasal spine is present.

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131

Which of the following embryologic structures gives rise to the tragus and helical root of the external ear?

(A) First branchial arch
(B) First branchial cleft
(C) First pharyngeal pouch
(D) Second branchial arch
(E) Second branchial cleft

The correct response is Option A.

Development of the six branchial arches occurs within the walls of the anterior foregut during the fourth week of gestation, as neural crest cells migrate into the future head and neck region, and alternating ridges and depressions develop. Each branchial arch is composed of endoderm, ectoderm, and mesoderm. During development, a series of clefts forms to create the branchial grooves externally and the pharyngeal pouches internally. Although the clefts eventually obliterate in most cases, persistent branchial clefts (especially incompletely obliterated remnants of the first and second branchial clefts) can present later in life as sinus tracts, fistulas, or cysts.

The auricle arises from the first (mandibular) and second (hyoid) branchial arches and is further defined by the development of six hillocks, which appear on these arches during the sixth week of gestation. The anterior (first through third) hillocks give rise to the tragus, root of the helix, and superior helix, while the posterior (fourth through sixth) hillocks give rise to the antihelix, antitragus, and lobule.

The first (mandibular) branchial arch also gives rise to Meckel's cartilage, which ossifies to form the malleus and incus, as well as to the mandible and the sphenomandibular ligament. Reichert's cartilage, which ossifies to form the stapes, is also derived from the second (hyoid) branchial arch, along with the styloid process, stylohyoid ligament, lesser cornu of the hyoid, and upper part of the hyoid body.

The parathyroid glands are derived from the pharyngeal pouches.

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132

After undergoing repair of an orbital fracture, a patient has progressive loss of vision resulting from the development of a retrobulbar hematoma. In order to immediately relieve intraocular pressure, which of the following structures should be released?

(A) Lateral canthal tendon
(B) Levator aponeurosis
(C) Orbicularis oculi muscle
(D) Tarsal plate
(E) Tenon's capsule

The correct response is Option A.

Intraocular pressure is similar to compartment syndrome in that an excessive amount of pressure on the optic nerve resulting from bleeding or edema can increase intraorbital pressure and ultimately lead to blindness. An acute increase in intraorbital pressure can occur following orbital fracture repair, blepharoplasty, or other surgical procedures. Physical examination in an affected patient will show visual loss associated with a pupillary defect, such as a loss of pupillary reaction to light. Increased intraocular pressure can be measured at the bedside using a tonometer. Lateral canthotomy, or release of the lateral canthal tendon, should be performed immediately to relieve pressure and restore sight. Any proptosis that is present will be accentuated immediately after surgery and can thus be diagnosed at this time; it can be measured to confirm adequate release of the check-rein ocular support. Surgical exploration can also be performed after lateral canthotomy to control any persistent bleeding.

In contrast, eyelid structures such as the levator aponeurosis, orbicularis oculi muscle, and tarsal plate do not need to be released. Because these structures lie external to the support sling created by the lateral canthal tendon and Lockwood's suspensory ligament, they already have at least partial mobility.

Tenon's capsule covers the globe and extraocular muscles, creating a barrier between these structures and the orbital fat. The lower portion of the capsule comprises Lockwood's suspensory ligament. Because of their position proximal to the globe, it is more prudent to detach the lateral canthal tendon from the bony rim in order to allow for advancement of the intraorbital contents. Surgical detachment of the lateral canthal tendon will disrupt the globe only minimally. Any loss of lower eyelid height can be restored later with lateral canthopexy.

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133

A 30-year-old woman has painful clicking of the jaw six months after sustaining blunt trauma to the face in a motor vehicle collision. Radiographs taken at the time of injury showed no evidence of fracture. Which of the following is the most appropriate diagnostic study in the evaluation of this patient?

(A) Arthroscopy
(B) CT scan
(C) Digital subtraction angiography
(D) MRI
(E) Tomography

The correct response is Option D.

MRI is the most appropriate diagnostic study in the evaluation of this patient who has painless clicking of the jaw after sustaining blunt trauma to the face. In fact, MRI is preferred for evaluation of all conditions involving the articular disk and temporomandibular joint (TMJ), including internal derangement of the TMJ. This painless noninvasive modality allows examination in multiple planes and produces an accurate visualization of the soft tissues without exposing the patient to ionizing radiation. Fast-scanning techniques can be used to assess TMJ pathology.

Arthroscopy involves insertion of a scope into the joint space to allow for direct visualization of internal structures. Although this more invasive procedure allows surgeons to visualize the TMJ, it puts the patient at increased risk for the development of adhesions.

CT scans are more effective than conventional radiographs for the evaluation of fractures and tumors within the jaws; they can also be used to evaluate the bony structures of the TMJ. However, this modality exposes the patient to ionizing radiation and provides a less accurate representation of the soft tissues.

Digital subtraction angiography is used for visualization of the vascularity of the head and neck and not the soft tissues of the TMJ.

Tomography has been replaced by the more accurate CT scan and MRI, and is no longer used.

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134

According to the Tessier classification, which of the following clefts is most closely associated with macrostomia?

(A) No. 1
(B) No. 3
(C) No. 5
(D) No. 7
(E) No. 9

The correct response is Option D.

The Tessier classification of craniofacial clefting was first proposed in 1973. This system integrates both tissue findings and underlying skeletal deformities; embryopathogenesis is not considered. According to the Tessier system, the No. 7 cleft manifests as macrostomia and absence of the zygomatic arch. This common sporadic cleft, which has variable expressivity, is more likely to be seen in male neonates and occurs in one of every 3000 births.

The Tessier No. 1 cleft lies just lateral to the midline, beginning at the cupid's bow and passing through the dome of the nostril lateral to the anterior nasal spine. Notching of the alar dome is a distinctive feature. The nasal bone may be absent, but the septum is unaffected. Hypertelorism and encephalocele may also be associated.

The Tessier No. 3 cleft involves the orbit. It begins in the alveolus between the lateral incisor and canine and extends through the maxilla into the lacrimal bone. This cleft is commonly referred to as a naso-ocular cleft because the inferomedial wall of the orbit is absent. Associated soft-tissue deformities include shortening of the nose, colobomas of the nasal alae and the lower eyelids medial to the punctum, obstruction of the nasolacrimal duct, malformation of the lower canaliculus, and hypoplasia of the medial canthal tendon.

With the rare Tessier No. 5 cleft, the cleft moves laterally and becomes oblique. It begins beneath the canine and extends through the maxillary sinus to the orbital floor. Colobomas of the lateral lower eyelids and clefting of the upper lip medial to the oral commissure are associated.

The Tessier No. 9 cleft is merely a supraorbital extension of the Tessier No. 5 cleft.

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135

A 27-year-old woman has numbness of the left cheek after being hit in the eye with a tennis ball. Radiographs show an orbital blowout fracture. Which of the following is the most likely cause of the numbness?

(A) Edema of the skin over the cheek
(B) Entrapment of the infraorbital nerve distal to the foramen
(C) Fracture of the body of the zygoma
(D) Fracture of the infraorbital rim
(E) Injury of the infraorbital nerve within the orbital floor

The correct response is Option E.

A patient who experiences paresthesias of the cheek skin after sustaining a pure blowout fracture of the orbital floor usually has an injury of the infraorbital nerve. This nerve, which is a branch of the maxillary division of the trigeminal nerve (V_2), courses within the inferior orbital canal along the floor of the orbit and exits the body of the zygoma through the infraorbital foramen.

Patients with pure orbital blowout fractures rarely have involvement or fracture of the infraorbital rim or body of the zygoma. The fracture fragments from the orbital floor and medial orbital wall are typically displaced into the sinus. Edema usually occurs in the periorbital region and not the soft tissues of the cheek. Although there are no sites to entrap the nerve distally, patients with more extensive periorbital fractures can have an injury of the infraorbital nerve, but will exhibit additional physical findings.

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136

In a 52-year-old woman with a malignant neoplasm of the parotid gland, CT scan shows a metastatic lesion in the right lung. Biopsy of the parotid lesion is most likely to show

(A) acinic cell carcinoma
(B) adenocarcinoma
(C) adenoid cystic carcinoma
(D) malignant mixed tumor
(E) mucoepidermoid carcinoma

The correct response is Option C.

In this patient who has a malignant parotid gland tumor and a metastatic lesion in the right lung, the parotid tumor is most likely an adenoid cystic carcinoma. Approximately 25% of patients with tumors of the parotid gland have malignancies. Parotid gland tumors occur most frequently in patients between ages 44 and 66 years. Although adenoid cystic carcinoma comprises only 7% of all parotid gland malignancies, this aggressive, typically unilateral tumor is most frequently associated with the development of metastatic disease, which occurs in 33% to 50% of patients with adenoid cystic carcinoma. Distant metastases are more common than lymph node involvement and are often discovered in patients with advanced disease who have already undergone treatment of the primary tumor. Histologic examination of a biopsy specimen will show epithelial masses that contain basophilic and pale-staining cells.

Acinic cell carcinoma is a bilateral or multicentric lesion that is rarely associated with malignant transformation or lymph node metastases. Approximately 12% to 17% of malignant parotid tumors are acinic cell carcinoma. Adenocarcinomas comprise approximately 10% of parotid gland tumors, but are more frequently associated with lymph node involvement, which is seen in 33% of patients at initial diagnosis. Mucoepidermoid carcinoma is the most common malignant tumor of the parotid gland, with 16% to 17% of all parotid malignancies being mucoepidermoid carcinomas. Malignant mixed tumors are the second most common malignancies of the parotid gland. They usually develop in untreated pleomorphic adenomas or as recurrent tumors following inadequate excision of a pleomorphic adenoma; as such, they are also referred to as carcinoma ex-pleomorphic adenoma. None of these tumors exhibits a tendency for lung metastases, except in extreme end-stage disease. Lung metastases are only typical of adenoid cystic carcinoma.

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137

A 30-year-old man sustains an injury to the left side of the face in a fistfight. Radiographs show an isolated fracture of the zygomatic arch; surgical reduction of the fracture is planned. Following incision in the temporal region, the instrument should be passed immediately beneath which of the following layers of the scalp?

(A) Hair follicles
(B) Subcutaneous fat of the scalp
(C) Superficial temporal fascia
(D) Deep temporal fascia
(E) Temporalis muscle

The correct response is Option D.

In the temporal (Gillies) approach, a technique used for operative fixation of zygomatic fractures, the initial scalp incision extends down through skin, subcutaneous tissue, and the superficial and deep temporal fascia. An elevating device is then inserted to raise the fractured arch in order to facilitate effective reduction. This instrument is passed immediately beneath the deep layer of the deep temporal fascia, which lies just beneath the arch. Guiding the instrument beneath the deep layer of the deep temporal fascia allows for careful elevation of the fractured bone.

Because the hair follicles, subcutaneous fat, and superficial temporal fascia are all positioned superficial to the zygomatic arch, passing the elevating device beneath any of these structures will not allow for elevation of the zygoma and may instead result in damage to the frontal branch of the facial nerve. Guiding the elevating device beneath the temporalis muscle is a less optimal approach; if the surgeon passes the instrument too deeply, it will also pass beneath the coronoid process and make elevation of the zygomatic arch more difficult.

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138

An 8-year-old boy has had a painless mass in the midline of the neck that has slowly enlarged over the past two years. This finding is most consistent with

(A) branchial cleft cyst
(B) dermoid cyst
(C) laryngocele
(D) lymphatic malformation
(E) thyroglossal duct cyst

The correct response is Option E.

This 8-year-old boy has a thyroglossal duct cyst, a slowly enlarging, painless mass of the midline of the neck that results from incomplete degeneration of the thyroglossal duct before birth. This duct connects an endodermal diverticulum (which later becomes the thyroid gland) to the foramen cecum in the developing fetus; in most cases, the duct degenerates once the diverticulum becomes a solid gland. Although thyroglossal duct cysts can be found from the base of the tongue to the cricoid cartilage, most cysts are located inferior to the hyoid bone. Infection and rupture are fairly uncommon; if these occur, antibiotics should be administered. Definitive management of a thyroglossal duct cyst is complete surgical excision of the cyst and central portion of the hyoid bone; this is known as the Sistrunk procedure.

Branchial cleft cysts rarely occur in the midline of the neck. Instead, most of these cysts develop from remnants of the second branchial cleft and are found at the anterior border of the sternocleidomastoid muscle. Dermoid cysts are also rare in the neck and are more likely to affect the nasion, lateral brow, or calvarium. A laryngocele is an air pocket that normally communicates with the larynx and often enlarges with coughing or other changes in pressure within the trachea; the report of a slowly enlarging, painless mass would not be expected to describe a laryngocele. Lymphatic malformations are present at birth and would not be seen in the midline of the neck. Because these malformations do not occur in a specific plane, diffuse involvement of head and neck tissues is common.

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139

In a 29-year-old woman who sustained trauma to the face during a rugby game four weeks ago, intranasal inspection with a nasal speculum shows a perforation of the nasal septum. A physical examination and radiographs obtained in the emergency department at the time of initial injury showed findings consistent with a displaced nasal fracture.

Which of the following is the most likely cause of the septal deformity?

(A) Foreign body perforation
(B) Nasal bone puncture
(C) Septal hemangioma
(D) Septal hematoma
(E) Turbinate bone perforation

The correct response is Option D.

The nasal septal perforation seen in this patient is most likely caused by a septal hematoma that was not diagnosed at the time of injury. Because undiagnosed septal hematomas can cause pressure necrosis of the nasal mucosa and cartilage and ultimately lead to septal perforation, intranasal inspection using a nasal speculum should be performed in any patient who has sustained a nasal fracture and/or trauma to the nasal bones. Any hematoma seen on intranasal inspection should then be immediately drained. A #11 blade or a #16-18 needle and syringe can be used for drainage of the hematoma in order to relieve pressure and allow blood to flow into the nose.

A foreign body, nasal bone puncture, septal hemangioma, or turbinate bone perforation is unlikely to result in a perforation of the nasal septum.

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140

Patients with paralysis of the trigeminal nerve have loss of function of which of the following muscles?

(A) Levator veli palatini
(B) Palatopharyngeus
(C) Stylohyoid
(D) Stylopharyngeus
(E) Tensor veli palatini

The correct response is Option E.

Because the tensor veli palatini muscle receives its motor innervation from the trigeminal (V) nerve, a patient who has paralysis of this nerve will experience a loss of function of the tensor veli palatini, which is a derivative of the first branchial arch. In contrast, the anatomically adjacent levator veli palatini muscle is a derivative of the fourth branchial arch and is innervated by the superior laryngeal branch of the vagus (X) nerve. The palatopharyngeus muscle has this same origin and innervation. The stylohyoid muscle is derived from the second branchial arch and innervated by the facial (VII) nerve, while the stylopharyngeus muscle is derived from the third branchial arch and innervated by the glossopharyngeal (IX) nerve.

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141

A 55-year-old woman has numbness of the earlobe after undergoing biopsy of an internal jugular lymph node. The most likely cause is injury to which of the following structures?

(A) Auricular branch of the vagus nerve
(B) Auriculotemporal nerve
(C) Great auricular nerve
(D) Posterior auricular nerve
(E) Ventral ramus of the first cervical root

The correct response is Option C.

This 55-year-old woman has numbness of the earlobe due to injury to the great auricular nerve. This nerve arises from the second and third cervical nerves and emerges from the posterior border of the sternocleidomastoid muscle, then travels anterosuperiorly between the sternocleidomastoid and platysma muscles and divides into auricular, facial, and mastoid branches. The auricular branch provides sensation to the earlobe and posterior two thirds of the ear and is prone to injury during surgery in the region of the upper lateral neck.

The auricular branch of the vagus nerve, also known as Arnold's nerve, arises from the superior ganglion, receives a contribution from the glossopharyngeal nerve, and travels along the temporal bone, emerging through the auricular fissure between the mastoid process and external auditory meatus. It supplies sensation to the posterior aspect of the ear and external auditory meatus.

The auriculotemporal nerve is a sensory branch of the trigeminal nerve. This nerve branch courses posterior to the external pterygoid muscle, emerges from beneath the parotid gland, crosses the zygoma, and travels in a superior direction. The anterior auricular branches of this nerve supply sensory innervation to the anterior upper helix and tragus.

The posterior auricular nerve arises from the facial nerve at the stylomastoid foramen, receives a contribution from the auricular branch of the vagus nerve, and supplies two nerve branches, one of which joins with the mastoid branch of the great auricular nerve and another that joins with the lesser occipital nerve. Both branches provide sensibility to the posterior side of the pinna and the concha. The posterior auricular nerve supplies motor innervation to the posterior auricular and occipitalis muscles.

The ventral ramus of the first cervical root courses parallel to the vertebral artery and supplies motor innervation to the rectus capitis muscles.

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142

Distraction osteogenesis of the mandible in an 8-year-old boy is optimally performed at a rate of how many millimeters daily?

(A) 0.1
(B) 0.5
(C) 1.0
(D) 2.0
(E) 5.0

The correct response is Option C.

In a patient who is undergoing distraction osteogenesis for bone lengthening to compensate for a deformity, the distraction zone forms a radial pattern, allowing for the formation of bone at different rates within the zone. Although experimentation with different rates of distraction has had positive results with rates from 0.5 mm to 2.0 mm daily, distraction at a rate of 1.0 mm has been shown to be optimal in most situations, including mandibular lengthening in an 8-year-old child. Some surgeons are performing distraction osteogenesis in infants at rates as high as 2.0 mm daily because of the greater osteogenic potential seen in infants, which allows for an acceleration of the process. However, this high rate is associated with delays in ossification, especially in areas of low metabolism, such as the diaphysis. Rates of 0.5 mm daily or less are associated with an increased risk for premature consolidation.

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143

A 7-year-old boy has a mass covering the entire right cheek that was present at birth and has progressively enlarged with the child. On physical examination, a thrill can be palpated over the mass, and the skin temperature is increased in the area of the lesion. A bruit can be heard on auscultation. MRI shows a high-flow lesion with multiple feeding vessels.

Which of the following is the most appropriate management?

(A) External beam radiation therapy
(B) Ligation of feeding vessels
(C) Laser ablation
(D) Angiographic embolization
(E) Embolization followed by excision

The correct response is Option E.

This patient has an arteriovenous malformation, or AVM, which is characterized by rapid, turbulent blood flow through multiple feeding vessels from the high-pressure arterial system to the low-pressure venous system. These lesions are often pulsatile; a thrill or bruit will be heard on auscultation. MRI is most helpful in delineating the anatomy of the AVM and its flow characteristics.

Because treatment can be associated with the same life-threatening complications as the existence of the lesion itself, appropriate management typically requires multi-modality therapy, including preoperative correction of any underlying consumptive coagulopathy, angiographic embolization of feeding vessels, complete surgical excision of the malformation, and soft-tissue reconstruction.

Radiation therapy and laser ablation are not appropriate management options for a patient with a congenital AVM. Ligation of feeding vessels or angiographic embolization alone will only worsen this patient's condition.

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144

Which of the following processes involves the transformation of recipient mesenchymal cells into osteoprogenitor cells resulting from the stimulation of bone morphogenetic protein?

(A) Endochondral ossification
(B) Membranous ossification
(C) Osteochondrosis
(D) Osteoconduction
(E) Osteoinduction

The correct response is Option E.

Osteoinduction describes the process by which tissue types induce cellular differentiation through their actions on each other. Bone morphogenetic protein is stimulated to induce the transformation of perivascular mesenchyme-like cells, known as pericytes, into osteoprogenitor cells.

Endochondral ossification involves the formation of new bone within a hyaline cartilage framework in the epiphysis of the long bones. The process of membranous ossification is primarily responsible for bone formation in the cranial vault and face; this process involves condensation of mesenchymal tissue. Osteochondrosis describes a group of ossification disorders in children. These disorders, which may affect solitary or multiple sites of ossification, are characterized by degeneration of aseptic necrosis of bone followed by reossification. Osteoconduction is the process of tissue ingrowth from the host recipient bed into the grafted material; the bone-producing osteoprogenitor cells play a crucial role in this process.

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145

In patients with 2-cm squamous cell carcinomas of the lip being treated with external beam radiation therapy only, the percentage who will experience complete tumor remission is closest to

(A) 10%
(B) 25%
(C) 50%
(D) 75%
(E) 90%

The correct response is Option E.

Because squamous cell carcinoma of the lip is radiosensitive, approximately 90% of patients who have tumors of 2 cm or smaller will experience complete tumor remission following treatment with external beam radiation therapy only. This rate of remission is comparable to that reported with complete tumor excision alone.

In patients who have larger tumors, radiation therapy can be administered prior to surgical excision to reduce the size of the tumor, thus decreasing the total amount of tissue to be removed during excision. It has been shown that patients who have undergone radiation therapy followed by surgical excision have less aesthetic deformity and dysfunction; this is especially true in patients who have tumors of the oral commissure. Complete tumor clearance has been seen with lesions as large as 6 cm.

Radiation therapy can also be administered postoperatively in patients who have poorly differentiated tumors or tumors associated with positive margins, perineural invasion, or recurrence.

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146

A 25-year-old woman comes for evaluation because she desires surgical correction of a gummy smile and a weak chin. On examination, she has clinical signs consistent with long face syndrome. Which of the following is the most appropriate management?

(A) Anterior segmental maxillary osteotomy with intrusion of the anterior segment
(B) Le Fort I osteotomy with inferior repositioning of the maxilla
(C) Le Fort I osteotomy with superior repositioning of the maxilla and genioplasty
(D) Sagittal split osteotomy with mandibular advancement and genioplasty
(E) Sliding genioplasty

The correct response is Option C.

In this patient who has long face syndrome resulting from vertical maxillary hyperplasia, the most appropriate management is Le Fort I osteotomy with superior repositioning of the maxilla combined with genioplasty. Long face syndrome is characterized by excessive length of the lower third of the face. Affected patients have lip incompetence with the lips in repose, a large interlabial gap, and excessive maxillary incisor show with the upper lip at rest; normal maxillary incisor show is quantified as 2 mm to 3 mm. In addition, the nasolabial angle is obtuse and the alar bases are narrow and constricted. Occlusion is often Angle class II with an anterior open bite. The chin is often vertically long and somewhat retruded.

Le Fort I osteotomy with superior repositioning of the maxilla (intrusion) should be performed for management of this patient's vertical maxillary excess. If autorotation alone does not correct the chin positioning, genioplasty can be performed as well. Sagittal split osteotomy with mandibular setback may also be considered in order to effectively treat the malocclusion without significantly repositioning the maxilla.

Anterior segmental osteotomy with intrusion will treat the transverse maxillary arch deformities but not the vertical maxillary excess. Le Fort I osteotomy with inferior repositioning will only further increase lower facial height. As mentioned above, sagittal split osteotomy with mandibular advancement and genioplasty can be used in conjunction with Le Fort I osteotomy in this patient to correct the Angle class II malocclusion and/or any facial asymmetry, but will not address all of this patient's facial concerns if performed alone. Sliding genioplasty will treat the weak chin only, and not the maxillary excess, nose and lip findings, or malocclusion.

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147

A 24-year-old woman with maxillary hypoplasia is scheduled to undergo Le Fort I osteotomy. In order to protect the maxillary dentition, the osteotomy must be carried out above the dental apices. Which of the following maxillary teeth have the longest roots?

(A) Central incisors
(B) Lateral incisors
(C) Cuspids
(D) First bicuspids
(E) First molars

The correct response is Option C.

The cuspids, or canine teeth, have the longest roots in both the maxilla and mandible. The average length of a cuspid tooth from the tip of the root to the tip of the crown is 27 mm.

Knowledge of the length and position of the dental roots will help to prevent injury during Le Fort I osteotomy and placement of internal fixation during fracture reduction. The dentition can also be injured during stabilization of maxillary or mandibular fractures.

The average length of a molar tooth from the tip of the root to the tip of the crown is 24 mm. The length of the upper first molar is 21.3 mm.

The cuspid tooth is named for its single cusp; bicuspids have two cusps (buccal and lingual), and molars have three cusps (mesiobuccal, distobuccal, and mesiolingual). The average adult has two maxillary cuspids, four maxillary bicuspids, and six maxillary molars.

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148

Which of the following bones comprises the greatest portion of the medial orbital wall?

(A) Ethmoid
(B) Lacrimal
(C) Maxilla
(D) Palatine
(E) Sphenoid

The correct response is Option A.

The medial orbital wall is comprised primarily of the orbital plate of the ethmoid bone. This bone is made up of a horizontal or cribriform plate, a midline perpendicular plate that forms the nasal septum, and symmetric lateral masses. The outer wall of each lateral mass is the medial orbital wall, the inner walls are the sidewalls of the nasal cavity, and the ethmoid sinuses can be found between these walls.

Knowledge of the anatomy of the medial orbital wall is important when diagnosing and treating extensive orbital blowout fractures, which often include the orbital floor. These fractures can extend to involve the inferomedial hillock and central section of the medial orbital wall; if this occurs, the orbital contents may be displaced into the maxillary and ethmoid sinuses. If the anatomic volume of the bony orbit is not restored surgically, the patient may develop posttraumatic enophthalmos and diplopia. This will most likely occur in those patients who have an increase in bony orbital volume of greater than 5%.

The lacrimal and palatine bones give off smaller contributions to the medial orbital wall, as does the lesser wing of the sphenoid bone. The orbital floor is comprised of the maxilla medially and the zygoma anteriorly.

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149

Which of the following structures is a branch of the mandibular division of the trigeminal nerve?

(A) Infraorbital nerve
(B) Lingual nerve
(C) Nasopalatine nerve
(D) Posterosuperior alveolar nerve
(E) Posterosuperior nasal nerve

The correct response is Option B.

The lingual nerve, which supplies sensation to the anterior two thirds of the tongue, is a branch of the mandibular division of the trigeminal nerve (V_3). Other structures that arise from this nerve include the inferior alveolar nerve, which supplies sensation to the mandibular teeth; the long buccal branch, which supplies sensation to the buccal mucosa; and the mental nerve, which supplies sensation to the skin of the chin and lower lip and the mucosa of the lip and adjacent gingiva. In addition, the auriculotemporal nerve divides from the posterior border of V_3 immediately after exiting the foramen ovale, passes around the middle meningeal artery as two units, and then courses between the external auditory canal and temporomandibular joint (TMJ). This nerve supplies sensory innervation to the anterior auricle, a large portion of the temporal region, and part of the external auditory canal and gives off a branch to supply the TMJ.

The infraorbital nerve, nasopalatine nerve, posterosuperior alveolar nerve, and posterosuperior nasal nerve are branches of the maxillary division of the trigeminal nerve (V_2).

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150

A 42-year-old man is scheduled to undergo surgical excision of a lesion of the lower lip. During anesthetic blockade of the mental nerve prior to the procedure, the nerve foramen can be located beneath the apex of which of the following mandibular teeth?

(A) Central incisor
(B) Cuspid
(C) First molar
(D) Lateral incisor
(E) Second bicuspid

The correct response is Option E.

During anesthetic blockade of the mental nerve, the nerve foramen can be found beneath the apex of the second bicuspid tooth. This nerve, which is the terminal branch of the inferior alveolar nerve, supplies sensory innervation to the skin and mucous membranes of the lower lip as well as the skin of the anterior mandible and chin.

It is important to have knowledge of the location of the mental nerve and its foramen in order to prevent injury during reduction of anterior mandibular fractures or osseous sliding genioplasty procedures.

Because the inferior alveolar nerve is a branch of the mandibular division of the trigeminal nerve (V_3), it may be injured during sagittal split osteotomy procedures. Affected patients will have numbness in the distribution of the inferior alveolar nerve postoperatively.

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151

Stensen's duct can be found at which of the following anatomic sites?

(A) At the mandibular angle
(B) At the preauricular border
(C) At the zygomatic arch
(D) Between the superficial and deep lobes of the parotid gland
(E) Within the buccal space

The correct response is Option E.

Stensen's duct can be found within the buccal space, which is bordered anteriorly by the orbicularis oris muscle, posteriorly by the edge of the masseter muscle, superiorly by the zygomaticus major muscle, and inferiorly by the fascial attachment of the buccinator muscle to the mandible. The duct develops deep within the parotid gland and emerges from the superior third of the gland at its anterior border, then courses below the zygomatic arch and enters the buccal space, inserting into the buccinator and then entering the oral cavity opposite the upper second molar. The facial artery and vein, buccal branches of the facial nerve, and buccal fat pad can also be found within the buccal space.

Although Stensen's duct and branches of the facial nerve are vulnerable to inadvertent dissection in the area of the parotid gland, there are no major arterial branches in this region.

The external carotid artery can be found within the angle of the mandible, while the superficial temporal artery is located within the preauricular border. The transverse facial artery is found at the zygomatic arch. These locations do not lie within the typical course of Stensen's duct.

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152

The Frankfort horizontal line passes through which of the following points?

(A) Gonion-pogonion
(B) Porion (tragion)-nasion
(C) Porion (tragion)-orbitale
(D) Sella-nasion
(E) SNA-SNB

The correct response is Option C.

The Frankfort horizontal line passes through the porion (tragion) and orbitale. Anatomists in Germany in the last century determined this point to be a horizontal reference line for skull orientation. In addition, the sella-nasion line is used as a reference line; it is oriented at 6 to 8 degrees from the Frankfort horizontal. This reference line is used to define the length of the cranial base.

Maxillary relations can be evaluated using the anterior and posterior nasal spines, which can be used for maxillary orientation, as well as the SNA angle. This measures the position of point A (anterior maxilla) relative to the anterior cranial base (SN). A normal SNA angle is identified as 82 degrees ± 4 degrees. Decreased width indicates maxillary retrusion, while increased width indicates maxillary protrusion.

In contrast, the gonion-pogonion, which represents the mandibular plane, and the SNB angle can be used to evaluate mandibular relations. The SNB angle measures the position of point B (anterior mandible) relative to the anterior cranial base (SN). A normal angle is defined as 79 degrees ± 3 degrees. A wide angle denotes mandibular protrusion, while a narrow angle denotes inadequate mandibular development.

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153

A 21-year-old man sustains blunt trauma to the face while playing football. On examination, he has unilateral pain and facial swelling; he is unable to open his mouth. Radiographs show a nondisplaced coronoid fracture. Which of the following is the most appropriate initial step in management?

(A) Coronoidectomy
(B) Maxillomandibular fixation
(C) Endoscopic reduction and fixation
(D) Open reduction and rigid internal fixation
(E) Open reduction and wire fixation

The correct response is Option B.

In this 21-year-old man who has an isolated nondisplaced fracture of the coronoid process, the most appropriate management is short-term maxillomandibular fixation. The tendons of the temporalis muscle act as splints for the fracture fragments, allowing osseous union to occur spontaneously. Because ankylosis may develop between the coronoid process and the zygomatic arch if immobilization is prolonged, fixation should only be applied for one to two weeks. Following removal of fixation, physical therapy may be required to re-establish the normal vertical dimension of the face.

In rare patients who have displaced fracture fragments that obstruct normal mandibular motion, partial coronoidectomy may be performed. Endoscopic approaches to the temporomandibular joint are reserved for intra-articular injuries such as meniscal tears. Rigid or wire fixation is not required because of the expected osseous union associated with this type of fracture.

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154

A 31-year-old man has pain and loosening of mandibular teeth associated with a rapidly expanding mass in that region. Histologic examination of a biopsy specimen shows osteogenic sarcoma. Which of the following is the most appropriate management?

(A) External beam radiation therapy
(B) Interstitial brachytherapy
(C) Chemotherapy
(D) Radical excision
(E) Radical excision followed by chemotherapy and radiation therapy

The correct response is Option E.

Radical excision remains the recommended primary treatment method for patients with osteogenic sarcoma, which is an aggressive, rapidly expanding mass often seen in the maxilla or mandible. However, adjuvant chemotherapy and radiation therapy have also been recommended as of late; clinical randomized trials of patients with osteogenic sarcoma have shown improved disease-free survival rates following chemotherapy and radiation therapy in patients with tumors affecting either the head and neck or the extremities. In addition, combination therapy is recommended because these tumors recur frequently.

The mean age of onset of osteogenic sarcoma is age 31 years; symptoms at initial presentation include jaw pain and loosening of teeth. Risk factors include fibrous dysplasia and retinoblastoma, as well as previous exposure to ionizing radiation or colloidal thorium dioxide (Thorotrast).

In patients who undergo surgical resection alone, five-year survival rates range from 23% to 35%.

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155

An edentulous 65-year-old man sustains bilaterally displaced fractures of the mandibular body in a motor vehicle collision. Which of the following is most effective for determining the patient's maxillomandibular relationship prior to the application of rigid fixation?

(A) Analysis with a face-bow
(B) CT scans of the face
(C) Custom-fabricated intraoral splints
(D) Erich arch bars
(E) Plain radiographs

The correct response is Option C.

Management of maxillomandibular fractures involves determination of the anatomic relationship of the maxilla and mandible to each other, as well as to the cranial base. After the orientation of the jaws has been established, the fracture segments can be exposed and rigid fixation can be applied. Human teeth are typically used to establish maxillomandibular orientation; however, this is not possible in the edentulous patient. Custom-fabricated intraoral splints or the patient's own dentures can instead be rigidly fixed to the maxilla and mandible using wire or screws. The maxilla and mandible can then be brought into occlusion and fixed together.

A face-bow is used to determine the relationship of the maxilla and the midface to the cranial base; the mandible is not assessed. Plain radiographs and CT scans of the face are also helpful in determining the extent of the patient's injuries and in planning surgery, but not in establishing skeletal orientation. Erich arch bars can only be used in patients with functional dental occlusion.

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156

A 45-year-old man sustains an isolated fracture of the body of the zygoma that is displaced inferiorly and posteriorly. The accurate alignment of which of the following anatomic structures provides the most useful guide for surgical reduction of the fracture?

(A) Anterior maxillary wall
(B) Frontozygomatic suture
(C) Inferior orbital rim
(D) Lateral orbital wall
(E) Zygomatic arch

The correct response is Option D.

In this 51-year-old man who has a significantly displaced fracture of the body of the zygoma, accurate fracture reduction can be best accomplished using the lateral orbital rim as a guide. Although each of the structures listed above will provide useful information for accurate reduction of this type of fracture, the lateral orbital rim is least likely to be comminuted, and reduction of the lateral orbital wall with the greater wing of the sphenoid bone will allow for simultaneous correction of the reduction in all planes. Use of the lateral orbital rim for accurate fracture reduction will reduce the patient's risk for development of malar flattening, enophthalmos, and other secondary sequelae.

Reduction of the frontozygomatic suture will correct the inferior displacement but may leave persistent rotational changes. Likewise, although reduction of the anterior maxillary wall, the inferior orbital rim, or the zygomatic arch

alone without reduction of adjacent structures will allow correction in one plane, the rotational defects may remain undetected.

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157

A 64-year-old man develops a chylous fistula 10 days after undergoing left total parotidectomy and radical neck dissection for management of a parotid gland malignancy with metastasis to the ipsilateral neck. In addition to initiation of a medium-chain triglyceride diet, which of the following is the most appropriate management?

(A) Repair of the thoracic duct
(B) Closed suction drainage of the neck
(C) Radiation therapy of the neck and parotid bed
(D) Mediastinal exploration with ligation of the thoracic duct
(E) Surgical exploration of the neck with interposition of a pectoralis major myocutaneous flap

The correct response is Option B.

In this patient who has a chylous fistula, the most appropriate management is initiation of a medium-chain triglyceride diet and closed suction drainage of the neck. Chylous fistulas develop as a result of injury to the thoracic duct as it enters the jugular vein at the inferior region of the left neck; this finding is seen in as many as 4% of patients who have undergone radical neck dissection on the left. A medium-chain triglyceride diet will curb the flow of chyle into the region, while closed suction drainage will remove the existing chyle, allowing for closure of the fistula. Mediastinal exploration with ligation of the thoracic duct may be considered in patients who have refractory fistulas.

Repair of the thoracic duct is generally not performed initially. Radiation therapy should only be considered after closure of the fistula. Although interposition of a pectoralis major myocutaneous flap may help to seal the fistula, it should not be considered as a first-line treatment.

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Each of the following is a muscle of mastication EXCEPT the

(A) buccinator
(B) lateral pterygoid
(C) masseter
(D) medial pterygoid
(E) temporalis

The correct response is Option A.

The lateral and medial pterygoids, masseter, and temporalis muscles are muscles of mastication, capable of exerting force on the mandible. These muscles are innervated by the mandibular division of the trigeminal nerve (V_3).

The lateral pterygoid muscle has two heads, which arise from the infratemporal surface and infratemporal crest of the greater wing of the sphenoid bone and the lateral surface of the lateral pterygoid plate, and insert on the mandibular neck and the articular capsule and disk of the temporomandibular joint. This muscle pulls the condylar process of the mandible and articular disk forward, opening the mouth.

The medial pterygoid muscle arises from the medial surface of the lateral pterygoid plate and the pyramidal process of the palatine bone and inserts on the medial surface of the mandibular ramus and angle. It acts to elevate and protrude the mandible and produce side-to-side movements.

The masseter muscle arises from the zygomatic arch and inserts on the mandibular ramus and coronoid process; during mastication it elevates the mandible to occlude the teeth.

The temporalis muscle arises from the temporal fossa, passes deep to the zygomatic arch, and inserts on the coronoid process and anterior border of the mandibular ramus. This muscle elevates the mandible and contributes to side-to-side grinding movements. The posterior fibers of the temporalis aid in retraction of the mandible once it has been protruded.

The buccinator muscle arises from the alveolar process of the maxilla, from the mandible opposite the molars, and from the anterior border of the pterygoid mandibular raphe; it inserts into the submucosa of the cheeks and lips and is used to compress the cheeks against the teeth and gums. It is innervated by the facial (VII) nerve. Although it is not a muscle of mastication, it assists the tongue in directing food between the molars during mastication.

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159

Which of the following craniosynostotic disorders is NOT characterized by anomalies of the extremities?

(A) Apert syndrome
(B) Carpenter syndrome
(C) Crouzon syndrome
(D) Nager syndrome
(E) Pfeiffer syndrome

The correct response is Option C.

Patients with Apert syndrome have symmetric syndactyly of the hands and feet; other findings include synostosis of multiple sutures, exorbitism, and midface hypoplasia. In Carpenter syndrome, partial digital syndactyly and preaxial polysyndactyly of the feet are combined with suture synostosis. Nager syndrome is an autosomal recessive disorder in which the extremity anomalies range from hypoplasia to agenesis of the radius, thumbs, and metacarpals. Hypoplasia of the orbits, zygoma, maxilla, and mandible and auricular defects are also found. Patients with Pfeiffer syndrome have broad thumbs and halluces in addition to the suture synostosis. Partial syndactyly of the second and third digits has also been identified.

Crouzon syndrome is characterized by craniosynostosis, exorbitism, and midface retrusion; the extremities are unaffected.

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During dissection to the level of the digastric tendon in a patient undergoing microsurgical head and neck reconstruction, the hypoglossal nerve can be found in which of the following positions?

(A) Lateral to both the internal and external carotid arteries
(B) Medial to both the internal and external carotid arteries
(C) Lateral to the internal carotid artery and medial to the external carotid artery
(D) Medial to the internal carotid artery and lateral to the external carotid artery

The correct response is Option A.

During preparation of recipient vessels for free tissue transfer in a patient undergoing head and neck reconstruction, the branches of the carotid artery and internal jugular vein are dissected. The digastric tendon is divided or retracted, and then the carotid artery and hypoglossal nerve are exposed. The hypoglossal nerve passes between the internal carotid artery and internal jugular vein. It turns anteriorly, spiraling around the internal carotid artery, and passes under the occipital artery. It then loops across the lateral surface of the external carotid artery and passes deep to the insertion of the stylohyoid muscle and digastric sling before disappearing beneath the posterior edge of the mylohyoid muscle. The surgeon must take great care to avoid injuring the hypoglossal nerve because injury would lead to impaired tongue mobility and potential difficulties with speech and swallowing.

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During development, primary cleft palate occurs as a result of unsuccessful fusion of which of the following structures?

(A) Lateral palatine processes and median palatine process
(B) Maxillary prominence and lateral palatine process
(C) Maxillary prominence and mandibular prominence
(D) Medial nasal prominence and nasal septum

The correct response is Option A.

During development, primary cleft palate occurs as a result of unsuccessful fusion of the median palatine process, which forms the primary palate, and the lateral palatine processes, which form the secondary palate. In contrast, secondary cleft palate occurs following unsuccessful fusion of the lateral palatine processes to each other and with the nasal septum.

Because the lateral palatine process is derived from the maxillary prominence, these two structures cannot fuse. Unsuccessful fusion of the maxillary and mandibular prominences results in macrostomia, while cleft lip results from fusion of the medial nasal prominence and maxillary prominence. Fusion of the medial nasal prominences leads to development of the nasal septum; therefore, these structures cannot fuse to each other. The premaxilla, nasal tip, and the philtrum and cupid's bow of the upper lip are also formed from fusion of the medial nasal prominences; the lateral portion of the upper lip is formed from the first branchial arch.

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162

A 16-year-old boy is scheduled to undergo maxillary advancement for correction of a 10-mm negative overjet of the maxillary incisors. Which of the following additional findings is associated with the greatest risk for the development of velopharyngeal incompetence?

(A) Class III malocclusion secondary to mandibular prognathism
(B) Maxillary-mandibular disharmony secondary to craniofacial microsomia
(C) Midface hypoplasia secondary to Crouzon syndrome
(D) Midface hypoplasia secondary to repaired cleft palate

The correct response is Option D.

Patients with midface hypoplasia secondary to repaired cleft palate are at increased risk for development of velopharyngeal incompetence, especially following maxillary (Le Fort I) advancement of greater than 10 mm. In a study of 70 patients who underwent Le Fort I advancement, the incidence of velopharyngeal incompetence was increased in those patients who had previously undergone cleft palate repair. This was particularly true in patients who, on preoperative examination, exhibited evidence of nasal air emission, nasal resonance, borderline velopharyngeal incompetence, or a combination of these findings.

In patients with Angle class III malocclusion secondary to mandibular prognathism, maxillary advancement is not the treatment of choice; instead, the skeletal anomaly is more appropriately addressed by performing mandibular setback. This procedure should not increase the patient's risk for development of velopharyngeal incompetence.

Patients undergoing maxillary advancement for management of other conditions, such as craniofacial microsomia or Crouzon syndrome, are at much lower risk for development of velopharyngeal incompetence than those patients with a repaired cleft palate.

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According to Tessier's classification, which of the following is the most common craniofacial cleft?

(A) No. 0
(B) No. 3
(C) No. 4
(D) No. 6
(E) No. 7

The correct response is Option E.

The Tessier classification of craniofacial clefting was first proposed in 1973. This system integrates both tissue findings and underlying skeletal deformities; embryopathogenesis is not considered. Clefts No. 0 through 7 are located in the lower half of the face, while Nos. 9 through 14 occur in the upper hemisphere. According to the Tessier system, the No. 7 cleft is most common. This sporadic cleft, which has variable expressivity, is most likely to be seen in male neonates and occurs in one of every 3000 neonates. Macrostomia and absence of the zygomatic arch are typically associated.

Tessier No. 3 cleft involves the orbit. The cleft through the lip is located in the same position as a midline unilateral cleft lip. In the nasal area, the cleft changes its course and undermines the ala. The medial canthus is displaced inferiorly. Colobomas of the lower eyelid are medial to the punctum. The osseous component passes through the alveolus between the lateral incisor and canine. The cleft disrupts the lateral border of the piriform aperture.

Tessier No. 4 cleft passes lateral to the cupid's bow and philtrum. In most affected patients, the cleft is located lateral to the nasolacrimal canal and sac. Like the Tessier No. 3 cleft, the osseous component is located between the lateral incisor and canine. However, unlike the No. 3 cleft, the No. 4 cleft spares the piriform aperture and courses medial to the intraorbital foramen.

Tessier No. 6 cleft involves an incomplete form of Treacher Collins syndrome. The cleft is directed inferior and lateral to the oral commissure toward the angle of the mandible. Colobomas of the lateral lower eyelids are seen.

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164

A 25-year-old woman has facial asymmetry. She says that she has had progressive loss of soft-tissue volume on the right side of the face since age 10 years that became stabilized four years ago. Examination shows significant subcutaneous atrophy of the right side of the face without bony asymmetry. She also has hypopigmentation of the iris on the affected side.

Which of the following is the most appropriate management?

(A) Bone graft augmentation of the midface
(B) Alloplastic augmentation
(C) Reconstruction with a microvascular serratus anterior free flap
(D) Reconstruction with a microvascular parascapular free flap
(E) Reconstruction with a superficial temporal fascia flap

The correct response is Option D.

This 25-year-old woman has Romberg's hemifacial atrophy characterized by progressive unilateral loss of facial soft tissue. The underlying skeleton is also affected in patients with severe forms of the disease. Surgery should be delayed until the condition becomes stabilized, which is indicated by the cessation of facial atrophy. When this has occurred, a microvascular parascapular flap can be deepithelialized and customized to fit the dimensions of the defect, and then transferred and buried subcutaneously.

Skeletal augmentation with either bone graft or alloplast is not appropriate because the bones of the face are not affected. The serratus anterior flap would only atrophy over time, and the superficial temporal fascia flap would not provide the necessary volume.

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165

A 35-year-old man has persistent enophthalmos 18 months after undergoing open reduction of a fracture of the orbital floor and zygoma. Forced duction testing shows no restriction of eye motion. Which of the following is the most likely cause of this patient's enophthalmos?

(A) Fat atrophy
(B) Fibrosis of the extraocular muscles
(C) Herniated contents of the orbit within the maxillary sinus
(D) Inadequate fracture reduction
(E) Scar contracture

The correct response is Option D.

Persistent enophthalmos following facial trauma is primarily caused by increased bony orbital volume secondary to inadequate fracture reduction. An appropriate anatomic reduction should be the initial goal of surgery; bone grafting may be required to restore orbital volume to normal levels.

Fat atrophy, extraocular muscle fibrosis, herniation of orbital contents, and scar contracture can also contribute to the discrepancy between traumatic and nontraumatic orbital volume, but are less likely to contribute to postoperative enophthalmos than inadequate fracture reduction. In addition, extraocular muscle fibrosis and/or scarring would typically be associated with limited motion of the globe on forced duction testing.

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166

Intracranial communication of a frontonasal encephalocele is most likely to occur through which of the following anatomic structures?

(A) Cribriform plate
(B) Foramen rotundum
(C) Foramen ovale
(D) Foramen cecum
(E) Superior orbital fissure

The correct response is Option D.

Intracranial communication of a frontonasal encephalocele is most likely to occur through the foramen cecum because anterior encephaloceles herniate through this foramen. In contrast, the cribriform plate transmits the fibers of the olfactory nerve, the foramen rotundum transmits the maxillary division of the trigeminal nerve (V_2), and the foramen ovale transmits the mandibular division of the trigeminal nerve (V_3). The superior orbital fissure transmits the oculomotor (III), trochlear (IV), and abducens (VI) nerves, as well as the ophthalmic division of the trigeminal nerve (V_1).

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167

In a 5-year-old child, the optimal latency period for mandibular distraction is approximately how many weeks?

(A) 1
(B) 2
(C) 3
(D) 4
(E) 8

The correct response is Option A.

The latency period is defined as that time following the osteotomy procedure during which the cut bone surfaces begin to become bridged by initial fracture healing, just prior to initiation of distraction. Although recommendations regarding the optimal latency period for mandibular distraction have been controversial, current clinical protocols typically describe a latency period of five to seven days. However, some studies have questioned the necessity of a latency period. In experimental studies involving adult canines, premature consolidation of the tibial bone surfaces was noted following latency periods of either 14 days or 21 days. Because latency periods of 14 days or longer have been theorized to result in premature bony union, such lengthy periods are contraindicated in distraction osteogenesis. After active distraction is complete, the bone segments are held in rigid fixation until new bone mineralization occurs. This is known as the period of consolidation, which according to clinical protocols typically lasts for eight weeks.

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A 32-year-old man is undergoing evaluation because he has temporal headaches and a sensation of "sand in the jaw" when he eats. He sustained trauma to the face while playing football in college. On current physical examination, there is reciprocal clicking and transient locking of the jaw during opening and closing movements. MRI shows anterior malpositioning of the meniscus and posterosuperior displacement of the condyle.

These findings are most consistent with which of the following?

(A) Ankylosis of the temporomandibular joint
(B) Avascular necrosis of the condylar head of the mandible
(C) Dislocation of the temporomandibular joint
(D) Internal derangement of the temporomandibular joint
(E) Myofascial pain dysfunction syndrome

The correct response is Option D.

The findings in this patient are most consistent with internal derangement of the temporomandibular joint (TMJ), which is defined as an abnormal relationship between the articular disk and mandibular condyle. This condition is typically associated with anterior displacement of the meniscus and often with posterosuperior malpositioning of the condyle. The retromeniscal pad may be damaged and/or disrupted. Affected patients usually have preauricular pain and clicking of the joint, as well as other, less specific symptoms such as headache and aching pain in the ear or neck. A history of trauma or previous orthodontic treatment may be associated.

Ankylosis of the TMJ can result from trauma, infection, juvenile rheumatoid arthritis, or other conditions. In patients with TMJ ankylosis, destruction of the articular disk and joint elements occurs, resulting in fibrosis, narrowing of the joint space, and bony fusion.

Although avascular necrosis is rarely seen within the mandibular condyle, it may occur as a result of trauma or devascularization at the time of TMJ surgery. Affected patients have pain and limited jaw motion; MRI will show devascularization of the condyle.

Acute TMJ dislocation occurs following anterior extension of the condyle beyond the eminence; this condition occurs as a result of joint hypermobility secondary to either trauma or an excessively large mouth opening. Although spontaneous relocation typically follows, manual reduction under anesthesia may be required.

Patients with myofascial pain dysfunction have short, sudden episodes of aching pain in the jaw associated with stress; this condition is often referred to as masticatory muscle spasm secondary to bruxism. Malocclusion associated with long-term microtrauma to the joint (as seen in patients with bruxism) is thought to result in spasm of the lateral pterygoid or deep posterior masseter muscle, which is then further aggravated by episodes of anxiety and stress.

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169

In a 58-year-old man undergoing total parotidectomy, which of the following is the most appropriate technique to safely identify the facial nerve trunk?

(A) Identifying the temporal branches of the nerve and performing a retrograde dissection
(B) Using the midpoint between the fascial covering of the parotid gland and the earlobe as a landmark
(C) Using the plane between the superficial and deep lobes of the parotid gland as a landmark
(D) Using the tympanomastoid suture as a landmark
(E) Using a nerve stimulator

The correct response is Option D.

The safest and most convenient way to identify the facial nerve trunk during a parotidectomy procedure involves the use of the tympanomastoid suture as a landmark. This structure is defined as the suture line located between the posterior bony auditory canal and the mastoid portion of the temporal bone. The facial nerve can be found at a point 6 mm to 8 mm below the inferior end of the tympanomastoid suture line. If the region of the suture line is carefully dissected (ie, with a fine hemostat) in the direction of the facial nerve, the soft tissues can then be separated to reveal the glistening, white facial nerve.

Identification and dissection of the temporal branches of the facial nerve is a difficult, dangerous procedure; tagging of the distal branches is instead more reliable. With this technique, the surgeon identifies the marginal mandibular nerve as it crosses the facial vein and then performs a retrograde dissection to the nerve trunk.

Because the earlobe is not a fixed point, it cannot be used as a landmark. A tragal pointer, which is defined as the cartilaginous portion of the external auditory canal at its bony junction with the skull, is used instead. The facial nerve can be found within 5 mm from this point as it exits the stylomastoid foramen.

The plane between the superficial and deep lobes of the parotid gland is obscure; a proximal approach is safer and more effective.

Nerve stimulators are used as aids and are not the primary means for identifying the nerve trunk.

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170

In a patient who has undergone Le Fort I osteotomy, which of the following arteries provides the primary blood supply to the maxilla?

(A) Ascending pharyngeal artery
(B) Greater palatine artery
(C) Infraorbital artery
(D) Lesser palatine artery
(E) Posterior superior alveolar artery

The correct response is Option A.

Although the maxilla has an extensive blood supply as a result of its multiple anastomotic connections, much of its vascularity is irreversibly severed during the incisions and mobilization required for the Le Fort I osteotomy. Prior to surgery, the internal maxillary artery supplies blood to the maxilla through the descending palatine, posterior superior alveolar, and infraorbital arteries. However, after a Le Fort I osteotomy is performed, the ascending palatine branch of the facial artery and the palatine branch of the ascending pharyngeal artery provide the primary vascular supply. Both vessels are branches of the external carotid artery and contribute somewhat to the maxillary blood supply prior to surgery.

The greater palatine artery emerges from the greater palatine foramen and courses anteriorly; its arterial branches are distributed to the palate and soft tissue of the roof of the mouth. The lesser palatine artery emerges from the lesser palatine foramen and supplies vascularity to the soft palate and palatine tonsils.

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171

Which of the following congenital ear deformities is characterized by absence of the superior auriculocephalic sulcus?

(A) Cryptotia
(B) Cup ear deformity
(C) Lop ear
(D) Microtia
(E) Prominent ear deformity

The correct response is Option A.

Cryptotia ("hidden ear") is a congenital deformity of the cartilage of the scapha and antihelix. In neonates who have this deformity, the upper pole of the ear is buried beneath the scalp, and the superior auriculocephalic sulcus is absent. Conservative management is most appropriate initially; surgical release should be performed when the child is older.

Infants with the cup ear deformity have hooding of the scapha and helix and flattening of the antihelix. Lop ear is characterized by protrusion of the ear and folding of the superior helix. Microtia is a hypoplastic condition that manifests as varying degrees of ear absence, from anotia (complete ear absence) to a smaller than normal ear with normal morphology. The prominent ear deformity involves widening of the conchoscaphal angle, increased auriculocephalic distance, and loss of the antihelical fold.

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172

A 25-year-old woman seeks surgical correction of a "gummy" smile. On examination, she has lip incompetence and full incisal show with the lips in repose and 3 mm of gingival show with animation. There is Angle class II malocclusion and a horizontal chin deficiency. These findings are most consistent with which of the following?

(A) Gingival alveolar hypertrophy
(B) Mandibular prognathism
(C) Mandibular retrognathism
(D) Vertical maxillary deficiency
(E) Vertical maxillary excess

The correct response is Option E.

This patient's gummy smile is a manifestation of vertical maxillary excess. A gummy smile is defined as greater than 4 mm of incisal show with the lips in repose and greater than 2 mm of gingival show with animation. Patients with vertical maxillary excess, also known as the "long face" syndrome, have lip incompetence, an excessive interlabial gap, and mentalis muscle strain associated with attempts to overcome the labial incompetence. The chin is retruded and the mandible appears retrognathic secondary to a backward, or inferoposterior, high-angle clockwise mandibular rotation. The width of the inter-alar base is excessively narrow, and the nasolabial angle is open and obtuse. Appropriate management in this patient includes preoperative orthodontics followed by maxillary Le Fort I osteotomy and impaction, which will allow for autorotation and correction of the retrognathic appearance.

Gingival alveolar hypertrophy can result in excessive show of the teeth and gingiva but would not be responsible for all of the findings seen in this patient.

Mandibular prognathism is characterized by Angle class III malocclusion, effacement of the labiomental fold, and prominence of the lower third of the face. Several techniques may be considered depending on facial aesthetics, including mandibular setback, maxillary advancement, or a combination of both.

Patients with mandibular retrognathism have protrusion of the anterior teeth, associated lip incompetence, and a deep labiomental crease with eversion of the lower lip. There is Angle class II malocclusion; the lower third of the face may appear foreshortened. Mandibular advancement is recommended; genioplasty may also be required concomitantly.

Vertical maxillary deficiency manifests as a lack of maxillary incisor show, leading to an edentulous appearance. Affected patients have a concave facial profile with an "overclosed" appearance to the mandible. Other characteristics include excessive chin projection, an acute nasolabial angle, and an excessively wide inter-alar base. Appropriate management is Le Fort I osteotomy with interpositional grafting.

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173

A 46-year-old man undergoes excision of a 1-cm cyst on the right cheek that is thought to be an epidermal inclusion cyst. Histologic examination of a biopsy specimen shows pleomorphic adenoma. Which of the following is the most appropriate management?

(A) Observation
(B) Reexcision of the lesion
(C) Superficial parotidectomy
(D) Superficial parotidectomy and selective lymph node dissection
(E) Total parotidectomy

The correct response is Option C.

Pleomorphic adenoma is most appropriately managed with superficial parotidectomy. A pleomorphic adenoma is an isolated, firm, round tumor surrounded by a delicate capsule. It is the most common benign tumor of the salivary glands and is rarely associated with malignant transformation. Approximately 90% of pleomorphic adenomas affecting the parotid gland lie superficial to the facial nerve.

Because pleomorphic adenomas are characterized by microscopic extension of tumor through the capsule, and thus associated with a multifocal pattern of recurrence, superficial parotidectomy with preservation of the facial nerve is indicated.

Observation and/or simple reexcision are inadequate management and are likely to result in recurrence. Lymph node dissection is an unnecessary, excessive procedure in a patient with a benign tumor. Total parotidectomy is also excessive and can lead to serious morbidity resulting from injury or sacrifice of the facial nerve.

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A 25-year-old man sustains a fracture of the frontal sinus in a motor vehicle collision. A CT scan of the frontal sinus shows a comminuted fracture of the anterior table and a linear nondisplaced fracture of the posterior table. There is no evidence of cerebrospinal fluid leak. Following removal of the anterior table fragments during surgical exploration, methylene blue is instilled into the sinus and passes into the nasal cavity.

Which of the following is the most appropriate management?

(A) Fixation of the anterior table bone fragments only
(B) Enlargement of the nasofrontal duct
(C) Ablation of the frontal sinus
(D) Cranialization of the frontal sinus
(E) Obliteration of the frontal sinus

The correct response is Option A.

In this patient who has sustained a frontal sinus fracture, the most appropriate management is fixation of the anterior table fragments. Intraoperative testing showing unobstructed passage of methylene blue into the nasal cavity indicates an intact sinus that should remain functional postoperatively.

Enlargement of the nasofrontal duct with stent placement is a new procedure that has not yet gained wide acceptance and is only indicated for patients with compromise of the nasofrontal duct. Ablation of the frontal sinus involves removal of the anterior table, which allows the forehead skin to collapse into the sinus. This procedure is no longer used because of its resultant cosmetic defects.

With cranialization of the frontal sinus, the posterior wall is removed and the intracranial contents (dura and brain) gradually expand anteriorly to fill the open space within the cranium. This procedure is often recommended for patients with severe comminution of the posterior table of the frontal sinus, particularly in the presence of a cerebrospinal fluid leak. Frontal sinus obliteration is appropriate for correction of nasofrontal duct obstruction, which in patients with frontal sinus fractures can be confirmed by failure of the methylene blue to pass into the nasal cavity.

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175

A 25-year-old woman is brought to the emergency department after sustaining injuries in a motor vehicle collision. The patient is alert on initial evaluation and has a Glasgow Coma Scale score of 15. On physical examination, there is periorbital ecchymosis on the right, loss of sensation in the area of the left forehead, ptosis of the right upper eyelid, right-sided ophthalmoplegia, and a fixed, dilated pupil. Consensual light reflex is intact.

These findings are most consistent with which of the following?

(A) Dehiscence of the levator palpebrae superioris muscle
(B) Entrapment of the inferior rectus muscle
(C) Orbital apex syndrome
(D) Retrobulbar hematoma
(E) Superior orbital fissure syndrome

The correct response is Option E.

This patient has findings most consistent with superior orbital fissure syndrome, a high-velocity injury caused by extension of an orbital fracture into the superior orbital fissure. The oculomotor (III), trochlear (IV), and abducens (VI) nerves, and the ophthalmic division of the trigeminal nerve (V_1) pass through the superior orbital fissure, which is formed from the greater and lesser wings of the sphenoid bone. Affected patients typically have paralysis of the extraocular muscles and the levator palpebrae superioris muscle resulting from injury to multiple nerves. If the ophthalmic division of the trigeminal nerve is involved, the patient will have anesthesia of the forehead, eyebrow, and upper eyelid.

The other conditions listed above would result in some but not all of the findings seen in this patient. Dehiscence of the levator palpebrae superioris muscle manifests as isolated ptosis of the eyelid. In patients with entrapment of the inferior rectus muscle, complete ophthalmoplegia would not be seen. Orbital apex syndrome is characterized by the findings associated with superior orbital fissure syndrome as well as blindness resulting from involvement of the optic nerve. Patients with retrobulbar hematomas may also experience the onset of blindness caused by increased intraocular pressure and proptosis.

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176

During the application of rigid fixation in a 9-year-old child who has sustained a Le Fort I fracture, which of the following permanent tooth buds is at greatest risk for injury?

(A) Canine
(B) Central incisor
(C) First molar
(D) First premolar
(E) Lateral incisor

The correct response is Option A.

A 9-year-old child has mixed dentition; deciduous (primary) and permanent (secondary) teeth are present within the oral cavity simultaneously. This commonly occurs between ages 8 and 10 years. As a result, it is imperative for the surgeon to be aware of the potential for injury to the tooth buds when applying rigid fixation for management of pediatric maxillofacial fractures. The permanent canine teeth, or cuspids, erupt between ages 10 and 11 years. Therefore, the tooth buds can be injured during the application of rigid fixation in the region of the nasomaxillary buttress.

The central and lateral incisors erupt between ages 6 and 8 years. The permanent first molars erupt between ages 6 and 7 years, and the first premolars erupt between ages 8 and 9 years. Therefore, in a 9-year-old child, all of these teeth should have already begun erupting into the oral cavity, and the risk for injury to the tooth bud will be minimal.

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177

A 42-year-old woman develops gustatory sweating in the parotid region six months after undergoing parotidectomy for removal of a benign mixed tumor. The most likely cause of this complication is abnormal regeneration of which of the following nerves?

(A) Auriculotemporal
(B) Chorda tympani
(C) Facial
(D) Great auricular
(E) Lingual

The correct response is Option A.

Gustatory sweating that develops following parotidectomy is known as Frey's syndrome or auriculotemporal syndrome and results from abnormal regeneration of auriculotemporal nerve fibers to sweat glands within the skin. Placement of thin surgical flaps over the parotid gland has been shown to exacerbate this condition; interposition of a submuscular aponeurotic system (SMAS) flap between the parotid bed and overlying skin may lead to improvement. The diagnosis can be confirmed by placing a single-ply facial tissue on the skin overlying the parotid gland; damp patches will be seen in areas affected by gustatory sweating. The Minor starch-iodine test, which involves placement of a 1 × 1-cm test tape (containing iodine and starch) on the affected area, can be used to determine the total number of damp patches and thus confirm the distribution of the diaphoresis.

Although skin excision alone can successfully treat Frey's syndrome, tympanic neurectomy may be required. Systemic administration of anticholinergic agents results in abatement of symptoms but is associated with adverse effects and thus not recommended by many physicians. Topical glycopyrrolate (Robinul) or diphemanil methyl sulfate (Prantal) can be applied to the affected area to control gustatory sweating. When the diaphoresis has subsided, topical 20% aluminum chloride in alcohol (Drysol) should be applied once daily.

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178

During a rhytidectomy procedure, the risk for injury to the great auricular nerve is greatest at which of the following locations?

(A) 1 cm anterior to the tragus
(B) 2 cm posterior to the lobule
(C) 4 cm posterior to the lobule
(D) 6 cm inferior to the tragus
(E) 10 cm inferior to the tragus

The correct response is Option D.

The great auricular nerve emerges from behind the sternocleidomastoid muscle 9 cm below the caudal edge of the external auditory canal and 6 cm inferior to the tragus. The nerve lies posterior and superficial to the submuscular aponeurotic system (SMAS) and platysma at this point and is at greatest risk for injury during rhytidectomy. Injury to this nerve can result in numbness or painful dysesthesias of the lower two thirds of the ear and the adjacent skin of the neck and cheek.

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179

A 10-year-old boy has a laceration of the chin and pain in the jaw and ear after falling while ice skating. On examination, the maximal incisal opening is 10 mm, and the chin point is deviated to the left. There is an upward cant of the mandibular occlusion on the left with a right-sided lateral open bite.

These findings are most consistent with which of the following?

(A) Bilateral condylar fractures
(B) Bilateral temporomandibular joint dislocation
(C) Left-sided condylar fracture
(D) Left-sided mandibular body fracture
(E) Right-sided condylar fracture

The correct response is Option C.

The findings in this child are most consistent with a left-sided condylar fracture. It is necessary to exclude a diagnosis of condylar fracture in any child who sustains trauma to the chin. Indications for a diagnosis of condylar fracture include malocclusion, pain with range of motion of the temporomandibular joint, and preauricular pain. Lacerations of the external auditory canal may also be associated. Patients with unilateral condylar fractures exhibit loss of posterior ramus height unilaterally, resulting in premature contact of the maxillary and mandibular molars posteriorly and a contralateral lateral open bite. The mandibular occlusal plane will demonstrate an ipsilateral upward cant. The maximal incisal opening will be decreased, and the chin point and mandibular midline will be deviated ipsilaterally due to the unopposed action of the lateral pterygoid muscle on the contralateral side. Because this child has chin deviation and an upward cant on the left with a right-sided lateral open bite, a left-sided condylar fracture can be diagnosed.

A child with bilateral condylar fractures will have an anterior open bite resulting from premature contact of the mandibular and maxillary molars posteriorly. Ear pain and lacerations of the external auditory canal may also be present bilaterally.

Bilateral temporomandibular joint dislocation typically results in an open bite and severe limitation of jaw excursion, also known as “lock-jaw.”

Although left-sided mandibular body fractures can be associated with limited mouth opening, a contralateral open bite and an ipsilateral upward occlusal cant are not typical of this type of fracture.

As mentioned above, a right-sided condylar fracture would manifest as a left-sided lateral open bite with chin deviation and an upward occlusal cant on the right.

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180

Which of the following substances has been shown to be associated with the mechanisms of cranial suture fusion in animal models?

(A) Epidermal growth factor (EGF)
(B) Interleukin-6 (IL-6)
(C) Prostaglandin-E2 (PGE2)
(D) Transforming growth factor-beta (TGF-ß)
(E) Tumor necrosis factor-alpha (TNF-a)

The correct response is Option D.

Although the mechanisms of action resulting in premature fusion of cranial sutures, or craniosynostosis, are unknown, experimental animal studies have shown that transforming growth factor-beta (TGF-ß) plays a role in the fusion of posterior frontal sutures. According to immunolocalization techniques, certain isoforms of TGF-ß are expressed during fusion of posterior frontal sutures in rat and mouse models; increased immunoreactivity of isoforms of both TGF-ß and insulin-like growth factor (IGF) has also been shown to occur during premature fusion of the sagittal, coronal, and lambdoid sutures in humans. Qualitative analysis of TGF-ß protein levels in organ culture models has also demonstrated increased levels of TGF-ß during the period of active suture fusion.

Although basic fibroblast growth factor (b-FGF) has also been implicated in the process of cranial suture fusion, epidermal growth factor (EGF) has not been shown to be associated with suture fusion. Interleukin-6 (IL-6), prostaglandin-E2 (PGE2), and tumor necrosis factor-alpha (TNF-a) have been shown to mediate inflammatory responses but not to affect cranial suture fusion.

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181

The anterior fontanelle typically closes completely at how many months of age?

(A) 3
(B) 9
(C) 12
(D) 24
(E) 36

The correct response is Option D.

The fontanelles are nonossified membranous intervals in the skull located at the angles of the parietal bones in infants. The anterior and posterior fontanelles are located in the midline, and the anterolateral (sphenoid) and posterolateral (mastoid) fontanelles are found laterally.

The anterior fontanelle is the largest, measuring approximately 4 cm anteroposteriorly and 2.5 cm transversely. It is located at the junction of the sagittal, coronal, and frontal sutures. The posterior fontanelle is triangular in shape and is found at the junction of the sagittal and lambdoid sutures. The sphenoid and mastoid fontanelles are irregular, small fontanelles that correspond to the sphenoid and mastoid angles of the parietal bones, respectively. Although the posterior fontanelle typically closes by age 2 months, the anterior fontanelle does not completely close until between the ages of 18 and 24 months.

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182

A 24-year-old woman sustains facial injuries in a motor vehicle collision. On examination, there is tenderness in the preauricular region bilaterally, posterior facial height is decreased, and there is malocclusion with an anterior open bite. Panoramic radiographs show low subcondylar fractures of the mandible bilaterally. The mandibular condyles are seated within the glenoid fossa, and the proximal segment overrides the distal segment laterally.

Which of the following is the most appropriate management?

(A) Observation
(B) Intermaxillary fixation for two weeks followed by physical therapy
(C) Intermaxillary fixation for eight weeks followed by physical therapy
(D) Bilateral external fixation
(E) Open reduction and internal fixation

The correct response is Option E.

Because stable anatomic reduction of the fracture segments is crucial for management of this patient's injuries, open reduction and internal fixation should be performed via a preauricular approach. Accurate reduction of a subcondylar fracture is rarely achieved with closed reduction alone. In addition, the absence of internal fixation will lead to fracture instability secondary to the forces of the masseter, temporalis, and medial and lateral pterygoid muscles, ultimately resulting in decreased posterior facial height and abnormal condylar mechanics caused by displacement of the condylar head. The patient will be at greater risk for malocclusion and development of degenerative osteoarthritis. Therefore, accurate open reduction with rigid internal fixation is advocated to avoid any potential complications. With this approach, normal posterior facial height will be restored, and the risk for abnormal joint mechanics will be minimized. Endoscopically-assisted fracture reduction, with rigid fixation, is a new technique that shows promise

because it combines the advantages of the open approach (ie, anatomic reduction and early motion) while minimizing external scarring and the risk for facial nerve injury.

Observation alone is inadequate fracture management and will result in malunion, nonunion, and/or the development of pseudarthrosis.

Although a short course of intermaxillary fixation (two to three weeks) followed by graduated opening of the mandible has traditionally been implemented in the management of subcondylar fractures, it does not address fracture malalignment or its potential complications. Prolonged intermaxillary fixation (six weeks or more) is associated with an increased risk for temporomandibular joint stiffness and a subsequent decrease in interincisal opening.

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183

A 38-year-old woman has a 2.5-cm squamous cell carcinoma of the tongue. On examination, she has one mobile 2-cm homolateral palpable lymph node; there are no distant metastases. Which of the following is the most appropriate classification of this patient's tumor?

(A) T1 N0 M1
(B) T1 N1 M0
(C) T2 N1 M0
(D) T2 N2 M0
(E) T3 N2 M1

The correct response is Option C.

In this patient who has a 2.5-cm squamous cell carcinoma of the tongue with involvement of one lymph node only, the tumor is correctly classified as T2 N1 M0. The staging of squamous cell carcinomas of the lip involves three descriptors: T, N, and M. The T descriptor is based on the diameter or surface area of the tumor. The N descriptor describes nodal status. The M descriptor indicates distance of metastasis beyond the neck. This staging criteria allows physicians to predict patient outcomes and choose appropriate therapy based on comparisons with patients in large studies.

A TNM classification table is shown on the following page.

Status of Tumor (T)

TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma *in situ*
T1	Tumor 2 cm or less in greatest dimension
T2	Tumor more than 2 cm but not more than 4 cm in greatest dimension
T3	Tumor more than 4 cm in greatest dimension
T4 (lip)	Tumor invades adjacent structures (eg, through cortical bone, inferior alveolar nerve, floor of mouth, skin of face)
T4 (oral cavity)	Tumor invades adjacent structures (eg, through cortical bone, into deep [extrinsic] muscle of tongue, maxillary sinus, skin. Superficial erosion alone of bone/tooth socket by gingival primary is not sufficient to classify as T4).

Stages of Lymph Nodes (N)

NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node metastasis
N1	Metastasis in a single ipsilateral lymph node, 3 cm or less in greatest dimension
N2	Metastasis in a single ipsilateral lymph node, more than 3 cm but not more than 6 cm in greatest dimension; or in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimensions; or in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension
N2a	Metastasis in a single ipsilateral lymph node more than 3 cm but not more than 6 cm in greatest dimension
N2b	Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension
N2c	Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension

Status of Metastasis (M)

MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis

Stage Grouping

Stage 0	Tis	N0	M0
Stage I	T1	N0	M0
Stage II	T2	N0	M0
Stage III	T3	N0	M0
	T1	N1	M0
	T2	N1	M0
	T3	N1	M0
Stage IVA	T4	N0	M0
	T4	N1	M0
	Any T	N2	M0
Stage IVB	Any T	N3	M0
Stage IVC	Any T	Any N	M1

In order to determine the correct clinical staging of this type of tumor, the surgeon must first examine the primary lesion and the lymph nodes in the neck. A CT scan should be obtained to rule out potential invasion of adjacent structures; histologic evaluation of a biopsy specimen of the lesion will best establish and/or confirm the diagnosis. Further evaluation to determine the extent of metastases will include a radiograph of the chest, complete blood cell count, and blood chemistry studies. If the patient's symptoms are applicable to specific organ systems, other diagnostic tests may be required.

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184

Which of the following is the most common craniofacial anomaly?

(A) Bilateral craniofacial microsomia
(B) Goldenhar syndrome
(C) Hemifacial microsomia
(D) Nager syndrome
(E) Treacher Collins syndrome

The correct response is Option C.

Hemifacial microsomia is the most common craniofacial anomaly; affected patients have unilateral malformations of the mandibular ramus and facial paralysis. Mandibular growth is impaired, leading to inadequate development of the mandibular and osseous complex on the involved side.

Bilateral craniofacial microsomia is less frequent than hemifacial microsomia.

Goldenhar syndrome, a variant of hemifacial microsomia, is characterized by vertebral or hemivertebral anomalies, lipodermoids, and epibulbar dermoids. The facial abnormalities resemble a Tessier No. 7 cleft. This condition may be bilateral.

Nager syndrome is an autosomal recessive disorder that manifests as hypoplasia of the orbits, zygoma, maxilla, mandible, and soft palate, as well as hypoplasia or agenesis of the radius, thumbs, and metacarpals. Auricular defects may also be associated.

Treacher Collins syndrome is an autosomal dominant disorder that involves hypoplasia of the zygoma, maxilla, and mandible. The palpebral fissures have an antimongoloid slant and the lashes of the medial lower eyelids are absent. Colobomas of the lower eyelids and malar defects are also associated. The preauricular hair may be displaced, and micrognathia may be present. Findings are similar to the Tessier No. 6, No. 7, and No. 8 clefts.

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185

In pediatric patients, abnormalities in mandibular growth are most closely associated with fractures involving which of the following regions of the mandible?

(A) Angle
(B) Body
(C) Condyle
(D) Ramus
(E) Symphysis

The correct response is Option C.

In children, abnormalities in mandibular growth are most closely associated with fractures involving the mandibular condyle. More than one-third of all facial fractures in children involve the mandible. The pediatric condyle, which is the primary growth center of the mandible, is immature, highly vascular, and covered with a thin sheath of periosteum. Any compressive or traumatic forces may cause the condyle to burst, rather than fracture, resulting in fragmentation of bone, hemarthrosis, and increased osteogenic potential. Ankylosis and growth disturbances are potential long-term complications. According to one study, 47% of children who sustained condylar fractures subsequently developed temporomandibular joint dysfunction or abnormalities of facial growth.

In order to maintain the height of the mandibular ramus and adequate function of the temporomandibular joint, appropriate management should include closed reduction and immobilization for five to eight days, followed by initiation of physical therapy.

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186

A 24-year-old man sustains a Le Fort I fracture on the left and a Le Fort III fracture on the right in a motor vehicle collision. In this patient, which of the following bones is most likely to be fractured on both sides of the face?

(A) Ethmoid
(B) Orbital floor
(C) Palate
(D) Pterygoid plate
(E) Zygoma

The correct response is Option D.

In patients with Le Fort I fractures, the pterygoid plate is most likely to be affected, regardless of the type of fracture, because it lies posterior and thus forms the most posterior aspect of the fracture. The ethmoid, orbital floor, palate, and zygoma are each involved in some but not all types of Le Fort I fractures.

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187

A 17-year-old boy is referred for orthognathic surgery. On intraoral examination, the mesiobuccal cusp of the maxillary first molar is positioned distal to the buccal groove of the mandibular first molar. Which of the following best describes this occlusal relationship?

(A) Angle class I
(B) Angle class II
(C) Angle class III
(D) Overbite
(E) Overjet

The correct response is Option C.

Occlusion describes the relationship between the upper and lower teeth and is critical for planning reconstructive surgery of the jaws. The Angle classification of occlusion is based on the relationship of the mesiobuccal cusp of the maxillary first molar to the mandibular first molar when viewed in the sagittal plane. In this patient, the mesiobuccal cusp of the maxillary first molar lies distal (posterior) to the buccal groove of the mandibular first molar and instead is located in the buccal groove of the lower second molar, which is Angle class III malocclusion.

In patients with class I (normal) occlusion, the mesiobuccal cusp of the maxillary first molar lies in the buccal groove of the mandibular first molar. Angle class II malocclusion is defined as the mesiobuccal cusp of the maxillary first molar located mesial (anterior) to the buccal groove of the mandibular first molar. This classification of malocclusion has two divisions; in class II, division 1, the lateral incisors are flared labially, while in class II, division 2, the incisors are lingually inclined.

Overbite is a vertical measurement referring to the distance between the maxillary incisor edge and the mandibular incisor edge with the teeth in centric occlusion. Overjet is a horizontal measurement referring to the distance between the incisal aspect of the maxillary incisors and the incisal aspect of the mandibular incisors with the teeth in centric occlusion.

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188

Which of the following is a late complication following frontal sinus fracture?

(A) Cerebrospinal fluid leak
(B) Epistaxis
(C) Meningitis
(D) Mucocele
(E) Sinusitis

The correct response is Option D.

Patients with frontal sinus fractures, especially those involving the posterior table, can develop complications secondary to nasofrontal duct obstruction, dural injury, or entrapment of the sinus mucosa. Acute complications within the first few hours after injury can include epistaxis, cerebrospinal fluid leak, meningitis, and intracranial injury. The most common subacute complications occurring within the first few weeks following fracture are frontal sinusitis, mucocele, and meningitis. Long-term complications, such as osteomyelitis, mucocele, and chronic intracranial or orbital abscesses, can occur as late as several years after injury. Cosmetic deformities may also be seen late.

Because most complications occur in patients with fractures of the posterior table, appropriate reduction of all posterior fragments and repair of all dural tears are recommended. Reconstruction with pericranial flaps can decrease the risk for development of complications by distancing the brain tissue from the fracture site. Cranialization, which involves removal of mucosa and plugging of the nasofrontal ducts, can also be used to minimize complications. In patients who have nonfunctioning nasofrontal ducts, obliteration of the frontal sinus may be considered.

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189

A 62-year-old man is being evaluated for mandibular reconstruction after undergoing segmental mandibulectomy and resection of the anterior floor of the mouth for management of squamous cell carcinoma. On examination, the mandibular defect extends from the ipsilateral canine to the contralateral bicuspid; the tongue and remaining dentition have been preserved.

Which of the following is the most appropriate method for reconstruction of this patient's defect?

(A) Fibula osteocutaneous free flap
(B) Pectoralis major/rib osteomyocutaneous transposition flap
(C) Pectoralis major myocutaneous flap and reconstruction plate
(D) Radial forearm osteocutaneous free flap and iliac crest bone graft
(E) Radial forearm fasciocutaneous free flap and reconstruction plate

The correct response is Option A.

Reconstruction of the anterior mandible is best accomplished with the fibula osteocutaneous free flap. This flap provides excellent bone quality and a segmental blood supply, which allows for multiple osteotomies. This is crucial because successful reconstruction of the anterior mandible will require a minimum of two osteotomies in order to restore the contour of the mandibular arch.

Pectoralis major flaps with attached rib have been shown to be inadequate for mandibular reconstruction because of the poor quality of bone and difficulties with orientation. In addition, reconstruction plates are especially susceptible to fracture and exposure when used in the anterior mandible. Although the radial forearm flap provides excellent soft tissue for replacement of intraoral lining, only a limited amount of bone can be harvested, and osteotomies are poorly tolerated. Bone grafts are useful for reconstruction of defects less than 3 cm in patients who will not be undergoing radiation therapy.

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190

The external acoustic meatus is derived from which of the following structures?

(A) First branchial arch
(B) Second branchial arch
(C) First branchial groove
(D) Second branchial groove
(E) Third branchial groove

The correct response is Option C.

The external acoustic meatus is derived from the first branchial groove. During fetal development, the external ear arises from six hillocks derived from the first and second branchial arches. The anterior three hillocks (from the first branchial arch) form the anterior portion of the auricle, and the posterior auricle is formed from the fourth through sixth posterior hillocks (from the second branchial arch). The second through fourth branchial grooves are typically obliterated within the cervical sinus by the end of the seventh week of gestation, resulting in a neck with a smooth contour; however, a persistent branchial groove can manifest as a branchial fistula, sinus, or cyst.

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191

Which of the following is the most common site of squamous cell carcinoma affecting the paranasal regions?

(A) Anterior ethmoidal sinus
(B) Frontal sinus
(C) Maxillary sinus
(D) Posterior ethmoidal sinus
(E) Sphenoid sinus

The correct response is Option C.

Although squamous cell carcinoma rarely affects the paranasal regions, 80% of tumors that do appear in this region arise within the maxillary sinus. The ethmoid, frontal, and sphenoid sinuses are affected less frequently.

Approximately 3% of malignancies involving the upper aerodigestive tract are found within the nasal and paranasal regions. Furthermore, approximately 70% of malignant tumors seen in this region are squamous cell carcinomas; this frequency is thought to be related to exposure to nickel and other chemicals.

The nasal floor is typically not associated with the development of malignancy but can be affected as a result of direct tumor extension, as many tumors are asymptomatic and thus remain undiagnosed while enlarging and advancing locally.

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192

Which of the following is the most common etiology of ankylosis of the temporomandibular joint?

(A) Autoimmune
(B) Congenital
(C) Infectious
(D) Neoplastic
(E) Trauma

The correct response is Option E.

Intra-articular (true) ankylosis of the temporomandibular joint (TMJ) most frequently occurs as a result of trauma. In patients with true ankylosis, destruction of the articular disk and joint elements occurs, leading to fibrosis, narrowing of the joint space, and ultimately bony fusion.

Abnormalities of bone, cartilage, and/or soft tissue have also been shown to cause TMJ ankylosis.

Other causes of TMJ ankylosis, such as congenital abnormalities, idiopathic occurrences, infection, and juvenile rheumatoid arthritis, have been documented but are less common than trauma. Neoplasms of the TMJ are extremely rare.

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193

Which of the following permanent teeth erupts first?

(A) Central incisor
(B) Lateral incisor
(C) Canine
(D) First premolar
(E) First molar

The correct response is Option E.

The first molar is the first permanent tooth to erupt; this typically occurs between ages 6 and 7 years. The age of mixed dentition, in which there are both deciduous (primary) and permanent (secondary) teeth erupted in the oral cavity simultaneously, begins with the eruption of the first molars. In addition, Angle's classification, which describes the relationship between the mesiobuccal cusp of the maxillary first molar and the buccal groove of the mandibular first molar, has its basis in this pattern of eruption.

Knowledge of the eruption pattern of the teeth is crucial for management of facial fractures in children, especially for coordination of any necessary bone grafting and/or orthognathic surgery.

The central incisors erupt between ages 6 and 8 years, the lateral incisors between ages 7 and 9 years, the canine teeth between ages 9 and 12 years, and the first premolars between ages 10 and 12 years.

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194

When obtaining lateral cephalograms, which of the following represents a commonly used cranial base plane?

(A) Long axis of the maxillary incisor plane
(B) Nasion-to-point A plane
(C) Occlusal plane
(D) Palatal plane
(E) Sella-nasion plane

The correct response is Option E.

A cephalogram is a radiograph obtained from a standard distance (typically 60 inches) with the head placed in a mechanical device. The lateral cephalogram is most effective for demonstrating both occlusion and relationships between the maxilla, mandible, and base of the skull.

A typical cephalometric plane connects three or more cephalometric points. The most commonly used cranial base planes are the sella-nasion, basion-nasion, and Frankfort horizontal planes. Commonly used maxillary planes include the long axis of the maxillary incisor plane; the nasion-to-point A plane; the occlusal plane, which extends between the mesial cusp of the maxillary molar through the point that bisects the overbite; and the palatal plane, which joins the anterior nasal spine to the posterior nasal spine.

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195

In addition to the zygoma, which of the following bones forms the lateral orbital wall?

(A) Frontal bone
(B) Greater wing of the sphenoid
(C) Lacrimal bone
(D) Lesser wing of the sphenoid
(E) Maxilla

The correct response is Option B.

The lateral orbital wall is formed primarily by the orbital surface of the zygomatic bone and the greater wing of the sphenoid bone. In addition to the greater wing of the sphenoid, other bones that comprise the orbit include the ethmoid, frontal bone, lacrimal bone, maxilla, palatine bone, and the lesser wing of the sphenoid. The sphenoid portion of the lateral wall is separated from the roof of the orbit by the superior orbital fissure and from the floor of the orbit by the inferior orbital fissure.

Appropriate anatomic reduction of the greater wing of the sphenoid and lateral wall of the orbit is critical for adequate reduction of a fracture of the zygomaticomaxillary complex. Because correct reduction of the inferior orbital rim, zygomaticofrontal suture, and orbital floor does not ensure reduction of the lateral wall, the surgeon should verify that the complete reduction of all structures has been performed.

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196

Which of the following structures drains into the middle meatus?

(A) Frontal sinus
(B) Mastoid air cells
(C) Nasolacrimal duct
(D) Posterior ethmoidal air cells
(E) Sphenoid sinus

The correct response is Option A.

The frontal sinus drains into the middle meatus via the frontonasal duct. In addition, the anterior ethmoidal air cells and maxillary sinus drain into the middle meatus. It is important to assess the patency of this drainage system when managing fractures of the frontal sinus because any occlusion of the frontonasal duct may result in infection or mucocele.

The mastoid air cells communicate with the mastoid antrum, which then communicates with the tympanic cavity. The nasolacrimal duct drains into the inferior meatus, and the posterior ethmoidal air cells drain into the superior meatus. The sphenoid sinus drains into the sphenoethmoid recess, which is located above and behind the superior concha.

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197

Which of the following best describes the primary action of the superior oblique muscle on the globe?

(A) Abduction
(B) Adduction
(C) Depression
(D) Elevation
(E) Extorsion

The correct response is Option C.

The superior oblique muscle primarily acts to depress the globe. Its secondary actions include abduction and intorsion. This muscle originates outside of and superomedial to the annulus of Zinn (the common tendinous ring at the orbital apex). It courses around the trochlear nerve to insert onto the globe. Sensory innervation to the superior oblique muscle is provided by the trochlear nerve.

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198

In a 32-year-old man who sustained a panfacial fracture in a high-speed motor vehicle collision, what is the approximate risk for concomitant cervical spine injury?

(A) 5%
(B) 10%
(C) 15%
(D) 20%
(E) 25%

The correct response is Option B.

Patients who are involved in high-speed motor vehicle collisions have a risk for concomitant cervical spine injury that is closest to 10%. The incidence of associated cervical spine injury is greatly increased in these patients. Therefore,

a patient who has sustained a facial fracture in a high-speed collision should be evaluated for a potential cervical spine injury prior to treatment of the facial fracture.

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199

A 45-year-old man with a 50 pack/year history of smoking has a 4.5-cm lesion in the midline of the lower lip. Histologic examination of a biopsy specimen of the lesion shows findings consistent with squamous cell carcinoma. Intraoperative examination shows extension of the tumor to the mandible without erosion or invasion of the mandible. There are no palpable lymph nodes or evidence of sensory or motor nerve involvement.

Which of the following is the most appropriate management?

(A) Surgical excision alone
(B) Surgical excision with neck dissection
(C) Surgical excision with neck dissection and marginal mandibulectomy
(D) Surgical excision with neck dissection and segmental mandibulectomy
(E) Surgical excision with neck dissection and adjuvant chemotherapy and radiation therapy

The correct response is Option C.

This patient who has a squamous cell carcinoma of the lip should undergo surgical excision of the lesion with bilateral supraomohyoid neck dissection and marginal mandibulectomy. A 4.5-cm tumor of the lower lip with extension into the mandible but without palpable nodes in the neck is classified as T3 N0 M0. One study of patients with squamous cell carcinoma reported neck metastases in 63% of patients with T3 lesions; therefore, selective neck dissection is warranted. Marginal mandibulectomy is also appropriate in this patient who has tumor extension, but not invasion, into the mandible.

Segmental mandibulectomy is not required because the tumor has not invaded the mandible. Adjuvant chemotherapy is not recommended for patients with squamous cell carcinoma of the lip. Radiation therapy alone may be an option in patients with N0 tumors who are at increased risk for metastases or in patients who are poor surgical candidates, but radiation therapy is not used in combination with chemotherapy.

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200

A child who had a cleft palate repair in infancy is undergoing sphincter pharyngoplasty for management of velopharyngeal insufficiency. When performing this procedure, which of the following muscles is typically used to create the sphincter?

(A) Levator veli palatini
(B) Musculus uvulae
(C) Palatopharyngeus
(D) Salpingopharyngeus
(E) Tensor veli palatini

The correct response is Option C.

The success of sphincter pharyngoplasty, a secondary technique performed for correction of velopharyngeal insufficiency, is most dependent on elevation of myomucosal flaps of the palatopharyngeus muscle. These flaps can be used to construct a sphincter in the pharyngeal wall. This technique effectively obliterates the lateral ports of the velopharyngeal mechanism and decreases the diameter of the central port.

Because the levator veli palatini muscle is important for initial palatal closure and movement, it would not be available in this child who previously underwent cleft palate repair. The musculus uvulae is a small sagittal muscle of the uvula that is not useful in sphincter creation. The salpingopharyngeus muscle arises from the inferior portion of the auditory tube near its orifice. It passes downward and blends with the posterior fasciculus of the palatopharyngeus muscle. The tensor veli palatini follows close to the eustachian tube and is also affected in patients with cleft palate.

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201

Which of the following best describes the blood supply to the sternocleidomastoid muscle?

(A) One source
(B) One dominant source and one minor source
(C) Two equally dominant sources
(D) Three equally dominant sources
(E) Four equally dominant sources

The correct response is Option D.

The sternocleidomastoid muscle attaches to the mastoid process superiorly and to the clavicle and sternum inferiorly. The blood supply to this muscle is segmental and is derived from three equally dominant sources, each perfusing a portion of the muscle with some internal connections; each portion has its own musculocutaneous perforators that supply a small area of overlying skin. Vascularity to the superior third of the muscle is supplied by a branch of the occipital artery, to the middle third by a branch of the superior thyroid artery, and to the inferior third by a branch of the thyrocervical trunk.

Knowledge of this pattern of arterial anatomy is important when harvesting the muscle for reconstruction of the neck and mandible. If the entire muscle is harvested for use but is based only on the inferior or superior pedicle, the portion of muscle farthest from the pedicle may not be reliable.

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202

A 5-year-old boy has marked malar hypoplasia, a class II anterior open bite, and clockwise rotation of the occlusal plane. There is hypoplasia of the thumbs bilaterally. Which of the following is the most likely diagnosis?

(A) Bilateral craniofacial microsomia
(B) Goldenhar syndrome
(C) Klippel-Feil syndrome
(D) Nager syndrome
(E) Treacher Collins syndrome

The correct response is Option D.

This child has findings most consistent with Nager syndrome, or acrofacial dysostosis, an autosomal recessive disorder characterized by hypoplasia of the orbits, zygoma, maxilla, mandible, and soft palate. Although the findings are similar to Treacher Collins syndrome (an autosomal dominant disorder), patients with Nager syndrome can also exhibit preaxial limb anomalies and mental retardation. Auricular defects may be present.

Patients with bilateral craniofacial microsomia typically have hypoplasia of the mandibular ramus and varying degrees of auricular hypoplasia. Patients with Goldenhar syndrome have hemifacial microsomia and epibulbar dermoids.

Klippel-Feil syndrome is characterized by significant fusion of the cervical spine with varying involvement of the thoracic and lumbar spinal regions. Affected patients have limited cervical motion and a low posterior hairline.

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203

In a patient who has sustained a fracture of the zygomaticomaxillary complex (tripod fracture), accurate reduction of the fracture components is most likely to be accomplished with the use of which of the following anatomic structures?

(A) Inferior orbital rim
(B) Lateral orbital wall
(C) Orbital floor
(D) Zygomatic arch
(E) Zygomaticomaxillary plane

The correct response is Option B.

Appropriate reduction of a fracture of the zygomaticomaxillary complex involves a three-dimensional process. In order to obtain the most accurate reduction, the lateral orbital wall and sphenoid wing should be visualized from inside the orbit. This will allow for visualization of the relatively flat plane of the orbital portion of the zygoma and the relatively flat portion of the sphenoid wing; accurate reduction is obtained when these two areas are aligned completely.

Although the inferior orbital rim, orbital floor, zygomatic arch, and zygomaticomaxillary plane are helpful sites for alignment individually, use of any of the sites as a landmark for accurate fracture reduction can result in significant rotational malalignment at the other sites.

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204

Which of the following fixation materials causes the LEAST amount of scatter on CT scan?

(A) Polylactic acid
(B) Stainless steel
(C) Tantalum
(D) Titanium
(E) Vitallium

The correct response is Option A.

The copolymer of polylactic acid and L-glycolic acid (Lactasorb) is a nonmetallic substance that is currently used in craniomaxillofacial fixation, is not visible on plain radiographs and/or CT scans, and is completely resorbed within one year following implantation.

Among metals used in fixation, stainless steel alloy (comprised of chromium, nickel, and molybdenum) exhibits the most scatter, while titanium and Vitallium (cobalt-chromium alloy) produce the least scatter. Tantalum is not currently used for craniomaxillofacial fixation because it exhibits inadequate mechanical properties.

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205

Which of the following sites is osteotomized in the Le Fort III osteotomy but NOT in the monobloc advancement osteotomy?

(A) Frontozygomatic suture
(B) Inferior orbital fissure
(C) Lamina papyracea
(D) Pterygomaxillary fissure
(E) Zygomatic arch

The correct response is Option A.

Although the Le Fort III osteotomy is most often used for correction of midface hypoplasia in patients with craniosynostosis, the monobloc advancement osteotomy is now gaining acceptance. In the Le Fort III procedure, the osteotomies pass through the nasofrontal junction first, then laterally across the medial orbital wall (lamina papyracea) and onto the orbital floor, continuing into the inferior orbital fissure. The lateral orbital wall is cut through the frontozygomatic suture and separated from the cranium; it continues inferiorly and posteriorly, where a pterygomaxillary disjunction is performed. After the zygomatic arch is cut, the advancement can be performed.

In the monobloc advancement, the osteotomy lines are similar to the Le Fort III osteotomy, but the nasofrontal junction and frontozygomatic suture are not osteotomized. An advantage of the monobloc procedure is simultaneous correction of the supraorbital and midface deformities. However, this technique is associated with higher rates of infection and cerebrospinal fluid leakage, which is most likely due to direct communication between the cranial and nasal cavities.

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206

Which of the following muscles is/are NOT involved in normal velopharyngeal closure?

(A) Levator palatini
(B) Palatopharyngeus
(C) Superior pharyngeal constrictors
(D) Tensor veli palatini
(E) Uvulus

The correct response is Option D.

Muscles involved in velopharyngeal closure include each of those mentioned above except for the tensor veli palatini. Normal velopharyngeal closure is crucial for production of intelligible speech; any abnormalities in this mechanism can result in hypernasality, nasal emissions, imprecise production of consonants, decreased speech volume, and/or shortness of phrases.

The levator palatini muscles are of primary importance in pharyngeal closure. These muscles join in the midline to form a sling in the normal palate, inserting into the palatal aponeurosis. Their mechanism of action is to pull the middle third of the soft palate superiorly and posteriorly, resulting in contact with the pharyngeal walls.
In contrast, patients with cleft palate have abnormal insertion of the levator palatini on the posterior aspect of the hard palate. Cleft palate repair recreates the "normal" muscle sling by reorienting the muscles horizontally through a procedure known as intravelar veloplasty.

If normal pharyngeal closure is not achieved following cleft palate surgery, additional procedures may be considered to allow for a more complete velopharyngeal closure. Sphincter pharyngoplasty or reconstruction with pharyngeal flaps is most frequently performed.

The palatopharyngeus muscles pull the soft palate posteriorly, while the superior pharyngeal constrictors move the lateral and posterior pharyngeal walls. The uvulus muscle enhances velopharyngeal closure by thickening the uvula.

Although the tensor veli palatini attaches to the eustachian tubes, acts to tense the soft palate, and is important for eustachian tube function, it does not provide an important contribution to velopharyngeal closure.

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207

Which of the following structures does NOT attach to the lateral orbital tubercle?

(A) Fascial extension of the lateral rectus muscle
(B) Lateral check ligament
(C) Lateral horn of the levator aponeurosis
(D) Lateral limb of Lockwood's ligament
(E) Lateral palpebral ligament

The correct response is Option D.

Attachments to the lateral orbital tubercle (also referred to as Whitnall's tubercle), which is found within the zygomatic bone approximately 10 mm beneath the lateral orbital rim, include the fascial extension of the lateral rectus muscle, the lateral check ligament, the lateral horn of the levator aponeurosis, and the lateral palpebral ligament, which anchors the tarsal plates.

Although the suspensory ligament of Lockwood attaches to the walls of the orbit and contributes to the thickened lower portion of the bulbar sheath, it does not attach to the lateral orbital tubercle. This contribution to the bulbar sheath is formed by fascia from the inferior rectus and inferior oblique muscles as they cross beneath the globe.

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AESTHETIC AND BREAST — 1998

1

The superior epigastric artery enters the pedicle of a TRAM flap at which of the following orientations?

(A) Anterolaterally
(B) Anteromedially
(C) Posterolaterally
(D) Posteromedially

The correct response is Option D.

The superior epigastric artery, the continuation of the internal mammary system, enters the rectus abdominis muscle medial and posterior to the muscle. Knowing the orientation of this artery is essential when elevating the rectus abdominis muscle, since division of the intercostal nerves and vessels up to and including the costomarginal vessels will produce muscle atrophy and decrease the epigastric bulge associated with a pedicle TRAM flap.

Reference

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2

Which of the following is the most appropriate use of spreader grafts?

(A) Buttressing of a high dorsally deviated septum
(B) Correction of an overly long nose
(C) Correction of a dorsal irregularity following hump resection
(D) Lengthening of a foreshortened nose

The correct response is Option A.

Spreader grafts were originally described for use in patients undergoing primary rhinoplasty who are predisposed to middle vault collapse. Since then, their use has been expanded to include secondary rhinoplasty in which middle vault collapse may already exist because of upper lateral cartilage overresection or avulsion.

For example, a spreader graft can be used quite successfully to buttress a high dorsally deviated septum. The graft is placed at the dorsal aspect of the septum. Once secured with sutures, a spreader graft provides a strong buttress to the dorsal septum.

Spreader grafts would have little effect on dorsal irregularities occurring after dorsal hump reduction. The camouflaging of these irregularities usually requires a thin, wide onlay graft that covers a large portion of the nasal dorsum. Since spreader grafts are inserted between the nasal septum and upper lateral cartilages, they would be ineffective in correcting or disguising such irregularities. Even if a spreader graft were placed so that it extended anterior to the nasal dorsum, it would probably only exacerbate any problem caused by dorsal irregularities rather than improving it.

Spreader grafts have no reported effect on nasal length.

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3

A 52-year-old woman undergoes bilateral lower eyelid blepharoplasty that involves excision of fat and skin. Intraoperatively, there is marked lower eyelid ectropion on one side after skin closure. Preoperatively, there was no exophthalmos, and lower eyelid tone was normal. Which of the following is the most appropriate next step?

(A) Excise more skin from the contralateral side
(B) Perform a lateral canthoplasty on the affected side
(C) Place tapes on the lateral aspect of the affected eyelid
(D) Replace a portion of the excised skin on the affected side

The correct response is Option D.

One of the most common problems seen after cosmetic blepharoplasty is scleral show or lower eyelid retraction. This condition is caused by overresection of lower eyelid skin, which places more tension on the lower eyelid margin than the lid can support. This patient with markedly excessive unilateral scleral show most likely had excessive resection of eyelid skin . The most appropriate next step would be to replace some of the resected skin (i.e., the excess from what was needed as a skin graft). This technique is a well-established means of dealing with the technical mishap of overresection and usually does not lead to unacceptable scarring.

Excising more skin from that contralateral side is not likely to be useful because the ectropion then would be bilateral.

Because the patient had normal lower eyelid tone preoperatively, canthoplasty is not indicated.

Taping of the lower eyelid is often performed postoperatively for minor problems with lower eyelid retraction but is unlikely to help this patient.

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4

An 18-year-old man has a depressed nasal tip and a narrow alar base width. Examination shows hyperactive chin musculature, lip strain with closure of the lips, and 12 mm of incisor exposure with the lips in repose. Which of the following is the most likely diagnosis?

(A) Benign masseteric hypertrophy
(B) Transverse maxillary deficiency
(C) Vertical maxillary deficiency
(D) Vertical maxillary excess

The correct response is Option D.

This patient has vertical maxillary excess (long-face syndrome), a condition generally associated with a "gummy smile" and an anterior open bite. It is always associated with excess dental display (greater than 2 to 3 mm of exposure of the upper central incisors with the lips in repose). A prominent nose, with drooping of the nasal tip, and a narrow alar base width are the primary soft-tissue manifestations. There is an increased interlabial gap secondary to the vertical maxillary excess that results in lip strain and hyperactive chin musculature. Surgical treatment generally consists of a Le Fort I osteotomy with maxillary impaction.

The most prominent feature in cases of vertical mandibular excess is a symmetrical increase in the height of the mandibular body. Accordingly, a common characteristic in persons with this condition is the appearance of a "strong jaw"; whereas this trait is often considered desirable in a man, many affected women view it as an aesthetic flaw. Surgical correction consists of resection of the inferior border of the mandible, with no alteration in the dental occlusion. This procedure reduces the height of the lower face.

Benign masseteric hypertrophy causes excess width of the mandible. This condition produces an often undesirable facial disproportion. The increased width occurs primarily at the angle of the mandible and is believed to result from hypertrophy of the masseteric muscle. Weight lifters are commonly affected, although the condition is sometimes associated with chewing gum and sometimes has no clear etiology. Benign masseteric hypertrophy can be managed conservatively with tranquilizers, spasmolytics, or dental occlusal adjustments. More invasive surgical therapy via an intraoral or extraoral approach can likewise be effective. In the more common intraoral approach, the medial portion of the masseteric muscle is resected and the lateral portion of the bony angle of the mandible is reduced.

Transverse maxillary deficiency most often results from a narrow maxilla in a mediolateral direction. The condition usually manifests itself as a malocclusion with posterior crossbites. Facial manifestations are generally insignificant. The deficiency is typically managed by surgical widening of the maxilla.

In patients with vertical maxillary deficiency (short-face syndrome), facial features generally include a short square jaw, a procumbent lower lip, a deep labiomental groove, and exaggerated nasolabial folds. Incisor exposure with the lips in repose is usually minimal or completely absent, making affected patients look older than their actual age. A Le Fort I osteotomy with inferior positioning and interpositional bone grafting is the usual management.

References

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3. Ousterhout DK. Mandibular width reduction including the surgical treatment of benign masseteric hypertrophy. In: Ousterhout DK, ed. *Aesthetic Contouring of the Craniofacial Skeleton*. Boston, Mass: Little, Brown & Co; 1991:451-469.

5

The incidence of hematoma formation requiring evacuation after rhytidectomy is in the range of

(A) 0% to 1%
(B) 3% to 5%
(C) 8% to 10%
(D) 12% to 15%

The correct response is Option B.

Hematoma formation is the most frequent complication following rhytidectomy. Hematomas can vary from large collections of blood that compromise the skin flap and require surgical evacuation to very small collections that subside on their own. Most clinically significant expanding hematomas occur within the first 10 to 12 hours after surgery and are usually noticed in the recovery room. Signs and symptoms include unilateral pain, unilateral facial fullness, and unilateral excessive periorbital ecchymosis.

The reported incidence of major hematoma formation requiring evacuation following rhytidectomy varies from 0.9% to 8%, with the largest series (a review of 7700 cases) reporting an incidence of 3.7%. The reported incidence in men is 7% to 8%, while the reported incidence in women is 3.4%. Control of expanding hematomas is performed in the operating room under general anesthesia. An isolated hematoma is seldom discovered.

Small hematomas (2 to 20 ml) generally do not become apparent until postoperative edema has subsided. These hematomas occur in 10% to 15% of patients and, if visible, can be aspirated 10 to 12 days after surgery as they begin to liquefy; most would subside on their own within several months.

An association has been suggested between hematoma formation and either an immediate postoperative increase in blood pressure or the postoperative use of chlorpromazine (Thorazine) to prevent reactive hypertension. There is no known correlation between intraoperative bleeding and subsequent hematoma formation. Substances known to cause bleeding problems such as aspirin and other nonsteroidal anti-inflammatory drugs, large doses of vitamin E, and dipyridamole should not be taken for two weeks prior to surgery.

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6

A 15-year-old boy is brought to the emergency department 30 minutes after sustaining an injury to the ear in a wrestling match. Examination shows marked swelling of the right ear but no external lacerations. The landmarks of the ear are obliterated by swelling and edema.

Which of the following is the most appropriate management?

(A) Application of a compression dressing followed by observation
(B) Aspiration of the hematoma with a 14-gauge needle
(C) Evacuation of the hematoma through a limited anterior incision followed by splinting
(D) Evacuation of the hematoma through an extensive posterior approach followed by drainage and splinting

The correct response is Option C.

This patient has wrestler's ear, or cauliflower ear, an acute condition caused by a hematoma in the subperichondral area. Because of the close adherence of the anterior skin to the perichondrium/cartilage, the hematoma is located anteriorly. This injury is common in wrestlers who fail to wear protective headgear. The posterior area is usually protected from this type of injury because subcutaneous tissue in that area allows sliding of the skin.

The most appropriate management is complete evacuation of the hematoma, which requires a lateral incision and dissection of the involved area. The incision is generally made parallel to the helix at the part of the ear that contains the hematoma. This procedure can be done under local anesthesia with epinephrine. Uninvolved areas should not be dissected, making a posterior approach inappropriate. Postoperatively, the patient should wear a splint dressing such as a cotton bolster over the involved area.

Application of a compression dressing followed by observation does not address the problem of the hematoma.

Aspiration with a 14-gauge needle generally results in incomplete evacuation and is inappropriate for this type of injury.

Reference
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7

Which of the following lasers is likely to be most effective in removing the tattoo shown in the photograph above?

(A) Argon laser
(B) CO_2 laser
(C) Flashlamp-pumped pulsed dye laser
(D) Q-switched Nd:YAG laser

The correct response is Option D.

A Q-switched Nd:YAG laser is likely to be most effective in removing the tattoo shown in the photograph. Over 10 million Americans have tattoos. Amateur tattoos tend to be more superficial, although they often have irregular depth penetration and typically contain smaller pigment particles. Professional tattoos contain larger, multicolored pigments and typically have uniform depth penetration. Q-switched lasers use high energy at short pulse durations to minimize the complications of laser therapy. The longer wavelength (1064 nm) is efficient in removing deeper black/blue ink. The shorter wavelength (532 nm) is more useful for brightly colored tattoos.

The exact mechanism of tattoo removal is unclear. The process likely involves phagocytosis of liberated pigment from tattooed cellular components following treatment. While lightening does occur at the treated site, the pigment is not completely eliminated and has been found in lymph nodes draining tattooed skin. Potential side effects of the Nd:YAG laser include texture changes, darkening of the tattoo, transient hyperpigmentation, and hypopigmentation. Scarring is an unlikely complication. The Q-switched ruby and alexandrite lasers can also be used for the removal of tattoos. However, these lasers tend to penetrate more deeply and may result in scarring.

The argon laser's light emission ions are preferentially absorbed by chromophobes contained in blood and are, therefore, not as effective as the Nd:YAG laser in destroying tattoo pigment. The CO_2 laser operates at a very high wavelength (10600 nm) and is preferentially absorbed by water. It is used primarily in facial rejuvenation. The pulsed-dye laser, a relatively shallow laser, is typically not used in tattoo removal. It is targeted at selective absorption by blood vessels and is used extensively in the treatment of port-wine stain and other vascular anomalies.

References
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8

Laser abrasion is the most effective treatment of which of the following skin conditions?

(A) Deep nasolabial folds
(B) Fine periocular rhytids
(C) Hypopigmentation
(D) Ice pick acne

The correct response is Option B.

Laser abrasion is commonly used for skin resurfacing in patients with fine periocular rhytids and other signs of sun-damaged skin. It achieves rejuvenation in a specific and predictable fashion that is often not seen with chemical peels and dermabrasion techniques. Skin type must be evaluated prior to treatment; the six possible types of skin are listed below.

Skin Type	Color	Characteristics
I	White	Always burns / never tans
II	White	Usually burns / tans with difficulty
III	White	Sometimes mildly burns / usually tans
IV	Medium brown	Rarely burns / tans easily
V	Dark brown	Rarely burns / tans very easily
VI	Black	Never burns / tans very easily

The best candidates for skin resurfacing have skin types I through III. Patients with skin type IV require pretreatment with retinoic acid, hydroquinone, and sunscreens followed by the same regimen postoperatively to decrease the risk of skin pigmentary changes. Skin types V and VI are not as amenable to laser resurfacing, so the technique should be approached cautiously in patients with these skin types.

Proper safety and efficacy of laser resurfacing procedures rely on an accurate assessment of when the desired endpoint is reached. Complete obliteration following the first treatment of the epidermis is seen. Usually, a pink color is evident, which indicates penetration into the papillary dermis. With subsequent treatments, a gray/blanching color, indicative of penetration into the upper reticular dermis, is seen. Yellow coloration of the dermis signifies penetration deeper into the reticular dermis. At this point, treatment should be terminated, regardless of the status of the facial rhytides, since further penetration will result in scarring. Generally, the procedure is terminated once the rhytides are no longer seen or the dermis becomes yellow, whichever occurs first. CO_2 laser resurfacing will tighten skin but will not eliminate gross skin excess or significant soft-tissue descent. Fine periocular rhytides are also effectively treated with chemical trichloroacetic acid (TCA) peel.

Significant improvements in the nasolabial folds and jowls are best accomplished with rhytidectomy.

Hypopigmentation is a result of peeling in general and is not improved by laser treatment.

Ice pick acne is best treated by resection of the involved areas.

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9

A 37-year-old man has left nasal obstruction that is exacerbated by forced inspiration. Which of the following is the most likely physical finding?

(A) Hanging columella
(B) Internal valve angle of less than 10 degrees
(C) Nasolabial angle of less than 95 degrees
(D) Prominent anteronasal spinal angle

The correct response is Option B.

This patient with left nasal obstruction exacerbated by forced inspiration most likely has an internal nasal valve angle of less than 10 degrees. Traditional thinking about nasal obstruction has focused on problems anterior to the septum and turbinates. A weak or narrowed internal nasal valve and an overhanging tip can cause nasal obstruction, which is worsened by forced inspiration. The normal angle of the internal nasal valve is 10 to 15 degrees. Collapse of the external nasal valve, which is caused by weak, hypoplastic, overresected, or malpositioned alar cartilages, can also lead to nasal obstruction. Patients with collapse of the external nasal valve characteristically actively flare their alae to try to resist the inward collapse caused by the Venturi effect of inhalation.

External nasal valve obstruction can be diagnosed by observing alar collapse on resting or forced inspiration and correction of the collapse by the Cottle maneuver, i.e., manually holding the ala away from the septum with inspiration. However, a hanging columella is not necessarily caused by alar retraction.

The normal nasolabial angle in a man is 90 to 95 degrees. Moreover, even if this patient had an acute nasolabial angle, it would not cause nasal obstruction. Although it might be aesthetically displeasing, such an angle would not obstruct the intake of air through the nares.

The anterior nasal spine does not contribute to nasal obstruction since it is a small midline structure not anatomically located in the passageway through which inspired air flows.

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10

A 62-year-old woman is scheduled to undergo excision of a basal cell carcinoma of the lower eyelid. The lower canaliculus, as well as the surrounding skin, muscle, and tarsal plate, are to be excised with the conjunctiva left intact. The upper canaliculus is not involved. Which of the following techniques is most appropriate for primary management of the lacrimal system?

(A) Dacryocystorhinostomy
(B) Reconstruction of the eyelid over a silicone stent in the stump of the canaliculus
(C) Reconstruction of the lower canaliculus with a conjunctival flap
(D) Reconstruction of the lower canaliculus with a vein graft

The correct response is Option B.

Patients who need canalicular resection because of tumor excision tolerate this procedure without epiphora as long as the eyelids themselves are adequately reconstructed to lie against the globe. The canalicular remnant can be externalized into the conjunctiva with or without a stent. Reconstruction of the eyelid over a silicone stent in the stump of the canaliculus is easy to perform and will keep the canaliculus functional because everything medial to the canaliculus is unaffected by the resection, and the silicone stent will divert tears into the lacrimal sac.

More complex reconstruction such as dacryocystorhinoplasty is unnecessary. Dacryocystorhinostomy is indicated for obstruction of the lacrimal sac or lacrimal duct, as seen with nasoethmoid fractures, and assumes that normal canaliculi enter the lacrimal sac. Consequently, it would be inappropriate in this patient.

Reconstruction with a conjunctival flap is ineffective because of short-term patency.

Reconstruction with a vein graft is ineffective because of poor long-term patency.

References

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11

A 72-year-old man has undergone resection of a basal cell carcinoma. A photograph is shown on the previous page. Which of the following types of closure is most appropriate to recontour the helical rim?

(A) Advancement flap coverage
(B) Composite graft from the opposite side
(C) Primary closure
(D) Retroauricular tube flap

The correct response is Option A.

Although there are many ways to reconstruct the auricle, using a helical rim advancement flap is the most effective means of reconstructing a medium-sized defect of the helical border that results from resection of a basal cell carcinoma. This procedure was initially recommended for defects in the upper third of the ear but works well in the middle third also.

Primary closure of a medium-to-large defect may cause unnatural coning of the auricle unless secondary wedges are excised within the concha.

Composite grafts of up to 1.5 cm may be transferred from the other ear but are prone to fibrosis, resorption, and abnormal pigmentation.

A narrow tube flap from behind the ear neatly reconstructs the lost curl of the helical rim but often does not adequately define the rim contour.

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12

Which of the following nerves provides primary innervation of the dorsal nasal tip?

(A) Anterior ethmoid
(B) Infraorbital
(C) Infratrochlear
(D) Nasopalatine

The correct response is Option A.

The sensory innervation of the septum is provided by the nasopalatine nerve interiorly and the internal branches of the anterior ethmoid nerve superiorly. The continuation of the external branch of the anterior ethmoid nerve exits the nose at the osseocartilaginous junction to supply the nasal lobule.

The superolateral aspect of the external nose is supplied by the infratrochlear nerve, and the inferolateral aspect is supplied by the infraorbital nerve.

The lateral wall of the nasal cavity is supplied posteriorly by branches of the sphenopalatine ganglion and the posterior nasal nerve and superiorly by the internal branch of the nasociliary nerve.

Reference

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13

A 31-year-old woman requests correction of the breast deformity shown above. Which of the following is the most appropriate surgical management?

(A) Augmentation with a periareolar mastopexy
(B) Augmentation with a Wise-pattern mastopexy
(C) Latissimus flap reconstruction of the tuberous breast
(D) Reduction of the contralateral breast
(E) Transaxillary augmentation

The correct response is Option A.

This patient has a tuberous breast deformity characterized by three components: herniation of the breast tissue into the nipple-areola complex area with a cylindrical projection accompanied by a relatively large areola; deficiency of the lower pole of the breast in both vertical and horizontal axes; and hypoplasia. Periareolar mastopexy with augmentation will allow areolar reduction and simultaneous access for radial-releasing incisions to allow expansion of the base of the breast and correction of the deformity shown. For a more severely deficient skin envelope than is evident in this patient, two-stage reconstruction with tissue expansion may be indicated.

Wise-pattern mastopexy is indicated in patients with more severe breast ptosis. Reconstruction with a latissimus flap is an accepted form of treatment for congenital chest wall deformities such as Poland's syndrome but is not recommended for tuberous breast correction. Reduction of the contralateral breast will not correct the asymmetry of the tuberous deformity. Transaxillary augmentation of the breast alone accentuates the deformity, causing the nipple and areola to protrude even further.

References

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2. Rees TD, Aston SJ. The tuberous breast. *Clin Plast Surg*. 1976;3:339-347.

14

Which of the following abnormalities associated with a weak chin can be corrected by a sliding genioplasty?

(A) Class II skeletal pattern
(B) Long upper facial height
(C) Malocclusion
(D) Recessive and procumbent lower lip
(E) Short lower facial height

The correct response is Option E.

A short lower facial height can be corrected with a sliding genioplasty. This procedure is used to vertically elongate or shorten the chin, in addition to allowing for horizontal anteroposterior movements. Moreover, the depth of labiomental fold can be affected. A chin advancement deepens the fold and vertical elongation tends to make the fold less prominent.

Sliding genioplasty will not correct a class II skeletal relationship or malocclusion. It is used as a camouflage for these conditions.

In addition, sliding genioplasty has no effect on mandibular height in that the movement is in the anteroposterior plane and is not cephalocaudal.

A recessive and procumbent lower lip is not affected by forward movement of the bony chin. Such a lip may, however, limit the amount of chin advancement possible, as advancing the chin anterior to the lip is likely to result in an unaesthetic appearance.

References

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2. Rosen HM. Aesthetic guidelines in genioplasty: the role of facial disproportion. *Plast Reconstr Surg*. 1995;95:463-469.

15

Which of the following is the most likely complication of a retrogenioplasty?

(A) Chin ptosis
(B) Numbness of the chin
(C) Periodontal defects of the mandibular anterior teeth
(D) Posterior relapse of the advanced segment
(E) Tooth loss/damage

The correct response is Option B.

The most likely complication of a retrogenioplasty is permanent or temporary numbness of the chin. Neurosensory deficits have been reported in up to 20% of patients immediately after surgery. This number decreases to 10% at 14 months after surgery. The incidence is higher when a sagittal split osteotomy is performed.

Chin ptosis has been reported following genioplasty and is believed to result from excessive stripping of the mentalis muscles. However, it occurs less commonly than neurosensory deficits. Treatment strategies generally involve a procedure to reattach the mentalis muscles more superiorly on the mandible.

Periodontal defects can occur following advancement genioplasty but are similarly less common than are neurosensory deficits. Periodontal complications can be avoided by proper placement of the intraoral incision midway between the vermillion border of the lip and the depth of the vestibule.

Bony relapse, or posterior movement of the advanced bony segment, is relatively rare with genioplasty with current stabilization techniques.

Tooth loss or damage is also rare with genioplasties. Any damage to teeth that does occur may necessitate root canal therapy.

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2. Zide BM, McCarthy J. The mentalis muscle: an essential component of chin and lower lip position. *Plast Reconstr Surg*. 1989;83:413-420.

16

A 32-year-old woman has chin ptosis after undergoing a reduction genioplasty that involved removal of bone at the pogonion. Which of the following is the most likely cause of the chin ptosis?

(A) Bone resorption at the pogonion
(B) Inadequate use of a postoperative compressive dressing
(C) Loss of the attached mandibular gingiva
(D) Mentalis muscle elongation and origin displacement
(E) Paralysis of the levator anguli oris and levator labii superioris muscles

The correct response is Option D.

The most likely cause of the chin ptosis in this patient is mentalis muscle elongation and origin displacement. With the labial sulcus incisions used in genioplasties, mentalis muscle origin displacement can occur secondary to failure to resuture or reattach the mentalis muscle. Examination will reveal an excessively deep, scarred vestibular sulcus. The lip may also be pulled down. Mentalis muscle elongation and abnormal redraping can occur with burring of the anterior symphysis, with aggressive soft tissue dissection that degloves the symphysis, or with removal of an excessively large implant. Treatment strategies involve reattachment of the mentalis muscle to the mandible.

Bone resorption at the pogonion following bony reduction is not a significant problem in genioplasties, even though some bony remodeling may occur.

Compressive dressings are used to prevent hematoma formation and to immobilize the soft tissue during healing. Compressive dressings do not prevent chin ptosis.

Loss of attached mandibular gingiva can occur following genioplasty when the vestibular incision is placed too close to the attached gingiva. Such a loss does not affect the chin soft tissue but can lead to periodontal disease.

Paralysis of the facial musculature is not associated with genioplasty or other facial osteotomies.

References

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17

A 40-year-old woman develops decreased projection of the chin five years after undergoing placement of a silicone chin implant. Which of the following is the most likely cause?

(A) Bone erosion under the implant
(B) Displacement of the implant
(C) Progressive anterior drift of the dentition
(D) Rupture of the implant
(E) Thinning of the soft tissue

The correct response is Option A.

This patient has most likely had some bone erosion under the chin implant, which is the most common cause of loss of chin projection following placement of a silicone implant. In some patients the chin implant erodes into the symphysis and even damages the underlying tooth roots. Treatment involves removal of the implant and possible sliding advancement genioplasty. If the tooth roots have been damaged, root canal therapy may be necessary.

Displacement of the implant usually results in chin asymmetry, not loss of chin projection.

Anterior tooth movement may occur after placement of a silicone chin implant, but not to the extent that labial soft-tissue displacement could result in an apparent loss of chin projection. The most common result of anterior tooth movement is orthodontic tooth crowding.

The concept of implant rupture is not pertinent to chin implants, since these implants do not contain silicone gel.

Thinning of the soft tissue resulting in loss of chin projection has not been reported following placement of a chin implant. Usually, there is a predictable soft tissue advancement with chin augmentation.

References

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18

A 5-year-old boy undergoes otoplasty for correction of prominent ears. Which of the following is the most likely complication?

(A) Hematoma
(B) Infection
(C) Keloid scarring
(D) Necrosis of the anterior skin
(E) Recurrent deformity

The correct response is Option E.

The most likely complication following otoplasty in this patient is residual or recurrent deformity. Whereas certain otoplasty techniques are associated with specific complications, the most common problem with each of them is residual or recurrent deformity. Recent studies have reported that revision otoplasty is required in 8% to 24% of patients, depending on the technique employed.

Hematoma, infection, or abnormal scarring can occur as a result of any surgery, but these conditions are less common than are residual or recurrent deformities in patients who underwent otoplasty. Similarly, necrosis of the anterior skin has been associated with techniques requiring anterior degloving but is not the most common complication following such techniques. According to a published review of a large series of patients who underwent otoplasty, hematoma occurred in 2%, infection in 5.1%, abnormal scarring in 2.1%, and skin necrosis in 1.4%.

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19

Approximately how much of the lidocaine injected in the tumescent technique of anesthesia for suction lipectomy is removed with the liposuction itself?

(A) 20%
(B) 40%
(C) 60%
(D) 70%
(E) 80%

The correct response is Option A.

Studies have shown that only 10% to 30% of the lidocaine injected in the tumescent technique of anesthesia for suction lipectomy is removed with the aspirated fat.

The current recommended maximum dosage with the tumescent technique is 35 mg/kg. This amount is based on clinical experience and studies demonstrating that 95% of patients will have a peak plasma concentration less than 4 µg/ml when the lidocaine dose is 35 mg/kg. Symptoms of lidocaine toxicity correlate directly with the plasma concentration. Subjective symptoms such as light-headedness, drowsiness, and dizziness can occur between 3 and 6 µg/ml. Objective symptoms of central nervous system toxicity can occur at 5 to 9 µg/ml, and seizures can occur at greater than 10 µg/ml.

The standard recommended dose of lidocaine with epinephrine is 7 mg/kg and without epinephrine is 4 to 5 mg/kg. Several facts are thought to allow the use of higher doses with the tumescent technique. The injection of lidocaine into relative avascular subcutaneous tissue decreases the systemic absorption. The slow rate of injection also decreases peak plasma concentration. The dilute lidocaine and epinephrine concentrations of the infiltrates also contribute to lower plasma concentration.

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20

A patient with which of the following preexisting abdominal scars is most likely to develop postoperative complications after undergoing abdominoplasty?

(A) Abdominal suction lipectomy scar
(B) Appendectomy scar
(C) Median infraumbilical scar
(D) Paramedian supraumbilical scar
(E) Transverse cesarean incision scar

The correct response is Option D.

The preexisting abdominal scar most likely to contribute to the development of postoperative complications in patients undergoing abdominoplasty is a supraumbilical scar. This type of scar remains after surgery, can hinder dissection, and may impair blood supply.

Previous abdominal liposuction scars should not pose a significant problem with blood supply to the skin because of their small size. Previous liposuction is not a contraindication to abdominoplasty.

Most infraumbilical scars, including appendectomy and median infraumbilical scars, do not present a problem and are removed during abdominoplasty.

The transverse cesarean incision, if located low on the abdomen, requires placement of the incision in the same location; this necessity may place undue tension on the flap with downward pull. Alternatively, the incision can be placed above the previous scar, but such placement may impair blood flow to the intervening skin between the incision and cesarean scar. However, a scar from this type of incision causes fewer postoperative complications after abdominoplasty than the supraumbilical scar because of its transverse orientation.

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21

Which of the following is the mechanism of action of ultrasound-assisted lipectomy?

(A) Thermal energy generated by the ultrasonic probe melts adipocyte contents in the probe's immediate area
(B) Ultrasonic energy disrupts adipocyte membranes
(C) Ultrasonic energy disrupts fibrous tissue surrounding adipocytes
(D) Ultrasonic energy enables the probe to cut adipose tissue more efficiently than would a standard liposuction cannula
(E) The ultrasonic probe allows for lower (i.e., more negative) suction pressures

The correct response is Option B.

Ultrasound-assisted liposuction (UAL) works by disrupting adipocyte cell membranes through the application of intense and localized ultrasonic energy. Cell membranes are composed of phospholipid bilayers that behave physically as complex liquids. When sound waves are applied to any physical object, that object is subjected to oscillating energy waves that alternate between compression (high pressure) and expansion (low pressure). If the energy generated by a sound wave is adequate, its application to a fluid causes microbubble formation during its expansion phase. Once microbubbles are formed, they continue to be affected by the ultrasonic wave and alternately expand and contract with each oscillation of the sound wave. During this time, gases diffuse into and out of the microbubble. The rate

of gas diffusion depends on the surface area of the bubble and the partial pressure of each gas within the bubble. Because of the relation of the size of the bubble to the phase of the ultrasonic pressure wave, the microbubble tends to be larger when the extracellular pressures exceed the intracellular pressures. The microbubble then expands slightly more than it contracts with each cycle of the ultrasonic wave (approximately 20,000 times per second). Once the microbubble reaches a critical size (approximately 170 microns in diameter), it can no longer increase as quickly as necessary to absorb the ultrasonic energy. The bubble then implodes because of the unopposed pressure of the surrounding tissues. The implosion of multiple microbubbles within the cell membrane leads to the complete disruption of the membrane and of the adipocyte. The intracellular contents are then spilled into the extracellular milieu and are aspirated.

The mechanism of UAL is cavitation and ultrasound-induced cellular disruption, not thermally induced melting of adipose tissue. In fact, when cold tumescent infiltration is employed, the tissue temperatures remain below core body temperature.

Ultrasonic energy is absorbed preferentially by adipocytes and does not disrupt the fibrous connective tissue that surrounds fat cells.

Adipose tissue is disrupted at the cellular level and not cut, so the comparison of ultrasound and a liposuction cannula does not apply.

The use of ultrasound in conjunction with suction lipectomy does not affect the suction pressure used during aspiration.

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22

Which of the following shows a proportional increase as dermis ages?

(A) Amount of ground substance
(B) Collagen biosynthesis
(C) Dermal volume
(D) Number and size of elastic fibers
(E) Number of Meissner's and pacinian corpuscles

The correct response is Option A.

Dermal aging is composed of two components: an intrinsic chronological process and an extrinsic process that results from environmental effects such as sun damage and cigarette smoking. In combination, these two processes lead to clinically evident aging of skin that is primarily manifested as an atrophic process when judged at the histologic or physiologic level.

Numerous histologic changes occur in aging dermis. For example, the amount of dermal ground substance in aging skin is increased relative to its previous state. More specifically, aging skin is thinner but the amount of ground substance remains the same, so the relative change is an increase as it relates to younger skin.

In contrast, decreased numbers of fibroblasts lead to decreased collagen biosynthesis. Dermal atrophy is also seen, manifested as a loss of dermal volume. Similarly, the number of mast cells decreases, a reflection of the decrease in aging skin's immunologic barrier function. Decreased numbers of blood vessels and shortened capillary loops lead to the gray hue seen in aging skin. The secretory output of sebaceous glands decreases, and histologic changes reflecting this decrease are seen in the cells that comprise these glands. The number and size of elastic fibers likewise decreases, resulting in a generalized skin atrophy. Finally, a decrease in the number of Meissner's and pacinian corpuscles leads to a diminution in tactile and pressure sensitivity, ultimately predisposing the aging skin to increased risk of injury.

Functionally, the skin undergoes an atrophic process as almost all of its normal functions (protection, secretion, absorption, thermoregulation, pigmentation, sensation, and immunologic regulation) subside. The flattening of the dermal-epidermal junction leads to a decreased resistance of the skin to shearing forces and also decreases the number of basal cells available for epidermal regeneration, reepithelialization, and nail growth. Healing is inefficient in aging skin, and the chemical barrier afforded by the stratum corneum is less effective. Decreases in collagen biosynthesis and changes in the histologic properties of aged collagen and elastic fibers lead to a dermis that is less stretchable and more prone to develop fine wrinkles. These same changes also contribute to poor wound healing and decreased tensile strength of healed wounds.

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23

Which of the following procedures is most likely to decrease nasal tip projection?

(A) Placement of a dorsal onlay cartilage graft
(B) Placement of a shield graft
(C) Resection of the alar domes
(D) Use of a transcolumellar incision
(E) Use of transdomal sutures

The correct response is Option C.

Given the many available techniques and the variety of interactions among the different anatomic regions of the noses, the surgeon must understand the effect that each technique has on each component of nasal anatomy. Resection of the alar domes is likely to lead to a decrease in nasal tip projection because any destruction of the nasal domes decreases their ability to support the nasal tip. Reconstituting them does decrease the likelihood that any functional disturbance will result, but resection of either the medial or lateral crura of the lower lateral cartilages will result in decreased tip projection.

Placement of a dorsal onlay graft may decrease apparent tip projection since the dorsum will have more prominence than before, but the actual tip projection itself will not be affected. Similarly, a transcolumellar incision has no direct effect on the projection of the nasal tip.

Placement of a shield graft directly increases the nasal tip projection by adding to the projection in proportion to the graft's thickness. Transdomal sutures also increase the projection by medializing the tip's defining points and thereby increasing the distance from these points to the base of the columella.

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24

Which of the following nerves or nerve branches is most commonly injured during a rhytidectomy?

(A) Auriculotemporal
(B) Buccal branches of the facial (VII)
(C) Frontal
(D) Great auricular
(E) Mandibular branch of the facial (VII)

The correct response is Option D.

Nerve injury, specifically motor nerve injury, is the most severe potential complication of rhytidectomy. Fortunately, most nerve injuries noted after rhytidectomy are limited to the sensory nerves. The lower portion of the ear, the preauricular skin, and the cheeks are always transiently hypesthetic following rhytidectomy because of the interruption of small sensory nerves intraoperatively.

The most common nerve injury during rhytidectomy, occurring at a rate of 3% to 5%, involves the great auricular nerve. Such injury occurs when the dissection penetrates deep to the sternocleidomastoid fascia over the middle portion of the muscle where the nerve crosses the muscle belly approximately 6.5 cm below the caudal edge of the external auditory canal. Injury to the great auricular nerve can be avoided during a sub-SMAS/platysma dissection by incising the deep layer just anterior to the sternocleidomastoid muscle.

Injury to the auriculotemporal nerve, a sensory nerve supplying the area behind the ear, is less common than injury to the great auricular nerve. The rate of such injury is 2%.

Facial (VII) nerve injury is less common in rhytidectomy, with the overall rate of injury to branches of this nerve being between 1% and 2%, depending on the depth of dissection. The most commonly injured branches of the facial nerve are the zygomatic and buccal branches; however, because of cross-innervation, injury to these nerves rarely causes any significant palsy. Injury to the temporal or mandibular branches of the facial nerve is less common but more troublesome, given the resultant noticeable weakness in the forehead and lower lip. Each of these is injured at an incidence of 1%.

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25

After undergoing an uncomplicated primary rhytidectomy, a 54-year-old woman has early onset of ischemia and subsequent full-thickness skin slough of a 3 × 5-cm area anterior to the left earlobe. Which of the following is the most appropriate first step in management?

(A) Local wound care and healing by secondary intention
(B) Debridement and split-thickness skin grafting
(C) Debridement and full-thickness skin grafting
(D) Delayed primary closure by readvancement of the cervicofacial flap
(E) Regional flap coverage

The correct response is Option A.

Appropriate initial management for this patient with skin slough following rhytidectomy should be conservative. Local care with healing by intention via secondary contracture and epithelialization is best; in addition, because this is a stressful time for both the patient and the surgeon, frequent physician-patient contact is critical. The wound should be kept moist and clean. Eschar formation should be avoided. Monitoring for the development of secondary infections is critical. Many smaller sloughs heal spontaneously within several weeks and may not require any secondary scar revisions. Larger wounds can also be allowed to heal, with scar revisions performed as necessary.

Debridement and skin grafting are not appropriate alternatives to obtain wound closure because they would produce quilt-like mismatches of texture and color.

Tension is a key factor in producing slough. Delayed primary closure by readvancement of the cervicofacial flap will only compound this problem.

Regional flaps are contraindicated in the correction of postrhytidectomy skin slough because the affected area will heal on its own with much less residual scarring than would be the case if a flap were used.

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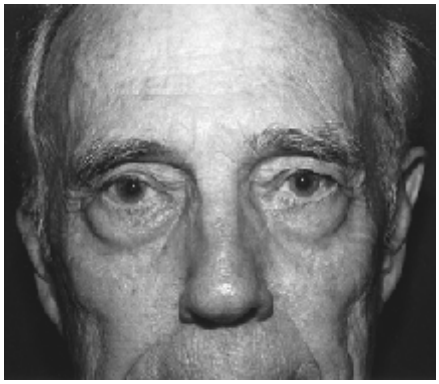
26



A 72-year-old man is scheduled for blepharoplasty of the lower eyelid. A photograph is shown above. Which of the following techniques should be used in this procedure?

(A) Laser skin resurfacing
(B) Lateral tarsal strip canthoplasty
(C) Levator advancement
(D) Medial canthoplasty
(E) Resection of Müller's muscle

The correct response is Option B.

Lower eyelid malposition is the most common complication following blepharoplasty. This patient already has some scleral show of the lower eyelid margin, and surgery could result in further scleral show and ectropion. Preoperative evaluation should therefore include evaluation of lid tone by a snap back test.

The most appropriate procedure to horizontally shorten the eyelid and eliminate any laxity is lateral tarsal strip canthoplasty. In contrast, a skin flap, skin muscle flap, or laser resurfacing would all predispose the lower eyelid to skin shortening, potentially worsening a lax lower eyelid.

Both levator advancement and resection of Müller's muscle are used to treat blepharoptosis, an upper eyelid condition, and do not have application to lower eyelid blepharoplasty or laxity. Medial canthoplasty is inappropriate for this patient because this is a maneuver to treat hypertelorism resulting from frontal bilateral ethmoid facial fractures.

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27

An otherwise healthy 13-year-old girl has juvenile breast hypertrophy. A photograph is shown above. Which of the following is the most appropriate management?

(A) Antiestrogen therapy
(B) Antiprogesterone therapy
(C) Reduction mammaplasty
(D) Subcutaneous mastectomies
(E) Weight reduction

The correct response is Option C.

Juvenile breast hypertrophy is characterized by rapidly enlarging breasts frequently associated with the onset of menses. The breasts are often disproportionately large compared with the rest of the body, which is commonly normal. The nipple/areolar complex is stretched and may become hypopigmented. Engorgement of the superficial veins and, in extreme cases, skin necrosis may develop. Skeletal and soft-tissue complications may also result. However, no endocrine abnormalities are found in these patients. An end-organ hypersensitivity is thought to result in hypertrophy.

Reduction mammaplasty is the treatment of choice for bilateral juvenile hypertrophy. Delaying surgery often results in persistent, significant psychological and physical stress. Prior to surgery, it is imperative that the patient and her family understand that there is a high likelihood of recurrence and that further surgery may be required.

Although endocrine therapy has been suggested as an alternative to surgery, the potential side effects of these hormones during puberty are unknown and may be significant. Dydrogesterone, a potent progesterone that does not disturb ovulation or cause masculinization, has sometimes been used to treat recurrent hypertrophy.

Mastectomy should not be considered as a primary therapy for juvenile breast hypertrophy. However, it too has been used as a method to treat severe recurrent hypertrophy.

Weight reduction is not an appropriate management because juvenile breast hypertrophy involves hypertrophy of the glandular elements of the breast, and weight reduction will not cause this tissue to decrease in volume.

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28

Which of the following arteries is a major contributor to the blood supply of the breast?

(A) Deep inferior epigastric
(B) Subscapular
(C) Thoracoacromial
(D) Thoracodorsal
(E) Transverse cervical

The correct response is Option C.

The blood supply to the breast arises from many different arteries. A significant collaterization exists among these vessels. The thoracoacromial artery supplies a significant portion of the overlying breast parenchyma via perforators through the pectoralis major muscle. This artery is preserved in submuscular breast augmentation.

The deep inferior epigastric artery does not directly contribute to the blood supply of the breast. It is, however, the primary blood supply to a Shaw-Payne flap.

Branches of the subscapular artery provide blood supply to a number of fasciocutaneous flaps such as the scapular and parascapular flaps but not to the breast.
The thoracodorsal artery, a branch of the axillary artery, is the primary blood supply to the latissimus dorsi muscle and does not contribute to the blood supply of the breast.

The transverse cervical artery provides the primary blood supply to the trapezius muscle but also does not contribute to the blood supply of the breast.

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29

A 36-year-old man is scheduled to undergo a secondary rhinoplasty to correct bilateral retracted alar rims. Which of the following is the most appropriate surgical management?

(A) Composite septal graft to the alar vestibule
(B) Placement of a columellar strut
(C) Placement of spreader grafts
(D) Resection of the caudal margins of the medial crura
(E) Resection of the medial crura and suture of the edges

The correct response is Option A.

Abnormal alar-columellar relationships have been classified into six different classes. Each type of discrepancy requires a different method of corrective treatment. The retracted alar rims in this patient who will undergo primary rhinoplasty fall into class III (i.e., pseudo-hanging columella). To correct the excessive columellar show secondary to this condition, treatment is directed at the retracted ala. A horizontal incision is made on the vestibular side of the alar wall parallel to the rim. The rim is pulled in a caudal direction, and the resulting open wound is filled with a nonanatomic composite graft of septal cartilage and mucosa.

Placement of a columellar strut can increase projection or increase columellar volume but would not address a retracted alar rim deformity.

Spreader grafts are primarily used to correct either the collapse of an internal valve or a narrowed midvault.

Resection of the caudal margins or the medial crura would be appropriate to correct a prominent columella.

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30

A 26-year-old Asian woman is scheduled to undergo blepharoplasty of the upper eyelids. Which of the following findings is most likely on preoperative examination?

(A) Deep palpebral crease
(B) Dense attachments through the pretarsal orbicularis
(C) Excessive corrugator muscle
(D) Inferiorly prolapsed prelevator fat
(E) Lateral epicanthal fold

The correct response is Option D.

In the Caucasian eyelid, the levator muscle inserts into the superior tarsal edge with dense attachments extending through the orbital septum to the pretarsal orbicularis muscle. However, these attachments do not exist in the Asian eyelid. This lack of attachments can allow the prelevator fat to prolapse inferiorly, making the lid appear full and puffy. A number of surgical techniques have been designed to address the absent attachments and correct the hooding of the medial epicanthal fold.

The typical Asian upper eyelid is characterized by an absent superior palpebral crease. The corrugator muscle is not involved in the differences that exist between Asian and Caucasian eyelids, and an excessive muscle is not a characteristic of the Asian eyelid. Finally, the typical Asian eyelid has a medial, not lateral, epicanthal fold.

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31

A Mohs' excision defect that measures 1 cm in diameter is most likely to heal by secondary intention with an acceptable aesthetic result if it is located at which of the following sites?

(A) Alar lobule
(B) Columella
(C) Medial canthus
(D) Middorsum
(E) Nasal tip

The correct response is Option C.

Skin losses on the face do not always require sophisticated reconstructive techniques to achieve good results. The key factor is wound location. Concave surfaces heal well by secondary intention, but convex surfaces may be compromised in appearance or have to function by contraction of thin scars. Even exposure of bone or cartilage is not necessarily a contraindication to healing by secondary intention, although delayed healing may occur. Wounds most likely to heal well are in the glabella and medial canthus. The dorsum and sidewall also heal well but may have suboptimal aesthetic results amenable to secondary revision.

Wounds of the convexities of the tip and alae of the nose should be reconstructed primarily. The alar crease is a concavity, but healing by secondary intention here can cause functionally limiting contracture of the ala.

If a 1-cm wound of the columella is allowed to heal by secondary intention, the structure will be foreshortened, resulting in a plunging tip.

A 1-cm defect of the nasal tip will heal secondarily with a shiny circular scar that will call attention to the area. Such defects will subsequently have to be covered.

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32

A 28-year-old man who works as a television sports commentator has mild recession of the anterior hairline and thinning of the vertex area. Which of the following is the most appropriate management?

(A) Orally administered vasopressin replacement
(B) Systemically administered corticosteroids
(C) Systemically administered estrogen
(D) Topically administered androgen
(E) Topically administered minoxidil

The correct response is Option E.

Male pattern alopecia is a genetically triggered condition in susceptible males. The early loss of hair in the anterior hairline and vertex region suggests a continued progressive loss over the next few years. The medical management of male pattern baldness has generally been very disappointing.

Minoxidil, a potent antihypertensive, has been noted to cause progressive hair growth when taken orally and when used topically. A 2% concentration can be applied to the scalp twice a day with expected stabilization of hair loss and potential increased hair growth in a patient with mild to moderate hair loss. A patient with more extensive baldness responds poorly to topical minoxidil.

Vasopressin and topically and systemically administered estrogen, progesterone, and corticosteroids have been tried without success. Topical therapy with androgen is not effective because it does not stimulate new hair growth.

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33

Following a standard abdominoplasty, the blood supply to the periumbilical area is derived primarily from which of the following arterial systems?

(A) Deep circumflex iliac
(B) Deep epigastric arcade
(C) Internal mammary
(D) Lateral intercostal
(E) Superficial circumflex iliac

The correct response is Option D.

In the normal unoperated abdomen, the blood supply to the abdominal skin is derived from three main zones. Zone I in the midabdomen is supplied by the deep epigastric arcade. Zone II, which is located in the lower abdomen, is derived from the external iliac artery system, and zone III, which is primarily located in the flanks and lateral abdomen, is derived primarily from the intercostal, subcostal, and lumbar arteries. During the abdominoplasty procedure, all of zone I arteries and most of zone II are divided. The resulting skin of the anterior abdomen, including the umbilicus, is therefore primarily supplied by zone III vessels, with some minor collateral flow from zone II.

The internal mammary artery supplies the area indirectly via its perforators from the rectus abdominis muscle. It does not supply the umbilicus.

Caution in aggressive liposuction to the lateral flank area should be exercised during an abdominoplasty because liposuction can damage zone III blood vessels.

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34

An 18-year-old man who was beaten in an aggravated assault has periorbital swelling and ecchymosis caused by a fractured nasal bone. There is no septal hematoma, but there is a laceration in the anterior superior nasal septum. Which of the following blood vessels is most likely to cause epistaxis from this region?

(A) Anterior ethmoid
(B) Descending palatine
(C) Greater palatine
(D) Posterior ethmoid
(E) Sphenopalatine

The correct response is Option A.

This patient has a laceration of the anterior superior nasal septum. The vascular supply to the nasal septum is derived from a number of blood vessels, with the superior septum being supplied by the anterior and posterior ethmoid arteries. The area of the anterior septum where the vessels converge is known as Little's area, the most common site of epistaxis.

Although the site of epistaxis can also be high in the nose near the nasal bones in cases of nasal trauma, the most commonly injured vessel is the anterior ethmoid. The posterior ethmoid is a less likely choice because its anatomic location is so far posterior that it is highly unlikely to be transected in a nasal fracture.

The descending and greater palatines do not significantly affect the nasal septum. The sphenopalatine vessels supply the posterior septum.

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35

The 67-year-old man shown in the photograph on the previous page has ptosis of the right upper eyelid. Eyelid excursion is 8 mm. Which of the following is the most appropriate management?

(A) Frontalis suspension
(B) Kuhnt-Szymanowski procedure
(C) Levator advancement
(D) Müllerectomy
(E) T-shaped excision of lid margin

The correct response is Option C.

This patient most likely has degeneration of the levator aponeurosis, the most common form of acquired ptosis. Acquired ptosis can be neurogenic, myogenic, or mechanical. Neurogenic acquired ptosis can be caused by disease, injury of the oculomotor (III) nerve, or loss of sympathetic innervation of Müller*s muscle as in Horner*s syndrome. Myogenic acquired ptosis includes problems with the levator muscle or tendon, such as aponeurotic degeneration or disruption; myasthenia gravis involving the levator also causes myogenic acquired ptosis. Mechanical acquired ptosis is caused by the weight of upper eyelid masses or traction by scars.

The patient shown does not have a mass (such as a xanthoma), enophthalmos, or the miosis characteristic of Horner*s syndrome. Myasthenia gravis is usually a disease of young women, although it can strike either sex at any age. It can cause either unilateral or bilateral ptosis, which is the most common clinical presentation of this disease. Thus, all patients with acquired ptosis who have normal pupils should have an edrophonium (Tensilon) test. Traumatic ptosis, a fourth category of acquired ptosis, includes any of the three types discussed when they are caused by injury.

Selection of the appropriate operation for upper eyelid ptosis depends on the degree of ptosis and the amount of levator function. Ptosis is mild at 1 to 2 mm below normal, moderate at 3 mm below normal, and severe at 4 or more mm below normal. Normal levator function is 12 to 15 mm, good function is 8 to 12 mm, fair function is 5 to 7 mm, and poor function is 2 to 4 mm.

This man has moderate ptosis and good levator function. For this type of patient, some form of levator shortening is usually used. The patient is ideally awake and responsive during surgery. An advance of 1 to 2 mm above normal is usually required.

Frontalis suspension is used for severe ptosis with absent levator function.

The Kuhnt-Szymanowski procedure is a wedge excision of the lower eyelid used to correct ectropion.

The Fasanella-Servat procedure (or Müllerectomy) may be used for mild ptosis if instillation of 2.5% phenylephrine (Neo-Synephrine) corrects the eyelid position to normal. This technique consists of transconjunctival resection of a portion of the tarsus, conjunctiva, and Müller*s muscle.

Excision of the margin of the upper eyelid with a wedge or T pattern will not correct ptosis and is more appropriately used for excision of tumors.

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36

Two years after undergoing rhinoplasty, a 27-year-old woman has a convexity deformity of the dorsal aspect of the supratip. Palpation of the supratip area does not allow compression. Which of the following is the most likely cause of this deformity?

(A) Collapse of the middle vault
(B) Inadequate resection of the lower lateral cartilages
(C) Inadequate thinning of the fibrofatty tissue
(D) Overresection of the dorsal aspect of the nose
(E) Underresection of the dorsal aspect of the septum

The correct response is Option E.

Following rhinoplasty, a supratip (parrot beak) deformity can result from inadequate lowering of the supratip septum or overresection of the nasal dorsum. The cause of this deformity can be determined by palpating the supratip area. If the supratip area does not permit compression, as is the case with this patient, then the deformity is the result of underresection of the dorsal septum. If compression occurs to an acceptable contour, the deformity is caused by an excess of skin resulting from overresection.

One series showed that 90% of supratip deformities were caused by overresection of the nasal dorsum. Correction of this deformity can be achieved by some form of dorsal augmentation.

Middle vault collapse is a possible consequence of dorsal resection. The T-shaped junction of the septum and upper lateral cartilage is excised, which can result in an inverted V deformity where the nasal bones are wider and visible in relation to the collapsed lower lateral cartilages. Internal nasal valve narrowing can also result and cause breathing difficulties. Although middle vault collapse can occur in a patient who has a polybeak deformity resulting from overresection of the dorsum, underresection has been demonstrated in the patient described by palpation.

Lack of tip projection is a component of the supratip deformity, often resulting from overresection of the lower lateral cartilages.

Thinning of the fibrofatty tissue causes thin skin in the supratip area. In cases of inadequate cartilaginous resection, this technique will not correct a convexity deformity.

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37

One month after undergoing an uncomplicated subcutaneous rhytidectomy, a 50-year-old man has an asymmetric smile. Examination shows unilateral palsy of the mandibular branch of the facial nerve. Which of the following is the most appropriate next step in management?

(A) Further observation
(B) Immediate exploration and repair of any injured nerves
(C) Anastomosis of the hypoglossal (XII) and facial (VII) nerves
(D) Cross-facial nerve graft
(E) Reanimation of the affected side of the face with a local muscle flap

The correct response is Option A.

Injury to the mandibular branch of the facial (VII) nerve is an unfortunate but rare complication of rhytidectomy, occurring most commonly when a deeper than subcutaneous plane of dissection is used. The injury causes asymmetry of the lower lip that is apparent with animation, such as a full smile, because of a weakness of the ipsilateral lip depressors. If nerve transection is noted intraoperatively, immediate repair of the two cut ends is indicated. When the injury is not noted until postoperatively, management is more problematic.

Because the vast majority of mandibular nerve palsies do not involve transection of the nerve and eventually resolve spontaneously, conservative management is most appropriate. When to intervene more actively in such cases is difficult to determine and requires a conclusive diagnosis of complete nerve injury. In this patient, no definite diagnosis of complete denervation secondary to nerve transection has been established, so the only acceptable step is further observation or more invasive electrodiagnostic testing in pursuit of a diagnosis.

Immediate exploration and repair of any injured nerves might result in better function postoperatively but at this stage is too aggressive an approach. Anastomosis of the hypoglossal (XII) and facial nerves, cross-facial nerve grafting, and reanimation of the affected side of the face with a local muscle flap are all likely to result in abnormal facial animation, even if successful, and should not be performed at this stage, even with a definite diagnosis.

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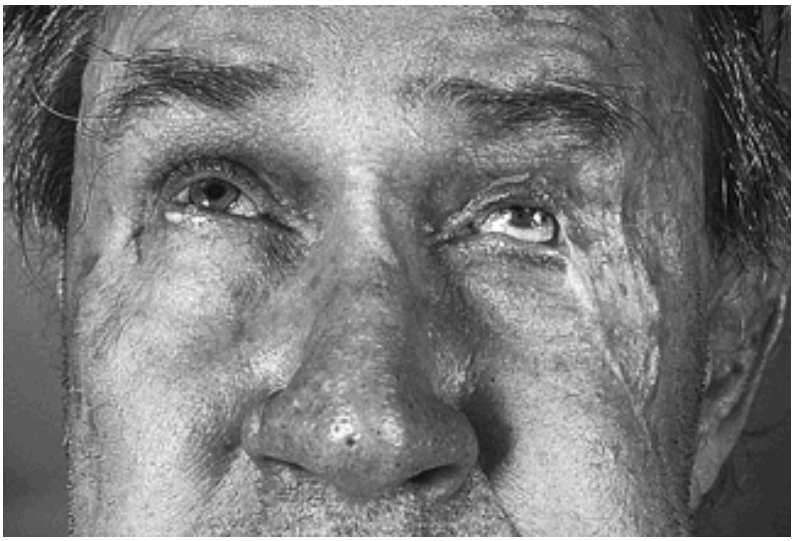
38



A patient has a retracted eyelid deformity after sustaining complex facial injuries in an automobile accident. A photograph is shown above. Which of the following procedures is most appropriate for the correction of the eyelid deformity?

(A) Full-thickness skin grafting
(B) Kuhnt-Szymanowski procedure
(C) Lateral tarsal strip advancement
(D) Scar release with rigid eyelid support
(E) Smith's lazy-T procedure

The correct response is Option D.

This patient has a retracted eyelid deformity resulting from complex facial trauma. It is characterized by retraction of the inner and outer lamellae and constriction of the supporting eyelid structures. This deformity must be differentiated from involutional ectropion or cicatricial ectropion. Involutional (senile) ectropion results from progressive laxity of the supporting structures of the eyelid, principally the medial and lateral canthi and the tarsus. Cicatricial ectropion may be caused by a partial-thickness eyelid burn or by overaggressive skin resectioning during blepharoplasty. Once the diagnosis of a retracted eyelid deformity has been established, the inner and outer lamellae and the middle supporting tissue need to be fully released from the scar formation and supported with a rigid graft (e.g., a nasal septal cartilage) to withstand subsequent deforming forces.

In a patient with a skin deficit alone, a full-thickness skin graft may be appropriate treatment. The Kuhnt-Szymanowski and the Smith's lazy-T procedures address the lateral and medial aspects of involutional ectropion but will not correct full-thickness lid retraction that is secondary to trauma. Finally, a lateral tarsal strip advancement may help reposition the eyelid but should only be used after scar release and internal support have been established.

Another method used by some physicians to treat full-thickness retraction of the lower eyelid involves releasing the scar, grafting anterior and posterior soft tissues, and placing an orbicularis flap between the grafts without rigid support.

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39

A 55-year-old man with male pattern alopecia undergoes placement of round punch grafts at the crown. The minimum amount of time that should elapse before a second grafting is performed is

(A) three weeks
(B) two months
(C) four months
(D) eight months
(E) one year

The correct response is Option C.

The hair follicles in all scalp grafts behave similarly in the postgraft period. There is an initial false growth of hair for up to four weeks after grafting. This hair is then shed during the telogen phase, which lasts two to three months after surgery. In addition, it has been reported that the blood supply of the recipient site shows optimal recovery three months following hair transplantation with punch grafts. Consequently, at least four months should elapse before attempting to place a second set of grafts. A more precise judgment can be made about when a second grafting should occur, depending on the adequacy of hair growth at four months after surgery.

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40

Which of the following local anesthetics produces vasoconstriction and increases blood pressure?

(A) Bupivacaine
(B) Cocaine
(C) Lidocaine
(D) Mepivacaine
(E) Tetracaine

The correct response is Option B.

Cocaine is the only local anesthetic that consistently produces vasoconstriction with an increase in blood pressure.

Bupivacaine, lidocaine, and mepivacaine can cause a positive inotropic effect prior to cardiovascular collapse when administered in increasing doses. However, these agents by themselves cause no vasoconstriction.

Tetracaine causes vasoconstriction but does not increase blood pressure.

Epinephrine is commonly mixed with a number of amide and ester local anesthetics and causes vasoconstriction and an increase in blood pressure. However, epinephrine by itself is not an anesthetic.

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41

Prominence of the nasolabial folds in elderly persons results primarily from loss of support in which of the following ligaments?

(A) Mandibular
(B) Masseteric
(C) Parotid-cutaneous
(D) Supraorbital
(E) Zygomatic

The correct response is Option E.

The zygomatic ligaments suspend the soft tissue in the malar region over the zygomatic eminence. In elderly persons, ptosis of the malar soft tissue caused by loss of support from the zygomatic ligaments occurs adjacent to the nasolabial fold, resulting in prominence of this fold. Rhytidectomy procedures may improve the appearance of the nasolabial fold by lifting the malar pad and reattaching it over the zygomatic eminence.

The mandibular ligaments arise from the periosteum through the facial soft tissue and insert into the dermis. They provide support to the facial soft tissue over the mandible.

The masseteric and parotid-cutaneous ligaments are formed between the superficial and deep facial fascia. They provide support to the soft tissue over the masseter muscle and parotid glands. Loss of support from the masseteric ligaments will result in prominent facial jowling.

The supraorbital ligament provides no support to the nasolabial fold.

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42

A 36-year-old man is brought to the emergency department after sustaining an injury to the ear in a motor vehicle accident. Examination shows missing perichondrium and denuded and exposed cartilage. Each of the following treatment options is appropriate EXCEPT

(A) coverage with a local flap
(B) coverage with a skin graft
(C) excision of the cartilage followed by skin grafting
(D) open treatment of the cartilage followed by delayed reconstruction
(E) wedge resection and primary closure

The correct response is Option B.

In this patient with an acutely traumatized ear with loss of both skin and perichondrium and exposed, denuded cartilage, a skin graft would not be successful if placed directly on the cartilage. A skin graft requires greater vascularity than denuded cartilage can supply.

Local flaps from either ear or the posterior auricular area can be used to reconstruct these defects. This type of flap is often used in resection of an area following the removal of cancerous tissue.

Another option is to excise the denuded cartilage, leaving the posterior skin; a skin graft could be placed directly on this area. The posterior skin and posterior perichondrium would be able to support a skin graft. This method is helpful when repairing central portions of the ear or conchal bowl but could lead to a weak area and abnormal contour along the helical rim and scapha.

The injury could also be managed by treating the cartilage openly, and the area could then be reconstructed using local flaps after debridement.

Wedge resection, consisting of trimming the edges, and closure using either an Antia-Buch or star resection, can also be performed in this case.

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43

A 30-year-old woman is undergoing septorhinoplasty to correct a 2-mm dorsal hump deformity, narrow nasal bones and midvault, and a nasal airway obstruction with septal deviation. Each of the following is appropriate as surgical management EXCEPT

(A) dorsal spreader grafts
(B) lateral osteotomies with cephalic greenstick and infraction
(C) rasping of the dorsal hump
(D) submucous resection of the septum
(E) turbinate resection

The correct response is Option B.

The external or open approach to rhinoplasty affords excellent exposure for more accurate evaluation and surgical treatment of nasal deformities. A small (less than 3 mm) dorsal hump can be rasped without creating an open roof, obviating the need for osteotomies and infractioning. Infractioning, in fact, is not warranted for patients with narrowed nasal bones and nasal airway obstruction.

The accurate placement and suturing of dorsal spreader grafts is made easier by an open approach to the dorsal septum. In the case of a narrow midvault, spreader grafts help correct the "inverted V-deformity." These grafts can either be positioned so as to widen the dorsum or be placed slightly lower in the extramucosal tunnel to avoid changing dorsal width. They can also open a narrowed internal nasal valve, alleviating nasal obstruction of less than 15 degrees, and can act as battens for a deviated septal L-strut.

Submucous resection is an excellent method of correcting a deviated septum, especially one that contributes to nasal obstruction or a deviated dorsum. Otherwise, only the amount of septum necessary for dorsal spreader grafts is harvested.

The most common cause of nasal obstruction is enlarged inferior turbinates, which are best treated by anteroinferior turbinate resection.

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44

A 55-year-old woman undergoes a browlift procedure involving en bloc resection of the medial two thirds of the corrugator muscles. Which of the following nerves is most likely affected?

(A) Lacrimal
(B) Nasociliary
(C) Supraorbital
(D) Supratrochlear

The correct response is Option D.

En bloc resection of the medial two thirds of the corrugator muscles is most likely to result in a loss of sensation in the area of the supratrochlear nerve. The corrugator muscles arise from the bony arch of the supercilii and travel upward and laterally to the deep surface of the skin above the supraorbital margin. They draw the eyebrows medially and inferiorly, producing the vertical wrinkles of the forehead and a frowning appearance. These muscles are divided medially by the supratrochlear nerve. Complete resection of the medial two thirds of the corrugator muscles would result in transection of the supratrochlear nerve and loss of sensation of the lower medial forehead.

Resection of the procerus muscle causes obliteration of the transverse wrinkles of the lower forehead and root of the nose. A patient with a resected procerus muscle would also be unable to depress the medial brow.

Inability to elevate the brow would result from resection of the frontalis muscle.

The supraorbital nerve is located in the lateral aspect of the corrugator muscles; therefore, resection of the medial two thirds of the corrugator muscles would not affect the supraorbital nerve.

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45

A 32-year-old woman is scheduled to undergo suction-assisted lipectomy using tumescent anesthesia with lidocaine. In this patient, the peak plasma concentration of lidocaine is most dependent on the

(A) total mg/kg dose
(B) patient's renal function and rate of excretion of the drug
(C) rate of systemic absorption of the drug
(D) ratio of the total volume of the suction aspirate to the amount of infused solution

The correct response is Option C.

Previous studies have shown a peak plasma concentration occurring 60 to 90 minutes after the use of lidocaine as a subcutaneous infiltration, intramuscular injection, or nerve block. Plasma lidocaine monitoring in patients undergoing suction-assisted lipectomy using an anesthetic solution containing lidocaine at a low concentration has shown a lower peak plasma concentration occurring many hours after the procedure.

In this 32-year-old woman, the peak plasma concentration of lidocaine depends primarily on the rate at which the drug is systemically absorbed. Factors that determine the rate of systemic absorption include drug concentration (very dilute in tumescent infiltrate), the vascularity and the type of tissue at the site of injection (fatty tissue with low vascularity), the operative use of vasoconstrictive agents such as epinephrine in the infiltrate, and the rate of infiltration.

Regarding the total dose of drug to administer, the widely accepted limit of 7 mg/kg is appropriate when lidocaine (with epinephrine) is infiltrated rapidly at a concentration of 1% to 2% into highly vascular tissue or mucosa. However, if smaller amounts of the same preparation are inadvertently injected intravascularly, they frequently produce immediate adverse systemic effects. Although an intravenous dose of plain lidocaine 20 mg/kg usually produces cardiovascular collapse and convulsion or coma, total doses of 35 mg/kg, in a much lower concentration and infiltrated over a greater period of time, have been used in anesthetic solutions for suction-assisted lipectomy. There have been no reports of adverse sequelae in a significant number of patients.

The half-life of lidocaine in the plasma or circulation is fairly brief. The primary mode of metabolism or elimination of lidocaine is via hepatic, rather than renal, excretion, so the patient's renal function is irrelevant to the peak plasma concentration.

Because the plasma concentration of the drug does not correlate with the volume of infused solution, the number of areas treated, or the amount of suction aspirate recovered, the possibility that the suction lipectomy itself would remove a significant amount of the injected lidocaine is unlikely.

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46

Long-term changes observed during microscopic analysis of the dermis following a chemical peel include decreased

(A) dermal thickness
(B) elastic tissue
(C) fibroblast density
(D) nonlamellar collagen

The correct response is Option D.

Microscopic analysis of skin immediately following chemical peel shows inflammation characterized by keratocoagulation, epidermolysis, and a zone of cellular destruction located in the upper dermis. A crust forms that consists of keratin and necrotic epidermis. The epidermis regenerates two days later, and the dermis thickens as the inflammation resolves.

Biopsy of the skin will aid in determining long-term changes following a chemical peel. Histologic analysis of peeled skin will show significant reorganization of collagen in the dermis. On examination, the collagen pattern parallel to the skin surface will be a straight lamellar pattern, compared with the more wavy, nonlamellar formation seen prior to peeling. The density of fibroblasts will also be increased. These changes are thought to correlate with long-term eradication of fine rhytids. Such changes are not seen following dermabrasion, which does not effectively relieve fine facial wrinkling.

Evaluation of the skin following a chemical peel will also show an increase in elastic tissue and a decrease in melanin-producing cells.

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47

A 50-year-old woman has a visible depression of the central forehead six months after undergoing open transcoronal browlifting. Which of the following is the most likely cause?

(A) Denervation of the frontalis muscle
(B) Excessive resection of the frontalis muscle
(C) Residual swelling of the surrounding tissues
(D) Subcutaneous atrophy

The correct response is Option B.

This 50-year-old woman most likely has a depression of the forehead following open transcoronal browlifting because of excessive resection of the frontalis muscle. In a patient undergoing open browlifting, the frontalis muscle can be resected between the two supraorbital nerves, extending as high as the anterior hairline. A visible depression will develop if the frontalis muscle is not dissected carefully and the full thickness of the subcutaneous fat is not preserved. Some surgeons prefer to incise the muscle in a gridlike pattern, resulting in defunctionalized brow elevation with maintenance of muscle bulk. Subcutaneous atrophy rarely occurs with this procedure.

Denervation of the frontalis muscle results from transection of or injury to the temporal branch of the facial nerve. The nerve emerges from beneath the parotid gland 0.5 cm below the tragus of the ear and extends on a line to 1.5 cm above the lateral portion of the brow, passing deep to the SMAS over the zygomatic arch and entering the frontalis muscle on its deep surface. The point at which the temporal branch enters the undersurface of the muscle is also the point at which the circumferential orbicularis oculi muscle intersects the lateral aspect of the frontalis (approximately 1.5 cm above the lateral aspect of the eyebrow). Injury to this branch results in unilateral brow ptosis and is associated with a complete return of function in less than 10% of patients, even with identification and repair of the cut ends of the nerve.

Postoperative swelling may be evident six weeks after surgery but should be resolved by six months and would not be the cause of this patient's findings.

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48

A 64-year-old man has a 2-cm heminasal defect that affects the skin, cartilage, and nasal mucosa. Which of the following flaps is best used to reconstruct the nasal lining?

(A) Dorsal nasal flap
(B) Septal mucosa pivot flap
(C) Turn-over flap
(D) Washio temporal flap

The correct response is Option B.

This 64-year-old man who has a 2-cm heminasal defect should undergo reconstruction of the nasal lining using a septal mucosa pivot flap. Because reconstruction of the nasal lining is critical to prevent contraction and distortion of the nasal architecture, a thin, vascular flap must be chosen to allow cartilage grafts to be inserted. In addition to providing these features, the septal mucosa flap can be used for nasal lining and permits immediate reconstruction of the framework using a cartilage graft. It can be used as either a mucoperichondrial or mucocartilaginous flap. Its vascular basis is the septal branch of the superior labial artery, which is preserved in a 1-cm anterior pedicle.

The dorsal nasal flap is a surface flap and cannot be used for reconstruction of the nasal lining. With this flap, the skin of the nasal dorsum is rotated and advanced to cover the defect.

A turn-over flap lifts the undamaged adjacent skin to cover a healed defect. This small flap has limited vascularity and can only be used for defects less than 1 cm.

Although the Washio temporal flap can be used to adequately reconstruct the nasal lining by folding the flap onto itself, its bulkiness can distort the nasal contour and obstruct the airway. Use of a prefabricated Washio flap would involve multiple procedures, and placement over the cartilage graft is often difficult. This flap can be combined with a skin graft on its underside to provide adequate, but not ideal, nasal lining for reconstruction. Other acceptable options include a forehead flap or prefabricated scalp flap.

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49

In order to obtain useful and accurate pre- and postoperative photographs for body contouring procedures, which of the following is the most appropriate focal length of the camera lens?

(A) 35 mm
(B) 55 mm
(C) 105 mm
(D) 135 mm

The correct response is Option B.

The focal length of the camera lens determines the viewing angle and the width and height of a subject at a given distance that can be exposed on the film plane. Longer focal length lenses flatten the perspective, thus avoiding distortion, but require the camera to be positioned farther away from large subjects than would be the case with shorter focal length lenses.

A lens with a focal length of 50 to 55 mm is the appropriate photographic choice for pre- and postoperative body contouring procedures, since pictures of nearly the full torso should be taken at a distance of five to six feet with minimal distortion. A 50- to 55-mm lens is the normal lens for a 35-mm camera; this focal length is roughly the same as the diagonal measurement of each film frame.

Wide-angle lenses (e.g., 35 mm) allow for the shooting of a large subject at close range, but the curvature of these lenses produces distortion of the image, making them less useful in clinical photography. The “macro” lens feature does allow better focus at close distances, so that very small images (e.g., a skin lesion) can be reproduced clearly.

Standardized photographs of the head and neck area or facial features are customarily taken at shorter distances (i.e., three feet or less). For these photographs, a "portrait" focal length lens of 90 to 105 mm is preferred for the best combination of clarity, shooting distance from the subject, and lack of distortion. However, lenses of this size have only approximately one-half the viewing angle of a 50- to 55-mm lens and therefore can accommodate only one-half the subject size. A photographer would have to be far enough from the subject to get the undistorted views necessary for body contouring surgery.

Use of a telephoto (135-mm or larger) lens requires that a photographer be even farther from the subject. Midrange zoom lenses can be used, but the zoom feature makes it difficult to maintain consistency among the shots, especially between pre- and postoperative photographs, particularly when they are taken by different photographers.

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50

In the pocket principle of ear salvage, the reattached segment is nourished by

(A) deep muscular perforators
(B) postauricular flap
(C) preauricular circulation
(D) temporoparietal fascia
(E) vascular reanastomosis

The correct response is Option B.

A patient who sustains an acute traumatic amputation of the ear and who is not eligible for microvascular replantation may undergo reattachment using the pocket principle. With this technique, the amputated ear is inserted into a "pocket" created by a raised postauricular flap. This flap completely covers the reattached ear and provides nourishment and vascular ingrowth for the 21 days that it remains within the pocket.

To successfully perform the pocket technique, the postauricular skin and amputated ear must both be in good condition; if either is extensively damaged, the take will not be adequate. The epithelium of the amputated ear is removed via dermabrasion, and the amputated part is attached to the remaining ear stump. The postauricular flap is raised using a retroauricular incision, advanced over the reattached ear, and sutured to the stump. Following revascularization, the flap is removed, leaving the external ear uncovered. Spontaneous re-epithelialization occurs.

Some patients who undergo pocket reconstruction of the ear may develop flattening of the cartilage convolutions with healing. Because of this possibility, the procedure can be modified to vary the amount of skin removed from the amputated ear. Adding perforations will increase vascular ingrowth and allow for better take.

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51

In a patient with ectopic polymastia, which of the following sites is most likely to be affected?

(A) Axilla
(B) Costal margin
(C) Dorsal thigh
(D) Pubis
(E) Vulva

The correct response is Option C.

Polymastic breast tissue can be categorized as either accessory or ectopic. Ectopic breast tissue is found in areas outside the milk line at such sites as the scalp, ear, back, shoulder, epigastrium, and posterior or dorsal thigh. Accessory polymastia occurs along the milk line. Greater than 90% of accessory breast tissue is localized to the chest region. The axilla, groin, vulva, and medial thigh may also be affected, as well as regions above or below the normal breast, such as the costal margin.

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52

Which of the following is the most common complication following ultrasound-assisted lipoplasty?

(A) Contour irregularity
(B) Hematoma
(C) Infection
(D) Seroma
(E) Skin necrosis secondary to thermal injury

The correct response is Option D.

A recent clinical study of 250 consecutive patients undergoing ultrasound-assisted lipoplasty was performed to determine specific complications following the procedure. The patients were observed for at least six months postoperatively; documentation included photographs and monitoring of all significant complications. The most common complication directly related to the procedure was the formation of a seroma. A significant seroma was defined as a fluid collection at the operative site of greater than 50 mL and/or requiring repeated aspiration for control. This complication was observed in more than 11% of the total number of patients and appeared to be most common following large-volume ultrasound-assisted lipoplasty of the abdomen.

Abdominal skin necrosis was observed in only three patients (1.2%). This complication was the focus of particular interest because ultrasound-assisted lipoplasty (in contrast to suction lipectomy) releases thermal energy, and will raise the temperature in the vicinity of the ultrasound probe if it is not kept in constant motion. Similarly, there were only three patients with wound infection or significant "cellulitis," each of whom responded to antibiotics without long-term sequelae. Hematoma was observed in only one patient; the lack of blood or hematocrit in the aspirate from the ultrasound-assisted lipoplasty was noteworthy. Contour irregularity, which is widely recognized as the most common negative result associated with suction-assisted lipectomy, was not observed to be a significant problem six months after surgery.

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53

Compared with the temporoparieto-occipital (Juri) flap, which of the following is the primary advantage of using expanded bilateral advancement transposition (BAT) flaps in the management of male pattern alopecia?

(A) Axial pattern flap
(B) Density of transposed hair
(C) Direction of hair growth
(D) Donor site scar
(E) Single stage procedure

The correct response is Option C.

The primary advantage of using expanded bilateral advancement transposition (BAT) flaps in the management of male pattern alopecia is the direction of hair growth seen following transfer. With this flap, hair grows more anteriorly, resulting in a less noticeable scar. One disadvantage of this procedure is that it requires two stages, including a step for placement of the tissue expanders.

In patients undergoing reconstruction of the hairline with the temporoparieto-occipital (Juri) flap, the transplanted hair grows posteriorly, exposing the anterior frontal scar. This axially patterned flap requires an initial delay and potentially a subsequent revision procedure.

There is no difference in the density of the hair or the donor site scar seen with either flap.

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54

A 31-year-old woman desires rhinoplasty. On examination, she has a wide nasal dorsum that lacks anterior height and a poorly projecting nasal tip. Which of the following surgical techniques is most appropriate to increase projection of the nasal tip?

(A) Division of the vertical dome
(B) Resection of the alar domes
(C) Resection of the lateral crura
(D) Rim strip grafting
(E) Use of transdomal sutures

The correct response is Option E.

In this 31-year-old woman who has a poorly projecting nasal tip, the use of transdomal (spanning) sutures will most effectively increase tip projection by medializing the defining points of the tip and increasing the distance from these points to the base of the columella. Structural integrity and support will be maintained.

Division of the vertical dome will decrease projection of the nasal tip. Resection of the alar domes leads to a decrease in tip projection because any destruction of the nasal domes decreases their ability to support the nasal tip. Resection of the lateral crura is used to correct an excessively prominent nasal tip. Rim strip (extra-anatomic) grafting provides support for the ala and prevents the onset of nasal collapse with forced inspiration. This technique has no effect on nasal tip projection.

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55

A 25-year-old woman requests removal of a 4.5-cm purple and violet professional tattoo on the right side of the face. Which of the following is the most effective method for removal?

(A) Dermabrasion
(B) Salabrasion
(C) Carbon dioxide laser
(D) Q-switched ruby laser
(E) Excision

The correct response is Option D.

This woman's tattoo should be removed with a Q-switched ruby laser, which works best in persons who have tattoos with purple and violet pigmentation. The laser process relies on selective photothermolysis to specifically separate the tattoo pigments without destroying the tissue or causing a scar. Several studies have shown 75% to 95% effectiveness following a course of three to 10 treatments with a Q-switched ruby laser.

Complications associated with the use of the Q-switched ruby laser include hypopigmentation and irreversible darkening of tattoos containing white, red, or skin-colored pigments. The darkening is thought to result from conversion of ferric oxide to ferrous oxide, which occurs during transmission of energy by the laser.

Laser therapy is most effective for removal of amateur tattoos. Professional tattoos can also be treated with a Q-switched laser to minimize the risk for scarring. The Q-switched alexandrite laser is most effective for blue and green pigments, while the Q-switched Nd:YAG laser is used for removal of brown and orange pigmented tattoos.

Dermabrasion is not often used for tattoo removal because it is associated with unpredictable scarring. Salabrasion involves rubbing salt crystals over unanesthetized skin using moistened gauze until the skin has a uniformly red appearance. Multiple treatments are required, typically every four to six weeks. Scarring is also a common complication.

Because the carbon dioxide laser affects the tissue rather than the pigment alone, scarring is likely. Excision is not possible in persons with large tattoos and often leaves an unsightly scar, especially in a patient with a tattoo on the face.

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56

A neonate has a cluster of yellowish orange plaques on the scalp and face. Which of the following is the most likely diagnosis?

(A) Eccrine poroma
(B) Nevus flammeus neonatorum
(C) Nevus of Ota
(D) Nevus sebaceus of Jadassohn
(E) Spitz nevus

The correct response is Option D.

This neonate most likely has a nevus sebaceus of Jadassohn. This lesion is a yellowish orange, slightly elevated plaque seen at or soon after birth. It is a benign, epidermal appendage tumor that occurs most frequently on the scalp and face. Surgical excision is recommended because 15% to 20% of these lesions develop into basal cell carcinoma.

An eccrine poroma is a painful papule that most commonly occurs on the soles or sides of the feet. These lesions, usually appearing first in middle-age, are firm papules less than 2 cm in diameter. Treatment includes surgical excision and histologic analysis to differentiate between eccrine poroma and basal cell carcinoma or other skin tumors.

A nevus flammeus neonatorum, or "salmon patch," is a fading macular patch that is present in 50% of neonates. Lesions in the facial region typically resolve; lesions of the nape of the neck and occiput are more likely to persist. They are benign lesions and are not prone to malignant transformation.

A nevus of Ota is a brownish blue lesion that usually occurs in the distribution of the first and second branches of the trigeminal nerve and predominantly involves the periorbital region. The cornea, nasal mucosa, and oral pharynx are rarely involved. Approximately 80% of these tumors occur in women. Approximately 5% of the lesions occur bilaterally. Treatment is only indicated for cosmetic reasons. Malignant transformation is rare.

A Spitz nevus, also referred to as juvenile melanoma, is a benign pink lesion with brown spots that is frequently first seen in children age 5 to 10 years.

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57

In a patient with prominent ears who is undergoing otoplasty, which of the following surgical techniques is most effective for creation of the antihelical fold?

(A) Abrading the cartilage of the posterior ear
(B) Excision of an ellipse of skin from the posterior ear
(C) Placement of permanent mattress sutures in the cartilage of the posterior ear
(D) Placement of permanent mattress sutures between the mastoid fascia and the cartilage of the posterior ear
(E) Removal of an ellipse of conchal cartilage from the posterior ear

The correct response is Option C.

In this patient who is undergoing otoplasty for correction of prominent ears, permanent mattress sutures should be placed in the cartilage of the posterior ear to create the antihelical fold. Tattoo marks are positioned precisely along the posterior ear cartilage to guide the surgeon. The sutures are then passed through the marked cartilage and tied, and an antihelical fold is created.

Another technique that would aid in creation of an antihelical fold is abrading the cartilage of the anterior ear. After this technique is performed, the cartilage will subsequently bend posteriorly, away from the abraded surface.

Abrading the cartilage of the posterior ear would bend the cartilage anteriorly and would hinder the creation of an antihelical fold. Although excising the skin from the posterior ear, placing sutures between the mastoid fascia and

conchal cartilage, and removing cartilage from the posterior ear may be required during otoplasty, none of these techniques will help to create an antihelical fold.

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58

A 70-year-old man with severe chronic obstructive pulmonary disease sustains a traumatic amputation of the left ear in an accident involving a chain saw. On examination, there are multiple lacerations of the preauricular and postauricular skin. The ear remnant is lacerated in four places.

Which of the following is the most appropriate method of ear reconstruction for this patient?

(A) Immediate microvascular replantation
(B) Immediate placement of tissue expanders
(C) Placement of the ear remnant cartilage in an abdominal pocket
(D) Delayed coverage using a temporoparietal flap followed by autologous rib reconstruction
(E) Delayed osseointegrated implantation

The correct response is Option E.

The most appropriate method of ear reconstruction in this 70-year-old patient is delayed osseointegrated implantation. This procedure is most effective in cancer patients who have inadequate local tissue, patients who are poor surgical risks, or for salvage following unsuccessful autologous reconstruction. It is a short outpatient procedure often performed during local anesthesia. The prosthesis provides an excellent color match and is symmetric with the opposite ear. One study of patients who underwent reconstruction using an osseointegrated alloplastic implant reported a success rate of approximately 98%. Daily care and placement of the implant are required; this may be a disadvantage for some patients.

Although immediate microvascular ear replantation can be successful, it is not possible when there are multiple lacerations of the ear remnant.

Immediate tissue expansion cannot be performed due to the extensive lacerations of the postauricular skin. This technique is typically used as a delay procedure, when the skin has healed and the risk for infection is lessened.

Placement of the amputated ear in an abdominal or subcutaneous arm pocket can be used for delay procedures, but warping of cartilage may result, making it inappropriate for permanent reconstruction.

Delayed reconstruction using an autologous rib graft and coverage with a postauricular or temporoparietal flap is typically the procedure of choice for ear amputations. However, surgical harvest of a rib graft from the chest would be inappropriate in a 70-year-old patient who has pulmonary disease and is a significant anesthetic risk. Autologous reconstruction is basically used for cosmetic purposes and has little functional benefit.

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59

A 65-year-old man has a scaly, erythematous lesion with poorly defined borders on the dorsal aspect of the left forearm. Which of the following is the most likely diagnosis?

(A) Actinic keratosis
(B) Cylindroma
(C) Keratoacanthoma
(D) Pyogenic granuloma
(E) Seborrheic keratosis

The correct response is Option A.

This 65-year-old man is most likely to have an actinic keratosis. Actinic keratoses are premalignant, keratotic papules that occur in middle-aged or elderly patients who have fair complexion and a long history of sun exposure. These lesions typically occur on sun-exposed areas such as the scalp, forehead, and dorsal aspect of the forearm and hand. According to some estimates, 20% of patients with actinic keratoses will eventually develop squamous cell carcinoma in one of the lesions. Appropriate treatment methods include cryotherapy, electrosurgery, curettage, shave excision, and chemical peeling. Patients should be observed carefully for signs of lesional transformation into squamous cell carcinoma.

A cylindroma (turban tumor) is a raised, rubbery, benign nodule that is usually located on the scalp. It is pink to blue and varies in size from a few millimeters to several centimeters. It is best treated with excision.

Keratoacanthomas are benign, self-healing tumors that occur more frequently in men older than age 60 years. Although their precise etiology is unknown, these tumors are believed to originate in hair follicles. They appear as nodules of squamous cells encircling a keratinous plug. Lesions grow rapidly for several weeks and then spontaneously resolve within six months of onset. Nevertheless, surgical excision and histopathologic analysis should be performed to rule out squamous cell carcinoma. Early excision of the lesion will limit scarring and prevent the development of an atrophic scar, which may appear following spontaneous regression.

A pyogenic granuloma is a raised red lesion that bleeds easily. It is derived from excess granulation tissue in a healing wound. Treatment includes cauterization of the lesion or excision.

A seborrheic keratosis is a superficial plaque of amber to brown color. It also occurs in elderly, fair-skinned persons and is best treated with shaving or excision.

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60

The tunable-dye laser functioning at a wavelength of 585 nm is absorbed by which of the following chromophores?

(A) Beta-carotene
(B) Melanin
(C) Oxyhemoglobin
(D) Protein
(E) Water

The correct response is Option C.

The absorption spectrum of tissue is determined by the chromophores (substances in organic tissue capable of absorbing light) present in the tissue. The absorbing chromophore for the tunable-dye laser functioning at a wavelength of 585 nm is oxyhemoglobin, which has a compatible absorption spectrum. This laser is effective for treating port-wine stains and telangiectasias.

The absorbing chromophore for the carbon dioxide laser is water, which absorbs carbon dioxide at a high rate. Because it causes minimal damage to adjacent tissues, the carbon dioxide laser is effective for ablation (skin resurfacing), cutting, and coagulation.

The Q-switched ruby laser has a wavelength of 694 nm, which is best absorbed by melanin and the carbon in tattoo pigments. Consequently, pigmented lesions and professional and amateur tattoos applied with black ink can be treated with this laser.

Although beta-carotene and protein can also function as chromophores, the absorption spectrum of these substances is not similar to the wavelengths of the lasers used for surgery.

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61

A 34-year-old man has Hamilton's Class 4 male pattern alopecia. This condition is most likely associated with an increase in which of the following laboratory values?

(A) Follicular 5alpha-reductase activity
(B) Hepatic alkaline phosphatase activity
(C) Lipocyte estrogen level
(D) Plasma testosterone level
(E) Testicular androgen level

The correct response is Option A.

Hamilton's system has been used to classify male pattern alopecia based on the appearance of the anterior hairline and the hair loss at the vertex. There are seven major classifications; each is used to draw conclusions regarding the potential for further hair loss.

Male pattern alopecia is triggered by a single, dominant, sex-linked autosomal gene. A genetically determined increased level of 5alpha-reductase activity has been noted in the susceptible follicles.

In patients with male pattern alopecia, plasma testosterone and estrogen levels are normal, as are liver and adrenal function.

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62

The absence of a demonstratable blood level of trichloroacetic acid (TCA) in a patient undergoing chemical peeling is best explained by the neutralization of TCA at which of the following sites?

(A) Epidermis
(B) Dermis
(C) Subcutaneous tissue
(D) Kidney
(E) Liver

The correct response is Option B.

In this patient who is undergoing chemical peeling, the absence of a demonstratable level of trichloroacetic acid (TCA) in blood occurs because TCA is neutralized by blood within the superficial dermal plexus after being absorbed from the skin surface. Chemical peeling with TCA is also associated with an absence of both systemic toxicity and adverse effects on the cardiovascular system; these patients do not require monitoring using electrocardiogram during the procedure.

Phenol peels are absorbed into the systemic circulation to some extent. As a result, the blood level of phenol should be monitored with spectrophotometry. Because cardiac irregularities are associated with the use of phenol, rapid peeling of extensive anatomic areas is not recommended. When the phenol peel is performed safely, any substance that is absorbed is then detoxified to hydroquinones and pyrocatechin and excreted by the kidneys.

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63

The photograph shown above is of a 6-year-old boy who has congenital microtia of the right ear. Which of the following anatomic structures is most likely to be present?

(A) Auditory ossicles
(B) Cochlea
(C) External auditory canal
(D) Middle ear cavity
(E) Tympanic membrane

The correct response is Option B.

Patients with congenital microtia have partial or complete absence of the external ear structures due to abnormal embryologic development of portions of the first and second branchial arches and pharyngeal pouches. This abnormality typically occurs during the fourth to twelfth week of intrauterine development and affects the auditory ossicles, external auditory canal, middle ear cavity, and tympanic membrane. Only a rudimentary external ear is present in some patients.

The cochlea is part of the inner ear, which is formed from an area of ectoderm above the pharyngeal pouches called the otic placode. In this patient, development of the inner ear has not been affected. Because children with microtia usually have normal structures within the inner ear, bone conduction hearing aids can be used bilaterally to help overcome auditory and speech difficulties. However, hearing aids are rarely used in patients with unilateral microtia; instead, maintenance of hearing in the unaffected ear is emphasized.

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64

During permanent cosmetic tattooing of lip liner in a 30-year-old woman, the dye is inadvertently misapplied. Multiple treatments using a Q-switched ruby laser result in black discoloration of the lips. The most likely cause is the presence of which of the following substances within the dye?

(A) Chromium
(B) Cobalt
(C) Iron
(D) Mercury
(E) Titanium

The correct response is Option C.

The dye misapplied to this 30-year-old woman is most likely to be composed in part of iron. Many cosmetic dyes are made with iron pigments. Iron has two oxidative states: ferrous oxide (FeO), which is black, and ferric oxide (Fe_2O_3), which is red-brown. On exposure to laser light, ferric oxide can undergo reduction to ferrous oxide, which turns instantly black. Prior to treating cosmetic tattoos, as well as professional tattoos, a test spot should be obtained and treated first.

Titanium oxides, which are also contained in some cosmetic dyes but are less common than iron, can be reduced from Ti_4O_2, which is white, to Ti_2O, which is black. Studies show that on reduction, the black pigment is often unremovable.

Mercury, cobalt, and chromium are contained in many tattoo pigments. However, none of these substances are likely to turn black with laser treatment. Hypersensitivity reactions to tattoo pigment containing these elements can occur during tattooing and laser removal. For example, mercury is a common component of red-based tattoo inks and, on dissemination, the pigments can induce a severe allergic reaction, which is exacerbated with each successive treatment.

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65

A 45-year-old woman desires cosmetic facial surgery. On examination, she has fullness of the cheekbones with a hollow area beneath the bones. Augmentation of the submalar region is to be performed via incisions into the upper buccal sulci. During this procedure, the implants should be placed on which muscle?

(A) Buccinator
(B) Levator anguli oris
(C) Masseter
(D) Orbicularis oculi
(E) Zygomaticus major

The correct response is Option C.

In this 45-year-old woman who is undergoing cosmetic facial surgery, the submalar implants should be placed on the masseter muscle. When the implants are placed in this region, they act as anatomic extensions of the malar bone, correcting the soft-tissue deficiencies that occur in the inframalar and midface regions with aging. The result is an increase in contour inferior and medial to the malar region.

The buccinator muscle is located medial and anterior to the masseter muscle; a submalar implant would be best placed superior and lateral to this muscle. Skeletal implants are typically placed deep to the levator anguli oris, orbicularis oculi, and zygomaticus major muscles because they are muscles of facial expression.

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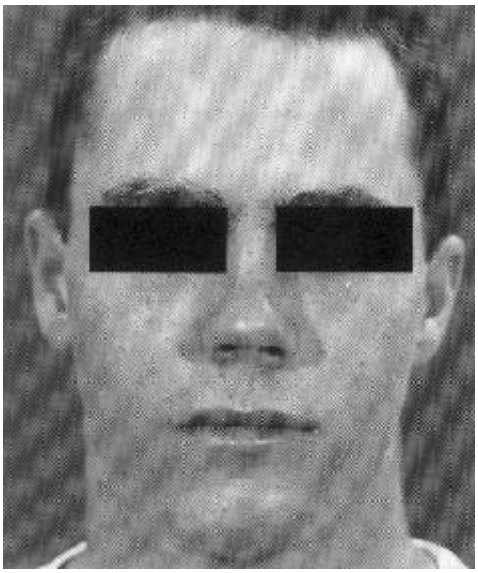
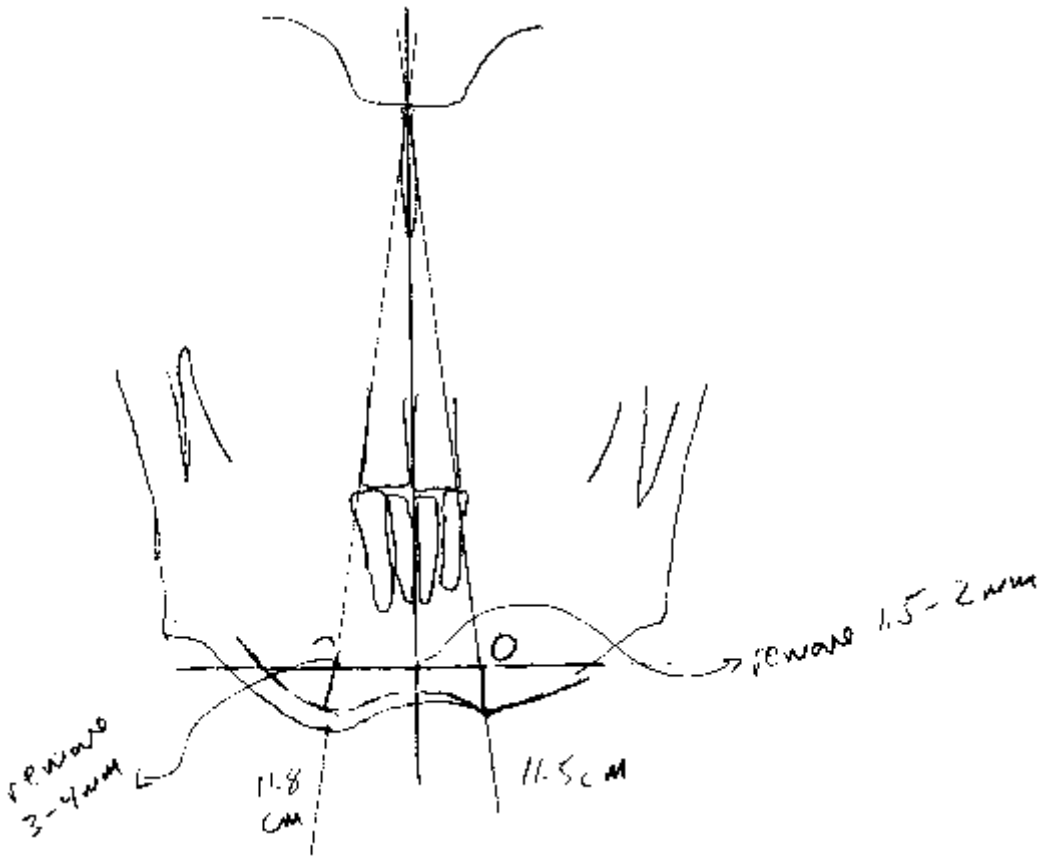
66



The above photograph is of a 19-year-old man with chin asymmetry. Occlusion is normal; there are no intraoral masses. Radiographs of the mandible show no osteolytic or hyperostotic lesions. Which of the following is the most appropriate next step in management?

(A) Cephalometric radiographs
(B) Dental radiographs
(C) Panoramic radiographs
(D) CT scan
(E) MRI



The correct response is Option A.

This 19-year-old man has benign chin asymmetry confirmed by clinical examination and radiographs of the mandible. The most appropriate next step in management is obtaining cephalometric radiographs, which are essential in planning surgery. In this patient, horizontal genioplasty should be performed, followed by removal of a wedge of bone from the right mandible, which will raise the right side and level the chin. In order to determine the amount of bone to be removed, tracings such as those shown above can be made from the cephalometric radiographs and skeletal relationships can be measured. These measurements can be transferred directly to the facial skeleton during surgery.

Periapical dental or panoramic radiographs would not be helpful in planning surgery. CT scan and MRI are expensive, unnecessary diagnostic procedures.

Postoperative results in this patient are shown in the photograph on the following page.

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67

A 25-year-old man is undergoing initial evaluation for primary aesthetic rhinoplasty. Which of the following patient concerns indicates the need for additional screening before proceeding with surgery?

(A) Improvement of breathing
(B) Refinement of the nasal tip
(C) Removal of a large hump
(D) Smoothing of a saddle-nose deformity
(E) Straightening of a crooked nose

The correct response is Option B.

A male patient who seeks plastic surgery solely for aesthetic improvements, such as refinement of the nasal tip, should undergo additional careful screening prior to surgery. Most men request rhinoplasty for correction of a nasal deformity or airway obstruction; consequently, the surgeon should be cautious with those who have aesthetic concerns only. Studies have shown that approximately 15% of these men have narcissicism and other psychological problems. These men may have identity crises and unreasonable expectations following surgery, including the belief that their social and economic condition is directly related to the appearance of their nose and will improve following surgery. In addition, the majority of physical assaults and murders of plastic surgeons by patients are committed by men who have undergone rhinoplasty.

Such men who request aesthetic rhinoplasty for refinement of the nasal tip only can often be categorized by the acronym SIMON (single, immature, male, overexpectant, and narcissistic). If the surgeon has concerns about the patient's psychological health, surgery should not be performed.

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68

When exposing the zygomatic arch through a coronal incision, which of the following layers should be incised at the level of the lateral orbital rim to assure protection of the frontal branch of the facial nerve?

(A) Superficial temporal fascia
(B) Superficial layer of the deep temporal fascia
(C) Deep layer of the deep temporal fascia
(D) Conjoined temporal fascia
(E) Galea aponeurotica

The correct response is Option B.

When exposing the zygomatic arch through a coronal incision, the frontal branch of the facial nerve can be protected by incising the superficial layer of the deep temporal fascia at the level of the lateral orbital rim. The two layers of the deep temporal fascia are separated by the temporal fat pad at this level. The frontal branch of the facial nerve runs along the underside of the superficial temporal fascia. In order to prevent injury, subgaleal dissection should be performed to approximately 2 cm above the zygomatic arch, which is the site of the superficial layer of the deep temporal fascia. This layer is then penetrated and the dissection is completed inferiorly within the temporal fat pad.

Incision to the superficial temporal fascia at the level of the lateral orbital rim is associated with a greater risk for frontal branch injury because the nerve runs deep in this plane. Incision to the conjoined temporal fascia would expose an area inferior and posterior to the zygomatic arch. Because the galea is continuous with the superficial fascia approximately 2 cm above the arch at the level of the lateral orbital rim, incision to the galea aponeurotica is associated with an increased risk for injury to the frontal branch.

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69

Which of the following anatomic sites is best defined as the 10- to 15-degree angle between the caudal area of the upper lateral cartilage of the nose and the septum?

(A) Anterior septal angle
(B) Dorsal keystone area
(C) External lateral triangle
(D) Internal nasal valve
(E) Soft triangle area

The correct response is Option D.

The internal nasal valve is normally the 10- to 15-degree angle formed between the caudal end of the upper lateral cartilage and the septum. Patency of the internal nasal valve is crucial for breathing. Persons who have an internal nasal valve with an angle of less than 10 degrees have incompetency with associated nasal obstruction. In order to re-establish a patent airway, cartilage grafting can be performed to increase the distance between the upper lateral cartilage and septum. The grafts are placed submucosally between the dorsum of the septum and the upper lateral cartilage.

The anterior septal angle provides support to the dorsum of the nose between and above the divergence of the lower lateral crura. This region is located just cephalad to the lower lateral cartilages.

In the dorsal keystone area, the fused nasal bones articulate with the superior edge of the perpendicular plate of the ethmoid and overlap with the cephalic edges of the upper lateral cartilages. The cartilaginous nasal septum also articulates with the perpendicular plate of the ethmoid. This confluence of structures acts to support the nasal dorsum in the middle third of the nose. In patients who have undergone osteotomies, maintaining the integrity of the perpendicular plate of the ethmoid and dorsal cartilaginous septum is especially important when the dorsum is lowered and the sidewalls are separated in the midline.

The external lateral triangle is lined by mucosa and covered by the transverse portion of the nasalis muscle; it can be composed of small sesamoid cartilages. This structure is bordered by the lateral edge of the upper lateral cartilage, lateral prolongation of the lateral crus, and the edge of the piriform fossa. It acts as a bellows during respiration.

The soft triangle consists of the covering skin of the nose and lining vestibular skin, which are separated by loose areolar tissue. It is located between the point of union of the lateral and medial crura of the lower lateral cartilage and the margin of the nostril. Incision into this area may lead to notching.

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70

The ratio of facial nerve injury following sub-SMAS rhytidectomy as compared with subcutaneous rhytidectomy is closest to

(A) 1:10
(B) 1:4
(C) 1:1
(D) 4:1
(E) 10:1

The correct response is Option D.

Facial nerve injury is a common complication following rhytidectomy. Patients who undergo rhytidectomy procedures that involve a deeper plane of undermining are more likely to have facial nerve injury. The reported incidence of facial nerve palsy following sub-SMAS rhytidectomy is 2% to 9%, with a mean of 4%. In contrast, the more superficial subcutaneous rhytidectomy has a 0.5% to 2% incidence of facial nerve injury, with a mean of 1%.

Although injury and the resultant nerve palsy occur most frequently in the buccal region, they are not often recognized by the patient because of the overlapping innervation in this area. Injury to the marginal mandibular or temporal branches of the facial nerve is more obvious and often results in permanent paralysis. Facial nerve palsy typically resolves over time, but some patients may have lasting paralysis.

Other complications of rhytidectomy include the development of hematoma and skin slough.

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71

A 19-year-old woman is brought to the emergency department after sustaining a complete amputation of the right ear flush with the scalp when she is attacked with a knife. The amputated ear is intact and properly preserved; microvascular replantation is performed. Three hours later, there is blue discoloration of the ear.

Which of the following is the most appropriate next step in management?

(A) Administration of aspirin
(B) Intravenous administration of dextran 40
(C) Placement of a leech on the replanted ear
(D) Revision of the vascular anastomoses
(E) Removal of the ear and subcutaneous burial of the cartilage in the abdomen

The correct response is Option C.

The blue discoloration seen in this patient three hours after surgery is consistent with the development of venous congestion. The most appropriate next step in management is placement of a leech on the replanted ear. Because microvascular repair of veins is extremely difficult during ear reconstruction, leech therapy is frequently used for several days following replantation to maintain vascular drainage. Heparin is often administered concomitantly to enhance the flow of blood from the replanted ear. Subsequent transfusions may also be required.

Although aspirin and dextran are both used to diminish clotting function and maintain patent anastomoses in patients undergoing microvascular surgery, neither agent used alone will effectively relieve acute venous congestion. These agents are less effective in this patient than leech therapy.

The venous congestion that occurs following ear replantation is often seen as a sign of a patent arterial anastomosis. Revision of the vascular anastomoses may be considered, but is not favored over leech therapy because of its invasiveness.

Removal of the replanted ear is only indicated if there is no improvement in venous congestion following leech therapy.

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72

A 25-year-old man has numbness of the nasal tip two weeks after undergoing rhinoplasty. The most likely cause is division of which of the following structures?

(A) External branch of the anterior ethmoidal nerve
(B) Medial branch of the anterior ethmoidal nerve
(C) Medial branch of the nasopalatine nerve
(D) Nasal branch of the infraorbital nerve
(E) Nasal branch of the supraorbital nerve

The correct response is Option A.

This 25-year-old man has numbness of the nasal tip resulting from division of the external branch of the anterior ethmoidal nerve. This branch, which supplies sensation to the dorsolateral aspect of the middle and distal thirds of the nasal tip, is derived from the first (ophthalmic) division of the trigeminal nerve. Division of the external branch often occurs during the early stages of rhinoplasty, when the soft tissues are undermined and separated from the underlying osteocutaneous vault. Temporary hypoesthesia of the nasal tip results; sensation usually returns within several months.

The medial branch of the anterior ethmoidal nerve supplies sensation to the dorsal aspect of the nasal septum, while the medial branch of the nasopalatine nerve supplies the posterior and inferior aspects of the septum. The sphenopalatine ganglion is the origin of this branch of the nasopalatine nerve; it also gives rise to the posterior nasal nerves, which supply sensation to the lateral nasal mucosa and concha.

The nasal branches of the infraorbital nerve provide sensation to the walls of the lateral nose and ala and the skin at the base of the columella. These branches are derived from the second (maxillary) division of the trigeminal nerve. The nasal branches of the supraorbital nerve supply sensation to the skin of the upper third of the nose at the radix.

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73

A 35-year-old woman requests improvement of fine rhytids and skin discoloration resulting from long-term sun exposure. Topical therapy with tretinoin is planned. In order to maximize results, which of the following is the most appropriate recommendation?

(A) Combination therapy with alpha hydroxy acids
(B) Continuous use of tretinoin for at least three to four weeks
(C) Discontinuation of tretinoin after one year
(D) Morning application of tretinoin
(E) Pretreatment with facial cleansers

The correct response is Option A.

Tretinoin is used for antiaging therapy because it can accelerate the reversal of skin damage caused by sun exposure. Its histologic effects include initiation of papillary collagen synthesis in the dermis, formation of blood vessels, increased glycosaminoglycan deposition, and exfoliation of retained stratum corneum. The epidermis thickens and exhibits hyperplasia. Tretinoin is applied topically to correct fine rhytids and skin discoloration; lines of facial expression are not affected.

In order to achieve the best result, a patient who is undergoing tretinoin therapy should be treated concomitantly with alpha hydroxy acids. Their hydrophilic action contrasts with the hydrophobic action of retinoids, increasing the effects of topical therapy on the skin. This combination is well tolerated in most patients.

In order to adequately improve fine facial lines and skin discoloration, topical retinoids should be applied for a minimum of three to four months. Adverse effects seen during the first six weeks of treatment may include erythema, dermatitis, burning, pruritus, and desquamation; these effects subside as the skin "hardens" in response to the irritating effect of tretinoin. The greatest improvement is seen after one year of use; continuous application is required because the skin will return to its pretreatment condition within six weeks if therapy is discontinued.

Because tretinoin increases cutaneous photosensitivity, it should be applied at night. Application of tretinoin following pretreatment with facial cleansers will minimize irritation but will not greatly improve the cosmetic effects.

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74

A 22-year-old woman with severe acne recently discontinued successful isotretinoin therapy. In this patient, skin resurfacing can be performed a minimum of how many months after discontinuation of the medication?

(A) 6
(B) 12
(C) 18
(D) 24
(E) 30

The correct response is Option D.

Several studies have shown that oral retinoids continue to have an effect on the dermal appendages for as long as 24 months following discontinuation of retinoid therapy. As a result, it is advisable for this patient who recently stopped taking isotretinoin to wait at least 24 months before undergoing skin resurfacing. At that time, the patient should be examined for the presence of skin oiliness or acne lesions; these findings indicate that the dermal appendages have recovered from the effects of isotretinoin.

If skin resurfacing is delayed for more than two years, it is associated with several adverse effects, including increased scarring and abnormal healing.

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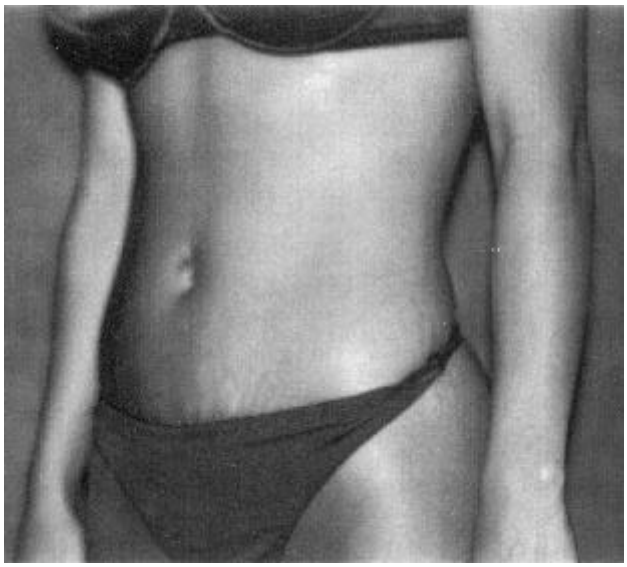
75



The photograph shown above is of a 36-year-old woman, gravida 2, para 2, who desires cosmetic improvement of a bulge and cutaneous stretch marks in the infraumbilical abdomen. On evaluation, she has moderate laxity of the lower abdominal wall and striae of the infraumbilical area.

Which of the following is the most appropriate surgical procedure?

(A) Conventional abdominoplasty
(B) Extended abdominoplasty
(C) Miniabdominoplasty
(D) Suction lipectomy of the lower abdomen
(E) Suction lipectomy and suprapubic skin excision

The correct response is Option C.

Selection of the proper surgical procedure for this patient should be based on evaluation of the anatomy of the abdominal wall and the existing aesthetic problems to be corrected, as well as on the patient's expectations. Abdominal wall deformities have been classified based on specific evaluation of the abdominal skin, the amount of abdominal fat in various areas, and the status of the musculofascial support system of the abdominal wall. This classification is further related to the extent of the abdominoplasty procedure required to produce significant aesthetic improvement in each type of patient.

This 36-year-old woman has minimal extra fat of the lower abdomen but has moderate weakness of the abdominal wall fascial support with some spreading of the rectus muscles, as well as some excess skin and unsightly striae confined to the infraumbilical area. She appears to be an ideal candidate for a lower abdominoplasty, frequently referred to as a "miniabdominoplasty." This procedure involves a suprapubic skin excision with limited undermining to allow removal of excess lower abdominal skin and stretch marks without excessive scarring and without the need for relocation of the umbilicus. Through the same exposure, suture plication and tightening of the fascial support and correction of the rectus muscle separation should also be performed.

A conventional abdominoplasty with dissection to the costal margin and relocation of the umbilicus would be unnecessary in this patient who has a deformity that is limited to the infraumbilical area. Likewise, extension of the abdominoplasty to involve vertical and horizontal skin incisions would be excessive for the amount of skin laxity in this patient and would result in a wide, unsightly T-shaped scar.

Because there is not a great amount of excess fat or skinfold thickness involved, suction-assisted lipectomy should be used as an adjunct procedure only; however, it would not improve this patient's results a great deal. Suction lipectomy alone would not address the lower abdominal wall laxity, and the excess skin and striae would remain. Suction lipectomy combined with lower abdominal skin excision would not produce maximum improvement because it would not address the fascial laxity of the lower abdominal wall.

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76

A 65-year-old man with obesity has a massive panniculus. Which of the following is the most appropriate surgical procedure?

(A) Full abdominoplasty
(B) Midabdomen abdominoplasty
(C) Miniabdominoplasty and adjunctive suction lipectomy
(D) Suction lipectomy
(E) Wedge resection

The correct response is Option E.

The safest approach for this high risk patient with obesity and a massive panniculus is the use of a single, transverse, elliptical wedge excision. Excision around the base of the panniculus only prevents undermining of the skin flaps, thus limiting the morbidity of the procedure.

A full abdominoplasty, which involves major undermining of the abdominal wall, is inappropriate for this patient or any patient with obesity.

Midabdomen abdominoplasty is appropriate for patients undergoing reconstruction with a transverse rectus abdominis myocutaneous flap who have previously undergone abdominal or pelvic procedures. It is not used as a primary approach for abdominoplasty because it requires undermining, which again is inappropriate for patients with obesity.

A modified abdominoplasty, or "miniabdominoplasty," is effective for patients with skin redundancy below the umbilicus. Surgical undermining is present but limited. Adjunctive suction lipectomy, or lipoplasty, does not increase the incidence of complications. Suction lipectomy by itself or combined with a full abdominoplasty is associated with an increased risk for developing complications.

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77

A 51-year-old woman has an erythematous, raised, firm papular skin lesion on the neck one year after sustaining a superficial laceration. Which of the following is the most appropriate method for distinguishing between a hypertrophic scar and a keloid in this patient?

(A) Clinical observation
(B) Fluorescein dye testing
(C) Electron microscopy
(D) Light microscopy
(E) Biopsy of the lesion

The correct response is Option A.

Whether this 51-year-old woman's papular skin lesion is a hypertrophic scar or a keloid can best be determined by continued clinical observation. A hypertrophic scar is a self-limiting type of excessive healing following injury. With time, the raised, red, hypertrophic scar becomes flat and pale. In contrast, a keloid extends beyond the confines of the original wound and does not regress. Consequently, clinical observation is the only absolute way to definitively distinguish a keloid from a hypertrophic scar. Treatment options will depend on the identification of the type of lesion involved. Intralesional injection of corticosteroids or surgical excision combined with other treatments may minimize

recurrence of keloids. Caution should be taken during any therapeutic intervention to minimize the possible development of a larger lesion.

If there is reason to suspect that the lesion is neither a keloid nor a hypertrophic scar, skin biopsy is mandatory. Dermatofibrosarcoma protuberans or other malignant fibromatous lesions can appear clinically similar to keloids and should be ruled out.

Fluorescein dye testing is not appropriate for diagnosis of either lesion because this test would only be indicative of vascularity.

Similarly, hypertrophic scars and keloids cannot be reliably differentiated using electron or light microscopy because the collagen whorls appear similar in both lesions.

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78

A 48-year-old man with prominent nasolabial folds undergoes rhytidectomy. Sub-SMAS dissection is performed to the level of the nasolabial folds. Which of the following is the most likely result?

(A) Denervation of the zygomaticus major muscles
(B) Flaring of the nostrils
(C) Flattening of the nasolabial folds
(D) Injury to the great auricular nerve
(E) Numbness in the submental region

The correct response is Option A.

The sub-SMAS area distal to the lateral border of the zygomaticus major muscle is not a safe plane for anatomical dissection. The facial (VII) nerve branches innervate the facial muscles at their deep surface. Although these branches are deep to the SMAS muscle layer, the nerve fibers turn superficially at some point to innervate the muscles. Any dissection in the sub-SMAS plane, whether a standard dissection of the SMAS as a separate layer or a composite rhytidectomy, requires the surgeon to change planes at the zygomaticus major muscle. Further dissection in the sub-SMAS plane beyond the zygomaticus major will denervate this muscle by injuring its nerve branch as it turns superficially to innervate the muscle.

If flattening of the nasolabial fold is to be achieved, there is a second anatomic reason for changing surgical planes from the deep plane to the superficial plane at the zygomaticus major muscle. Various studies suggest that the SMAS, although thin and attenuated in the cheek, continues into the upper lip where it becomes the fascia for the orbicularis muscles. Lateral traction on the SMAS during rhytidectomy has minimal effect on the medial cheek skin or nostril

because of this anchoring effect of the SMAS by the upper lip muscles. To better achieve smoothing of the nasolabial fold, the initial rhytidectomy dissection should be performed in the deep plane. When the lateral border of the zygomaticus major is reached, the investing attachments should be broken through, and the dissection should be continued medially in the subcutaneous plane. This procedure will allow traction on the rhytidectomy flap to be transmitted to the skin of the medial cheek.

The great auricular nerve lies deep to the SMAS-platysma layer and crosses the sternocleidomastoid muscle 6.5 cm below the caudal edge of the bony external auditory canal. Injury to the main trunk of the great auricular nerve as it passes over the sternocleidomastoid muscle may produce dysesthesia of the postauricular skin.

Numbness in the submental region results from injury to the mental nerve, which is located opposite to the second premolar, midway down the mandible from the cingulum of the second premolar to the mandibular border. Injury to this nerve is more likely during placement of chin implants and is best prevented by preservation of the periosteum in the soft tissue around the mental foramina.

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79

Which of the following vessels is the dominant blood supply to the preauricular skin that is undermined during rhytidectomy?

(A) Angular
(B) Inferior labial
(C) Posterior auricular
(D) Superficial temporal
(E) Transverse facial

The correct response is Option E.

The transverse facial artery provides the dominant vascular supply to the preauricular skin and is undermined during rhytidectomy. Its perforator is positioned approximately 3 cm lateral and inferior to the lateral canthus. Collateral circulation is minimal. Knowledge of this region prior to surgery is particularly crucial because inadvertent transection can result in the development of postauricular skin necrosis. In patients who smoke or have other factors that may compromise their blood supply, this vessel can be located and preserved. Following surgery, inspection of the perforator for excess bleeding can prevent complications associated with postoperative blood loss, such as the development of hematoma.

The submental artery perforator can also be transected during undermining, but this vessel has some collateral circulation within the facial artery, and its location is variable. If inadvertent transection does occur, necrosis of the submental skin may result.

The angular and inferior labial arteries lie within the central face and are not undermined during a rhytidectomy procedure. The posterior auricular artery provides the vascular supply for the skin behind the ear. The superficial temporal artery lies beneath the plane of rhytidectomy and supplies blood to the skin of the forehead and scalp.

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80

In planning breast reconstruction with a rectus abdominis myocutaneous flap based on a single superior pedicle, which of the following techniques is LEAST likely to improve the likelihood of flap survival?

(A) A delay procedure ligating the ipsilateral deep inferior epigastric artery and vein
(B) Inclusion of the anterior rectus sheath with rectus muscle elevation
(C) An inferior or infraumbilical flap design
(D) A midabdominal or middle transverse flap design
(E) A vertical flap design

The correct response is Option C.

The inferior or infraumbilical transverse flap design is very popular because of its lower abdominal scar, which is aesthetically more desirable. However, the inferior portion of the rectus muscle has fewer and smaller perforators than in the middle or periumbilical area. As a result, there will be relatively less blood flow to the overlying skin and subcutaneous tissues with this design, resulting in an increased risk for flap necrosis with the use of a single-pedicled superiorly based muscle. Careful patient selection and consideration of other factors that affect flap viability is of utmost importance when using this flap.

Studies have shown that delay procedures involving ligation of the deep and superficial inferior epigastric arteries of the ipsilateral muscle may substantially improve the viability of the superiorly based rectus abdominis myocutaneous flap. Enlargement of the intramuscular choke vessels frequently occurs within the rectus abdominis muscle.

Including a portion of the anterior rectus sheath during elevation of the rectus abdominis muscle also enhances flap viability. Because the anterior rectus sheath is especially adherent to the muscle at the tendinous insertions, any attempt to dissect the sheath may result in considerable trauma to the muscle and may compromise the blood supply of the flap.

The vertically oriented skin paddle placed over the rectus muscle may provide the best blood supply of all rectus abdominis myocutaneous flap skin paddle designs because the skin paddle is primarily located directly over the muscular perforators. However, the resultant vertical scar makes this flap design less popular and does not allow as many options for breast shaping with reconstruction.

Transverse skin paddle designs result in a more favorable scar lower on the abdomen and allow increased options for shaping the breast mound. The midabdominal or middle transverse flap includes multiple periumbilical perforators and

has the greatest blood supply of the transverse flaps. However, this procedure results in a higher abdominal scar at the umbilical level and a shorter muscle pedicle, which may limit shaping with flap inset. The midabdominal transverse flap design should be considered when a superiorly based flap is planned in a patient who may have other factors that will compromise flap viability.

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81

A 25-year-old woman with no children inquires about breast enhancement. Augmentation surgery is LEAST appropriate if the patient

(A) desires surgery to improve her self-esteem
(B) has congenital breast asymmetry
(C) is concerned about the risk for breast carcinoma following augmentation
(D) is planning on having children and would like to breast feed
(E) says that nipple sensation is very important to her

The correct response is Option E.

Although nipple sensation is not a major consideration for most patients, the incidence of permanently decreased sensation following breast augmentation is 15%, independent of the type of incision used. The primary cause of a permanent decrease in sensation is injury to the fourth lateral intercostal nerve, which may occur with aggressive dissection of the lateral pocket. While subpectoral augmentation reportedly allows greater preservation of nipple sensitivity, some patients may not accept the potential of permanent dysesthesias and anesthesias with breast enhancement surgery.

Many women requesting breast augmentation appear to place considerable emphasis on their physical appearance and often experience feelings of decreased femininity, which first appear during adolescence. If the patient is self-motivated, breast augmentation can be associated with a high level of patient satisfaction.

Most breasts exhibit some asymmetry. Although certain types of asymmetry may be improved with breast augmentation surgery, it is important to point out to the patient any asymmetry that may exist prior to surgery. If a woman is unaware of preexisting breast asymmetry, she may not be prepared for the resultant asymmetry following the procedure and may assume that the distortion has been caused by surgery.

The presence of a breast implant does not alter a woman's risk for breast carcinoma or affect the incidence or course of existing breast carcinoma. Patients should be examined on a yearly basis by their plastic surgeon and undergo scheduled breast imaging with appropriate views to image the implanted breast under the suggested guidelines.

The potential for lactation should not be impaired by breast implants, especially when the implants are positioned in the subpectoral pocket and incision within the breast parenchyma is avoided.

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82

Factors that make rhytidectomy more difficult to perform in men than in women include each of the following EXCEPT

(A) cephalad displacement of the sideburns
(B) greater likelihood of hematoma
(C) posterior displacement of the beard
(D) thickness and distribution of hair
(E) thickness of skin

The correct response is Option A.

There are several factors that frequently make rhytidectomy procedures in men more difficult than those performed in women. In general, facial skin is thicker in men, which may obscure postoperative results. Men are also more likely to develop hematomas due to increased vascularity in the beard area; the patient should be informed of this during preoperative planning.
Because men often have thinner, shorter hair or baldness, the surgical incisions need to be placed more carefully, in areas where they can be disguised. The placement of these incisions has an effect on patient recovery. In addition, performing a retrotragal incision can result in posterior displacement of the beard. This problem can be addressed by depilitation of the skin or positioning of the incision between the hair-bearing area of the cheek and preauricular area, which is typically alopecic.

One advantage that men undergoing rhytidectomy have is the position of the sideburns. Because the beard covers the cheek below the jaw line, cephalad displacement of the sideburns following rhytidectomy is not a great concern because the beard can be shaved at any level to determine sideburn position. In contrast, cephalad displacement of the sideburns in women can result in an unnatural appearance.

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83

Each of the following is an indication for prophylactic simple mastectomy in a woman without a history of invasive breast carcinoma EXCEPT

(A) bilateral atypical ductal or lobular hyperplasia and two relatives with premenopausal or bilateral breast carcinoma
(B) bilateral atypical lobular hyperplasia and a first-degree relative with premenopausal breast carcinoma
(C) bilateral florid adenosis with epithelial hyperplasia
(D) bilateral multifocal ductal carcinoma in situ
(E) unilateral lobular carcinoma in situ with contralateral atypical lobular hyperplasia

The correct response is Option C.

Prophylactic simple mastectomy may be indicated in patients who have indicators or markers associated with an increased risk for breast carcinoma. Conditions associated with a slightly increased risk (1.5 to 2 times) for developing breast carcinoma include moderate or severe hyperplasia without atypia. A moderately increased risk (4 to 5 times) for development of breast carcinoma is associated with atypical ductal or lobular hyperplasia. Conditions associated with a high risk (8 to 10 times) for development of breast carcinoma include lobular carcinoma in situ, noncomedo ductal carcinoma in situ, and multifocal ductal carcinoma in situ.

Adenosis (including florid), apocrine changes, ductal ectasia, and typical mild epithelial hyperplasia are not associated with an increased risk for proliferative disease. Therefore, prophylactic mastectomy is not indicated.

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84

A 48-year-old man comes for evaluation because he has had difficulty breathing for the past three years. His symptoms have not improved with administration of phenylephrine nasal spray. On examination, lateral traction of the paranasal skin of the left cheek results in improved airflow.

Which of the following is the most likely site of airway obstruction?

(A) Caudal septum
(B) Inferior turbinates
(C) Internal nasal valve
(D) Keystone area

The correct response is Option C.

This patient's findings indicate obstruction of the internal nasal valve. Accurate diagnosis of this type of obstruction can be made by placing lateral traction on the paranasal skin of the left cheek, which will distract the upper lateral cartilage away from the septum and open the angle of the internal nasal valve. This is known as the Cottle test. Any improvement in airflow seen with Cottle testing is considered a positive finding, thereby confirming the diagnosis of obstruction of the internal nasal valve. However, false-positive findings on the Cottle test may occur in patients who have collapse of the ala secondary to excessive resection of the lower lateral cartilages in the nose. A false-positive Cottle test may also be seen in patients who have occlusion of the nasal valve caused by scarring of the upper lateral cartilage of the septum. Typically, the caudal end of the upper lateral cartilage forms a 10-degree to 15-degree angle with the septum; this area of the internal nasal valve requires dynamic flexibility for adequate airflow.

The caudal septum frequently contributes to airway obstruction in patients with septal deviation. Although this patient has deviation of the septum to the right but obstruction of the internal nasal valve on the left, the septal deviation may in fact be contributing to the obstruction by interfering with the relationship between the caudal upper lateral cartilages and the septum. However, positive findings on Cottle testing are not associated with obstruction at the caudal septum.

Progressive enlargement of the inferior turbinates is the most common cause of airway obstruction; this enlargement may occur secondary to vasomotor, allergic, or irritative rhinitis. This cause of obstruction can be confirmed by applying a vasoconstrictive agent to the inferior turbinates. In most patients with turbinate hypertrophy, there will be complete relief of obstructive symptoms following shrinkage. Partial relief following vasoconstriction may indicate chronic hypertrophic rhinitis with a poor response to vasoconstriction, a significant septal deviation, or other intranasal abnormalities.

The keystone area is defined as that area in which the nasal bones and upper lateral cartilages overlap. Airway obstruction in this area is most likely to be diagnosed in a patient who has an overgrowth of bone or disruption of the perpendicular plate following trauma.

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85

In a patient who desires correction of vertical glabellar wrinkling, the most appropriate surgical procedure is resection of which of the following muscles?

(A) Corrugator
(B) Frontalis
(C) Orbicularis
(D) Procerus

The correct response is Option A.

The most appropriate surgical procedure in this patient is resection of the corrugator muscles. These muscles arise from the periosteum along the superior medial orbital rim and insert into the skin of the medial brow, with interdigitations into the orbicularis oculi muscle. Contraction pulls the brows medially, producing vertical wrinkling; resection will eliminate wrinkling in the glabellar area.

The frontalis muscles are paired extensions of the galea aponeurotica that insert into the supraorbital dermis with interdigitations into the orbicularis oculi muscle. Contraction elevates the eyebrows, resulting in transverse forehead wrinkling.

The orbital portion of the orbicularis oculi muscle interdigitates with the corrugator muscles medially and surrounds the lateral canthus in the zygomatic region. Contraction results in downward displacement of the lateral brow, while resection decreases lateral brow ptosis.

The procerus muscle arises from the upper lateral cartilage and nasal bones to insert into the glabellar skin at the medial edge of the frontalis muscle. Contraction causes transverse wrinkling at the radix of the nose.

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86

A 7-year-old boy has traumatic facial tattoos two months after a foreign body pigment was embedded in his facial skin. Which of the following is the most appropriate therapy?

(A) Carbon dioxide laser
(B) Dermabrasion
(C) Q-switched ruby laser
(D) Tunable dye laser

The correct response is Option C.

The Q-switched ruby laser is the most appropriate laser to use on this 7-year-old boy. It has excellent results in many patients with traumatic tattoos. There is nearly 100% clearing of the tattoo after three or fewer treatments.

Misapplication of decorative tattoo dye or dispersion caused by migration occurs in 4% to 5% of patients undergoing cosmetic tattooing. The carbon dioxide laser most effectively removes pigment granules in decorative facial tattoos. It has excellent results with minimal scarring. It removes pigment by evaporating tissue, in contrast to dermabrasion, which is associated with hypertrophic scarring. However, surgeons are cautioned to experiment with a small, obscure test area before beginning generalized treatment.

A tunable dye laser is appropriate for treatment of vascular malformations, such as port-wine stains.

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87

Which of the following conditions is best corrected by dacryocystorhinostomy?

(A) Ectropion
(B) Entropion
(C) Epiblepharon
(D) Epiphora

The correct response is Option D.

Epiphora, or excess tearing, is best corrected by dacryocystorhinostomy. This condition results from excess secretion of tears or obstruction of the lacrimal drainage system; however, surgery is usually only performed in patients with established obstruction. Any suspected blockage can be confirmed by using dye testing, dacryocystography, or dacryoscintigraphy. The dacryocystorhinostomy procedure involves burring a hole through the lacrimal fossa into the nasal cavity, which is then connected to the lacrimal sac.

Ectropion, which is defined as eversion of the eyelid margin, is best treated with a wedge excision procedure such as the Smith lazy T excision or a modified Kuhnt-Szymanowski procedure. The Smith lazy T procedure involves excision of a full section of the lower eyelid along with a horizontal conjunctival elliptical excision performed inferior to the medial puncta. With the Kuhnt-Szymanowski procedure, a full-thickness wedge is excised in the region of the lateral canthus. The skin excision is then hidden under a subciliary incision.

Entropion is an inward turning of the eyelid and eyelashes. Surgical correction of this condition involves a subciliary skin excision, suturing of the superior edge of the wound to the inferior tarsus, and release of any conjunctival adhesions.

Epiblepharon is a congenital condition characterized by an excess of horizontal skin on the eyelid caused by abnormal insertion of muscle fibers. Patients with this condition may be mistakenly diagnosed with blepharochalasis because the eyelashes may be rolled inward.

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88

A 41-year-old woman with lipodystrophy and tissue redundancy is scheduled to undergo a medial thigh lift. In order to decrease the risk for complications and achieve the best overall result, this patient should undergo dermolipectomy and suction lipectomy using which of the following surgical maneuvers?

(A) Suturing the skin flap to the gracilis muscle and overlying fascia
(B) Suturing the skin flap to Colles' fascia
(C) Suturing the skin flap to Scarpa's fascia
(D) Wide undermining of the medial thigh skin flap

The correct response is Option B.

Although the open medial thigh lift was first performed more than twenty years ago, it has not gained widespread acceptance as a surgical procedure because of the associated complications, including inferior migration and widening of the scar, early recurrence of ptosis, and distortion in the vulvar area (specifically, labial separation) in women. Carefully anchoring the inferior skin flap by suturing it to the inelastic deep layer of the superficial perineal fascia, which defines the perineal thigh crease, has decreased the incidence of such postsurgical complications.

Improved results were seen in 18 patients who had a medial thigh lift in combination with a suction lipectomy procedure and who were monitored for up to two years. In these patients, the inferior skin flap was suspended with subdermal sutures from the Colles' fascia. Scarring was decreased, and the results reported were longer lasting than with other thigh-lifting maneuvers.

The skin flap is not routinely anchored to the gracilis muscle during a medial thigh lift because the muscle origin is narrow and presumably would allow only limited fixation of the medial thigh flap. Similarly, Scarpa's fascia is a very thin anatomic structure; it separates the superficial and deep subcutaneous compartments in the abdomen and ends at the inguinal ligament. It would consequently not be useful for suturing in medial thigh lifting. Wide undermining of the skin flap is not necessary, particularly with the availability of suction lipectomy procedures for improvement of medial thigh contour. This procedure is not likely to offer better support or prevent recurrence of the original deformities.

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89

A 57-year-old man who developed facial paralysis after the onset of Bell's palsy 10 days ago is undergoing evaluation because he has moderate pain on the affected side of the face. Electroneuronography shows a 75% decrease in the amplitude of evoked compound muscle action potentials. Which of the following is the most appropriate management?

(A) Observation
(B) Administration of corticosteroids
(C) Physiotherapy
(D) Surgical decompression of the facial nerve

The correct response is Option B.

This patient who has pain following the onset of Bell's palsy should be treated with administration of corticosteroids, specifically prednisone. A total of 1 mg/kg of body weight should be administered daily in divided doses over the course of five days. The patient should then be re-evaluated; if he has incomplete paralysis, the prednisone can be tapered. A patient with steadily progressing paralysis should be given prednisone for five additional days. Some surgeons have advocated administering prednisone with acyclovir.

Observation is appropriate management of a patient who does not have significant pain and who has a decrease in the amplitude of evoked compound muscle action potentials of less than 90% two weeks after the development of Bell's palsy. However, studies have shown that one-half of Bell's palsy patients who had a decrease of more than 90% in the amplitude of evoked compound muscle action potentials had unsatisfactory return of function following recovery. In these patients, surgical decompression of the facial nerve may be indicated.

Surgery involves careful decompression of the labyrinthine portion of the facial nerve, and only some patients are appropriate candidates. In addition, several studies have shown no statistical improvement in facial nerve function following surgical decompression.

Electroneuronography is most effective in determining the likelihood of return of facial nerve function in the patient. However, this method of testing is expensive and must be performed daily for the first 10 days following the onset of paralysis. It has no use in patients who are not surgical candidates.

Physiotherapy, or electrical stimulation of the facial nerve, has been used in some patients with Bell's palsy, but its physiologic benefits have not yet been demonstrated. Instead, one study showed that physiotherapy was mainly used in patients with facial paralysis to maintain patient morale.

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90

A 38-year-old Caucasian American man with dark hair and fair scalp desires restoration of the anterior hairline and vertex. On examination of the scalp, there is dense hair growth in the temporo-occipital region. The patient wishes to have the fewest surgical procedures necessary to complete the restoration.

Which of the following techniques would provide the best aesthetic result in this patient?

(A) Micrografting/minigrafting
(B) Punch grafting
(C) Scalp reduction
(D) Tissue expansion

The correct response is Option A.

In this patient, micrografting and minigrafting would yield the best possible result. Micrografts, which contain one or two hair follicles, and minigrafts, which contain three or four hair follicles, can be positioned in an irregular pattern to mimic the normal anterior hairline. In addition, slitlike incisions are used, so visible scarring is not a concern. The grafts can be implanted in several short sessions or one extensive session, which may involve placement of greater than 1000 grafts. The time between sessions is limited, and the patient's appearance during graft placement is acceptable.

Punch grafting requires several procedures and can produce an unnatural, "doll"-like appearance, especially in patients with dark hair and fair scalp. Scalp reduction would be inappropriate in a patient with residual central hair who requires reconstruction of the anterior hairline. Tissue expansion involves multiple procedures and leaves anterior scars. Patients often express displeasure with their appearance during the expansion process.

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91

One month after undergoing open rhinoplasty, a 30-year-old woman has alar deformities and a loss of nasal tip projection; secondary rhinoplasty is required for correction of these deformities. The surgeon should wait a minimum of how many months before performing the secondary rhinoplasty?

(A) 3
(B) 6
(C) 9
(D) 12

The correct response is Option D.

In a patient who has already undergone one rhinoplasty procedure, a second procedure should be delayed for a minimum of one year. This will allow for healing of the nasal soft tissues and resolution of edema; as a result, the surgeon will be better able to accurately assess the deformity and plan the secondary surgery. If multiple procedures were performed initially, the surgeon should wait a minimum of two years before performing the secondary rhinoplasty. In patients who have undergone two rhinoplasty procedures, the waiting period prior to tertiary rhinoplasty should be at least one year.

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92

A 48-year-old woman is scheduled to undergo full-face rhytidectomy followed by phenol chemical peeling for improvement of aesthetic facial deformities. The most appropriate management in this patient is delaying the chemical peel for a minimum of how many months following the rhytidectomy procedure?

(A) 3
(B) 6
(C) 9
(D) 12

The correct response is Option A.

Following full-face rhytidectomy, the surgeon should wait at least three months before performing a phenol chemical peel. This will allow sufficient time for the undermined skin to heal. Performing chemical peeling at the time of rhytidectomy is not recommended because full-thickness skin loss may result. In addition, blepharoplasty and chemical peeling of the eyelids should not be performed simultaneously. However, regional perioral peeling can be performed at the time of rhytidectomy without complications in certain surgical candidates.

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93

Three days after undergoing upper and lower lid blepharoplasty, a 48-year-old woman has difficulty walking down flights of stairs because of impaired vision. This finding is most consistent with injury to which of the following structures?

(A) Inferior oblique muscle
(B) Levator aponeurosis
(C) Orbicularis oculi muscle
(D) Superior oblique tendon

The correct response is Option D.

This patient's findings are most consistent with injury to the superior oblique tendon. Because the actions of this muscle involve adduction and intorsion of the eye, this type of injury should be suspected in any patient who has difficulty reading or walking, particularly walking down flights of stairs. In addition, affected patients may have a forced or voluntary head tilt when looking downward and inward to compensate for diplopia. Although such symptoms can also indicate trauma to the trochlea or fascial sheath, injury to the superior oblique tendon is far more common. During blepharoplasty, the superior oblique tendon is at increased risk for injury during excision of the upper eyelid fat pad. Injury may also occur with penetration of the orbital septum or excessive use of cautery or clamps.

The inferior oblique muscle can be injured during penetration of the orbital septum of the lower eyelid at the junction of its middle and medial thirds. Patients with this injury would experience diplopia only with upward gaze; however, this type of ocular motion is not often used.

The blepharoplasty procedure presents multiple opportunities for injury to the levator aponeurosis, which fuses to the orbital septum several millimeters above the tarsal plate. A portion of the levator muscle may be inadvertently excised during resection of a strip of orbicularis oculi muscle for creation of a new eyelid fold; dehiscence and ptosis of the eyelid may subsequently result. Suturing the skin and/or muscle to the levator aponeurosis during wound closure can create an uneven upper lid crease. Whitnall's ligament can also be injured during opening of the orbital septum for removal of fat. An asymmetric eyelid configuration is associated with injury to Whitnall's ligament.

The orbital portion of the orbicularis oculi muscle is necessary for involuntary tight closure of the eyelids. Removal of the orbicularis oculi muscle strip from the upper eyelid may result in injury to the pretarsal portion of the upper eyelid muscle. Dissecting too close to the lateral canthus may lead to temporary denervation of the muscle; as a result, blinking will be slowed. Denervation of the lower eyelid during blepharoplasty may cause the eyelid to fall away, resulting in epiphora.

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94

A 6-year-old boy with congenital microtia of the right ear is scheduled to undergo reconstruction using a cartilage graft. This procedure will most likely involve excision of which of the following structures?

(A) Cartilage from the ipsilateral normal ear
(B) Ear lobe
(C) Hair-bearing scalp over the cartilage graft
(D) Skin over the vestigial ear cartilage
(E) Vestigial ear cartilage

The correct response is Option E.

Initial ear reconstruction in this 6-year-old boy should include excision of the vestigial ear cartilage. During the first procedure, the skin over the vestigial cartilage is meticulously preserved, and a skin envelope is created. A graft of rib cartilage is then harvested from the chest, carved into the appropriate framework, and inserted into the skin envelope. In order to appropriately remove the vestigial cartilage, a small incision should be placed anterior to it; the rib cartilage graft is also inserted through this incision.

If the ipsilateral ear is normal, it is usually left alone and cartilage is not harvested from it. Preservation of the ear lobe is important for proper alignment of the ears during reconstruction. The hair-bearing scalp over the cartilage graft should remain in place to cover and define the superior helical rim. The superior part of the cartilage framework is often partially placed under hair-bearing scalp at the time of reconstruction; electrolysis can be used later to remove the hair.

Conchal cartilage grafting can be used to effectively reconstruct the tragus during a final procedure.

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95

A 40-year-old man undergoes left total parotidectomy for management of a recurrent squamous cell carcinoma of the parotid gland. The facial (VII) nerve is excised from the extraparotid main nerve trunk to just outside the gland. Postoperative radiation therapy is planned.

Which of the following is the most appropriate reconstructive procedure to restore spontaneous smiling on the left side of the face?

(A) Immediate cross-face nerve grafting
(B) Immediate nerve graft reconstruction of the resected facial nerve
(C) Immediate transfer of the temporalis and masseter muscles
(D) Delayed cross-face nerve grafting
(E) Delayed nerve graft reconstruction of the resected facial nerve

The correct response is Option B.

In order to restore spontaneous smiling on the left side of the face, this patient should undergo immediate nerve grafting of the resected facial nerve. Facial nerve paralysis frequently occurs following resection of malignant parotid gland tumors. In order to provide a potential solution to this problem, nerve grafting should be performed immediately following resection in patients with no surgical contraindications as long as there is a stump of the primary trunk of the facial nerve outside the temporal bone to which nerve can be grafted. This procedure will provide the best chance for facial nerve regeneration and restoration of spontaneous smiling. In addition, postoperative radiation therapy is not a contraindication to immediate nerve grafting. According to several studies, patients who underwent facial nerve resection immediately followed by grafting had regeneration of the nerve through the graft and were able to experience some facial motion despite concomitant radiation therapy.

Cross-face nerve grafts are appropriate for restoration of spontaneous smiling in patients who have unilateral facial paralysis caused by loss of the primary trunk of the facial nerve through resection or Bell's palsy. If muscle atrophy has already occurred, microneurovascular muscle transfers can be performed adjuvantly to restore facial movement.

Immediate transfer of the temporalis and masseter muscles is appropriate for a patient who has had facial paralysis for an extended period of time; in these patients, reinnervation would not be possible because the muscles on the paralyzed side of the face would be extensively atrophied. However, because the temporalis and masseter muscles are innervated by the trigeminal nerve, they will not provide a spontaneous smile. Instead, symmetric facial movements are voluntary and must be learned.

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96

Which of the following types of breast implants has been known to exhibit visible rippling?

(A) Polyurethane
(B) Smooth saline
(C) Smooth silicone
(D) Textured saline
(E) Textured silicone

The correct response is Option D.

Textured saline implants have been known to exhibit visible wrinkling. Because textured saline implants are widely used for breast augmentation, this potential adverse sequela should be discussed preoperatively with the patient. The texturing causes the skin to adhere to the implant, making the rippling more evident. This effect is not seen perioperatively but instead becomes visible as the patient's skin begins to relax following surgery. In addition, it is especially noticeable in those patients who have minimal preoperative breast tissue. According to one study by the Food and Drug Administration (FDA), severe wrinkling of textured saline implants is an indication for replacement with silicone gel implants.

Many surgeons have begun to use smooth saline implants to prevent this problem; others have placed the implants under the pectoralis muscle, which will lessen the rippling effect on the superior pole of the breast. However, even with subpectoral placement rippling can still be palpated and seen in the inferior and lateral aspects of the breast and will be enhanced when the patient leans forward. Another technique advocated by some surgeons to minimize wrinkling is overinflation of the implants by 25 to 50 mL.

Wrinkling has not been seen with the use of silicone gel or polyurethane implants.

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97

A 25-year-old woman of Asian descent desires blepharoplasty to produce a higher, more prominent upper eyelid crease. Which of the following is the most appropriate operative management?

(A) Fasanella-Servat procedure
(B) Frontalis suspension
(C) Lateral canthoplasty
(D) Levator aponeurosis fixation
(E) Transpalpebral corrugator resection

The correct response is Option D.

In this 25-year-old woman of Asian descent, a more prominent eyelid crease can be produced with fixation of the levator aponeurosis to the overlying dermis. This can be performed alone or in conjunction with blepharoplasty. The less prominent eyelid crease typically seen in Asian persons results from an absence of filamentous dermal insertions into the lower levator aponeurosis. In addition, the septal insertion is positioned lower on the tarsus in persons of Asian descent; as a result, the preaponeurotic fat is positioned further down, obscuring the upper lid. Because this patient desires the more prominent upper eyelid crease typically seen in Caucasian persons, conservative excision of skin and fat in the area of the eyelid combined with fixation of the levator aponeurosis is indicated to produce the desired aesthetic appearance.

The Fasanella-Servat procedure is appropriate for patients with mild ptosis who have good residual levator function, while frontalis suspension is indicated for correction of severe ptosis in patients with poor levator function. Lateral canthoplasty is a horizontal tightening procedure performed for correction of lower eyelid laxity. Transpalpebral corrugator resection can be used to correct brow furrowing.

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98

A 30-year-old woman with acne scars who is scheduled to undergo chemical peeling using a 35% trichloroacetic acid (TCA) peel reveals that she discontinued oral isotretinoin therapy two months ago. This patient is at significant risk for development of which of the following complications following peeling?

(A) Bacterial infection
(B) Herpetic infection
(C) Hyperpigmentation
(D) Hypertrophic scarring
(E) Hypopigmentation

The correct response is Option D.

This patient who recently discontinued isotretinoin therapy is at increased risk for the development of hypertrophic scarring if she undergoes chemical peeling at this time. Isotretinoin is an oral retinoid that is used to treat acne by diminishing skin oiliness through the suppression of adnexal structures. In contrast, the re-epithelialization that occurs following chemical peeling requires intact adnexal epithelial cells. Therefore, it is recommended that chemical peeling be delayed until the patient has stopped taking isotretinoin for at least one year. At this time, normal oil secretion will have returned and the adnexal structures will no longer be affected.

Bacterial and herpetic infections are rare following chemical peeling and can be prevented altogether by prophylactic administration of antibacterial and antiviral agents. Previous isotretinoin use plays no role in the development of infection.

Any hyperpigmentation or hypopigmentation that occurs following chemical peeling is most likely related to Fitzpatrick skin type, not use of isotretinoin. Appropriate use of bleaching creams can help to prevent these complications.

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99

One week after undergoing auricular reconstruction for burn injuries of the left ear that he sustained in a fire, a 45-year-old man has a 3-cm area of necrosis over the central portion of the skin pocket that covers the cartilage framework. Following initial debridement of the necrotic area, which of the following is the most appropriate next step in management?

(A) Application of silver sulfadiazine cream
(B) Delayed primary closure
(C) Split-thickness skin grafting
(D) Placement of a tissue expander
(E) Coverage with a temporoparietal fascia flap

The correct response is Option E.

This patient who has developed necrosis one week after undergoing reconstruction for burn injuries of the left ear should undergo initial debridement of the burn necrosis followed by coverage with a local flap or a temporoparietal fascia flap if local tissue is not available. Either option provides well-vascularized skin of good quality. The necrotic ear can also be covered with postauricular fascia or a radial forearm free flap.

In patients with small areas of exposed cartilage, local wound care such as topical application of silver sulfadiazine cream and dressing changes will produce the wound granulation, contraction, and epithelialization necessary for healing. However, this healing process is unlikely to occur with large wounds.

Patients who have a burn injury such as the injury described typically have intrinsic damage of the tissue bed or excessive thinning of the localized skin flaps overlying the cartilage framework of the ear; therefore, primary closure is often not an option.

Because the ear cartilage has insufficient vascularization because of disruption of the perichondrium, a skin graft alone will ultimately fail.

Tissue expansion will increase the amount of localized skin available for coverage. However, following its placement, the tissue expander may become exposed and contaminated, leading to the development of infection and further tissue loss.

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100

A 45-year-old woman with class I occlusion who underwent alloplastic chin implantation five years ago has erosion of the symphysis and inadequate projection of the lateral chin with normal vertical height. The chin implant is visible and can be palpated on clinical examination.

Following removal of the implant, which of the following is the most appropriate surgical management?

(A) Interposition augmentation osteotomy
(B) Jumping osteotomy
(C) Mandibular sagittal split osteotomy
(D) Oblique osteotomy
(E) Sliding horizontal osteotomy

The correct response is Option E.

In this patient who has exposure of the alloplastic chin implant and inadequate chin projection five years after undergoing implantation for treatment of microgenia, a sliding horizontal (advancement) osteotomy should now be performed. Either osseous genioplasty or implantation of an alloplastic prosthesis is appropriate for initial management

of a patient with class I (normal) occlusion and microgenia; however, if large implants are used, erosion of the symphysis may result. In addition, adequate projection of the lateral chin may not be fully achieved. If these complications occur, the implant should be removed and a sliding horizontal osteotomy should be performed to correct the residual microgenia without affecting the vertical dimensions of the chin.

Interposition augmentation osteotomy can be used in a patient who requires greater horizontal movement of the chin, or combined horizontal and vertical movement. Jumping and oblique osteotomies will increase the vertical dimensions of the chin. Mandibular sagittal split osteotomy is appropriate for a patient with microgenia who has Angle class II malocclusion.

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101

A 32-year-old woman requests suction lipectomy to improve the contour of her calves and ankles. In order to achieve optimal results, the thickness of the skin fold in the region of the posterior calf should be a minimum of

(A) 0.5 cm
(B) 1.0 cm
(C) 1.5 cm
(D) 2.5 cm
(E) 3.5 cm

The correct response is Option C.

Because the highest rates of patient dissatisfaction following suction lipectomy occur when this technique is performed in the region of the calves and ankles, it is important to recognize the role that preoperative aesthetics play with regard to postoperative results. Specifically, patient satisfaction has been shown to be directly related to the preoperative thickness of the subcutaneous fat as measured by pinch testing. One study of 110 patients that correlated rates of satisfaction with findings on pinch testing showed that only 84% of those who underwent suction lipectomy of the calves and ankles were satisfied with the results of the procedure, compared with more than 95% of patients who had suction lipectomy involving other areas. Furthermore, patients who had at least 1.5 cm of subcutaneous fat were more likely to be satisfied with their results; these patients had a postoperative pinch test of 0.5 to 0.7 cm in the treated areas. In contrast, patients who had a layer of subcutaneous fat of less than 1.5 cm were more likely to be displeased with the contour of the calves and ankles following suction lipectomy; these irregularities were more likely the result of exposure of contour irregularities involving nonfat tissues and/or bone.

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102

A 23-year-old woman is undergoing cosmetic rhinoplasty using a cartilage graft to increase projection of the nasal tip. Which of the following is the most likely associated complication?

(A) Erosion
(B) Infection
(C) Rejection
(D) Resorption
(E) Visibility

The correct response is Option E.

Results of several studies have shown that, among patients undergoing primary or secondary rhinoplasty for correction of a poorly projecting nasal tip, the most likely associated complication involved graft visibility. In one series of 1252 patients who underwent cartilage grafting of the nose over a 10-year period, 5% developed problems with graft visibility. This complication was far more common than any other; for example, cellulitis occurred in only 1% of patients, while cartilage loss and/or absorption were not seen.

Another series of 311 patients reported visible irregularities in 12 patients following cartilage grafting. In this study, infection occurred in one patient, while skin erosion, rejection, and resorption did not occur.

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103

The surface anatomy of the nose is divided into how many aesthetic subunits?

(A) Six
(B) Seven
(C) Eight
(D) Nine
(E) Ten

The correct response is Option D.

The surface anatomy of the nose has been divided into nine aesthetic subunits based on the anatomic region and the unique contour and thickness of each subunit. These include the nasal dorsum, tip, and columella, as well as the paired sidewalls, ala, and soft triangle subunits. This system of classification of the nasal surface anatomy allows for greater

ease of reconstruction because scars can be positioned between the subunits, where they will be less obvious. In addition, knowledge of the aesthetics of each subunit will help in choosing replacement tissue of the appropriate contour and thickness. However, if a patient has a defect that encompasses more than one-half of the aesthetic subunit, it is best to reconstruct the entire subunit than to attempt to cover the defect.

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104

The carbon dioxide laser is absorbed by which of the following chromophores?

(A) Beta-carotene
(B) Melanin
(C) Oxyhemoglobin
(D) Protein
(E) Water

The correct response is Option E.

The absorption spectrum of tissue is determined by the chromophores (substances in organic tissue capable of absorbing light) present in the tissue. The absorbing chromophore for the carbon dioxide laser is water, which absorbs carbon dioxide at a high rate. Because it causes minimal damage to adjacent tissues, the carbon dioxide laser is effective for ablation (skin resurfacing), cutting, and coagulation.

The Q-switched ruby laser has a wavelength of 694 nm, which is best absorbed by melanin and the carbon in tattoo pigments. Consequently, pigmented lesions and professional and amateur tattoos applied with black ink can be treated with this laser.

The absorbing chromophore for the tunable-dye laser functioning at a wavelength of 585 nm is oxyhemoglobin, which has a compatible absorption spectrum. This laser is effective for treating port-wine stains and telangiectasias.

Although beta-carotene and protein can also function as chromophores, the absorption spectrum of neither is similar to the wavelengths of the lasers used for surgery.

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105

Which of the following complications is most frequently seen following aesthetic otoplasty?

(A) Chondritis
(B) Hematoma
(C) Keloids
(D) Recurrence
(E) Telephone deformity

The correct response is Option D.

The most common complication seen in patients following aesthetic otoplasty is recurrence of the deformity. In one study of 292 patients who underwent otoplasty, a recurrent deformity was seen in 4.3% of patients; other, less common complications included the development of keloids (2%), cellulitis (1.2%), hematoma (0.8%), chondritis (0.7%), and hypertrophic scarring (0.7%). Another study of 562 patients reported that 8% experienced a residual or recurrent deformity. Infection, keloids, hemorrhage, and necrosis of the anterior skin occurred less frequently. In addition, a study of 31 patients who were observed carefully over a period of one year after surgery showed that 33% had some postoperative recurrence. As a result, excessive correction of the deformity at the time of the initial procedure is advocated by some surgeons.

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106

A 45-year-old woman has numbness in the medial aspect of the right arm two weeks after undergoing right modified radical mastectomy followed by placement of tissue expanders. This finding is most consistent with injury to which of the following nerves?

(A) Fourth intercostal
(B) Intercostobrachial
(C) Long thoracic
(D) Medial antebrachial cutaneous
(E) Medial brachial cutaneous

The correct response is Option B.

This patient's findings are most likely caused by injury to the intercostobrachial nerve. This type of injury is common during modified radical mastectomy, in which the nerve is typically transected during resection of the axillary tissues. Numbness in the region of the medial arm is a frequent finding. The intercostobrachial nerve can also be injured during transaxillary placement of breast implants in a patient undergoing breast augmentation.

The fourth intercostal nerve supplies sensory innervation to the chest and nipple-areolar complex but does not affect the arm. The long thoracic nerve provides motor innervation to the serratus anterior muscle; injury to this nerve would result in a winged scapula deformity. The medial antebrachial cutaneous and medial brachial cutaneous nerves supply sensation in the region of the medial epicondyle and proximal forearm. Each of these nerves receives a contribution from the intercostobrachial nerve but is not located within the surgical field and therefore would not be injured during modified radical mastectomy.

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107

A 32-year-old woman has recurrent episodes of edema of the eyelids that is not associated with pain or erythema. On examination, she has ectropion and phimosis; there is redundancy and atrophy of the eyelid tissue. Which of the following is the most likely diagnosis?

(A) Blepharochalasis syndrome
(B) Cicatricial ectropion
(C) Floppy lid syndrome
(D) Paralytic ectropion
(E) Treacher Collins syndrome

The correct response is Option A.

This 32-year-old woman has findings consistent with blepharochalasis syndrome, a disorder frequently diagnosed in young women. Patients with blepharochalasis syndrome have recurrent episodes of edema of the eyelids without associated pain or erythema. Eyelid redundancy and atrophy typically develop, leading to laxity of the lateral canthal tendon. Late findings include ectropion and phimosis.

Cicatricial ectropion is associated with a deficiency of eyelid skin. This condition may result from burn injuries, trauma, inflammation, or iatrogenic causes.

In patients with floppy lid syndrome, the upper eyelid is floppy and can be everted easily. This condition is typically associated with papillary conjunctivitis. Entropion is a characteristic finding.

Paralytic ectropion occurs following denervation of the orbicularis muscle secondary to facial nerve palsy. The protractor muscle normally maintains opposition of the lower eyelid to the globe.

In Treacher Collins syndrome, an autosomal dominant disorder, eyelid abnormalities include notching, retraction, and eversion resulting from tissue agenesis and skin deficits.

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108

After undergoing Mohs' microsurgical resection of a basal cell carcinoma of the nose, a 68-year-old man has a 1.0 × 2.0-cm defect of the right alar margin. Which of the following is most appropriate for reconstruction of the nose?

(A) Split-thickness skin graft
(B) Full-thickness skin graft
(C) Composite ear graft
(D) Forehead flap
(E) Nasolabial flap

The correct response is Option E.

Following Mohs' micrographic resection of a basal cell carcinoma of the nose, this 68-year-old patient should undergo coverage of the defect using a nasolabial flap. Redundant skin from within the nasolabial fold can be rotated easily to the lateral ala to cover the defect. This flap can receive its vascular supply from either the facial or angular arteries and can be superiorly or inferiorly based.

Split-thickness skin grafting would not provide the appropriate color or thickness match for a nasal defect. In addition, the skin contraction seen with this type of graft would result in notching and asymmetry at the recipient site. Although a full-thickness skin graft would contract less, it would not provide skin of adequate color or texture. A composite graft from the ear would have the appropriate cartilage and lining for nasal reconstruction, but most surgeons do not use composite grafts larger than 1.5 cm due to their unpredictable take. A forehead flap is too large for coverage of this patient's defect, and the use of this flap would require multiple unnecessary procedures.

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109

A 22-year-old woman has cheek asymmetry and enophthalmos following facial trauma. Which of the following is the most appropriate surgical procedure?

(A) Malar implantation
(B) Submalar implantation
(C) Combined malar and submalar implantation
(D) Suborbital groove tear-trough implantation
(E) Zygomatic osteotomy

The correct response is Option E.

This 22-year-old woman has malunion of a zygomatic fracture, with its resultant cheek asymmetry and increased intraorbital volume, leading to the development of enophthalmos. Zygomatic osteotomy will correct these deformities. Reconstruction of the orbit with bone grafts may also be necessary.

Because rhytidectomy alone will not improve midface atrophy, it can be combined with submalar implantation to correct facial aging and midface atrophy in middle-aged patients. Submalar implants should be placed via an upper buccal sulcus incision at the time of rhytidectomy.

Malar implantation is most appropriate for young patients with small cheek bones who desire augmentation of the malar region; these implants are also placed via upper buccal sulcus incisions. Combined malar and submalar implantation is appropriate for correction of malar skeletal deficiencies and submalar soft-tissue atrophy. Suborbital groove tear-trough implantation is used in patients who have deep grooving at the junction of the eyelids, thin eyelids, and thick cheeks with prominent folds that course from the medial canthi across the infraorbital rims.

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110

In a patient with a prominent ear, which of the following anatomic measurements is most characteristic?

(A) Cephaloauricular angle of 20 degrees
(B) Conchal depth of 10 mm
(C) Helical apex protrusion of 24 mm
(D) Helical rim height of 7 mm
(E) Scaphoconchal angle of 80 degrees

The correct response is Option C.

The prominent ear deformity is characterized by protrusion of the helical apex; 24 mm of protrusion is consistent with a prominent ear deformity. Other characteristics include absence of the posterior fold, a scaphoconchal angle of greater than 90 degrees, and a cephaloauricular angle of greater than 25 degrees in men and 21 degrees in women. The concha is typically larger than 1.5 cm, and there is excessive protrusion of the anterior helical rim.

The height of the normal ear (5.5 to 6.0 cm) is typically twice that of normal ear width (3.0 to 4.5 cm). The helical rim is 10% of the vertical height (7 mm). It protrudes 10 to 12 mm at the helical apex, 16 to 18 mm at the midpoint, and 20 to 22 mm at the lobule.

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111

A 14-year-old girl has breast asymmetry. On examination of the right chest, the ribs and pectoralis muscle are normal, but there are no visible or palpable glandular breast elements and no identifiable nipple-areolar complex. There is no history of trauma or surgery. Her left breast is normal and is classified as Tanner stage IV.

Which of the following is the most likely diagnosis?

(A) Amastia
(B) Amazia
(C) Athelia
(D) Juene syndrome
(E) Poland syndrome

The correct response is Option A.

This 14-year-old girl has amastia, or congenital absence of the breast, a rare condition that involves absence of the nipple-areolar complex and glandular tissue.

Amazia is characterized by absence of the glandular tissue only, while athelia is absence of the nipple alone. Patients with Juene syndrome, a rare autosomal recessive disorder, typically have a narrowed, immobile thorax, polychondrodystrophy, and renal disease. Amastia is not an associated finding. Poland syndrome is characterized by unilateral hypoplasia or absence of the breast associated with deformities of the chest wall, overlying muscles, and upper extremity; however, affected patients will have a hypoplastic or absent pectoralis muscle on the involved side.

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112

A 70-year-old man has a rapidly growing, well-circumscribed lesion on the right cheek with firm, rounded borders and an umbilicated, scaly center. Which of the following is the most likely diagnosis?

(A) Actinic keratosis
(B) Cylindroma
(C) Keratoacanthoma
(D) Pyogenic granuloma
(E) Seborrheic keratosis

The correct response is Option C.

This 70-year-old man most likely has a keratoacanthoma. Keratoacanthomas are benign, self-healing tumors that occur more frequently in men older than age 60 years. Although their precise etiology is unknown, these tumors are believed to originate in hair follicles. They appear as nodules of squamous cells encircling a keratinous plug. Lesions grow rapidly for several weeks and then spontaneously resolve within six months of onset. Nevertheless, surgical excision and histopathologic analysis should be performed to rule out squamous cell carcinoma. Early excision of the lesion will limit scarring and prevent the development of an atrophic scar, which may occur with spontaneous regression.

Actinic keratoses are premalignant keratotic papules that occur in middle-aged or elderly persons who have fair complexion and a long history of sun exposure. These lesions typically occur on sun-exposed areas such as the scalp, forehead, and dorsal aspect of the forearm and hand. According to some estimates, 20% of patients with actinic keratoses will eventually develop squamous cell carcinoma in one of the lesions. Cryotherapy, electrosurgery, curettage, shave excision, or chemical peeling is used for treatment. Patients should be followed carefully for signs of transformation into squamous cell carcinoma.

A cylindroma (turban tumor) is a raised, rubbery, benign nodule usually located on the scalp. It is pink to blue in color and varies in size from a few millimeters to several centimeters. It is best treated with excision.

A pyogenic granuloma is a raised red lesion that bleeds easily. It is derived from excess granulation tissue in a healing wound. Treatment includes excision or cauterization of the lesion.

A seborrheic keratosis is a superficial plaque of amber to brown color. It also occurs in elderly, fair-skinned persons and is best treated with shaving or excision.

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113

During induction of anesthesia in a patient undergoing suction lipectomy of the abdomen and flank, 2 L of tumescent fluid (Klein formula) is injected over a period of approximately 15 minutes. In this patient, plasma levels of lidocaine will be greatest how many hours after injection of the anesthetic?

(A) 1
(B) 2
(C) 6
(D) 12
(E) 24

The correct response is Option D.

Because the mechanism of action of lidocaine involves binding to the subcutaneous tissues and slow release into the circulation, peak plasma levels of this anesthetic are typically seen 12 hours following infiltration. Although the

maximum recommended dose of lidocaine is 7 mg/kg, patients frequently receive much higher doses (as high as 35 mg/kg) during suction lipectomy without reported complications. Because the tumescent technique involves infiltration of a dilute solution combined with epinephrine into a hypovascular space over a lengthy period of time, high doses of lidocaine are well tolerated during suction lipectomy.

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114

A 50-year-old woman has epiphora 24 hours after undergoing bilateral blepharoplasty of the lower eyelids. Which of the following is the most appropriate immediate management?

(A) Observation
(B) Probing of the nasolacrimal duct
(C) Placement of a silicone tube
(D) Conjunctivodacryocystorhinostomy
(E) Dacryocystorhinostomy

The correct response is Option A.

Because epiphora is not an uncommon finding following blepharoplasty, the most appropriate immediate management is observation and reassurance of the patient. Epiphora may develop following eyelid surgery as a consequence of distortion of the lacrimal system secondary to chemosis and lid edema. The orbicularis muscle may also be temporarily paralyzed; however, these findings will typically resolve over time.

In contrast, patients who have persistent, intense epiphora several days after surgery should undergo evaluation because the lower eyelid gutter and/or lacrimal system may be injured or obstructed. The nasolacrimal duct can be probed and irrigated to relieve any potential obstruction.

Placement of a silicone tube is important for maintaining canalicular patency in patients undergoing reconstruction and/or repair following trauma.

In patients who have obstruction of both canaliculi, conjunctivodacryocystorhinostomy will establish direct communication between the conjunctival sac and nasal cavity.

Dacryocystorhinostomy is appropriate for management of nasolacrimal duct obstruction that occurs as a result of trauma, infection, or paralysis of the lacrimal pump.

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115

During resection of a lesion on the conchal bowl, a patient receives a wheal injection of local anesthetic posterior to the sulcus, below the lobule, and anterior to the tragus. After the procedure begins, the patient feels pain. The most likely cause is inadequate anesthetic field block of which of the following nerves?

(A) Auriculotemporal
(B) Chorda tympani
(C) Great auricular
(D) Lesser occipital
(E) Vagus (X)

The correct response is Option E.

This patient has pain resulting from inadequate anesthetic block of Arnold's nerve, which is a branch of the vagus (X) nerve. This nerve supplies sensation to the external auditory canal and the conchal bowl, exiting through the canal. Successful infiltration will result in adequate anesthesia of this region.

The auriculotemporal nerve supplies sensation to the upper lateral surface of the auricle within the posterior wall of the auditory canal. The great auricular nerve has both anterior and posterior branches. This nerve travels around the posterior border of the sternocleidomastoid muscle to supply innervation to the lobule, lower half of the lateral auricle, and posterior auricle. The lesser occipital nerve supplies sensation to the superior aspect of the auricle along the cranial surface.

The chorda tympani does not innervate any aspect of the auricle.

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116

A 50-year-old woman has numbness of the right ear 12 hours after undergoing rhytidectomy and neck lifting for treatment of facial aging. The most likely cause is injury to the auricular branch of which of the following structures?

(A) Cervical plexus
(B) Facial (VII) nerve
(C) Occipital nerve
(D) Spinal accessory nerve
(E) Trigeminal (V) nerve

The correct response is Option A.

This patient has numbness of the right ear that is most consistent with injury to the great auricular nerve, which forms from branches of cervical nerve roots C2-3 within the cervical plexus. If this nerve is not identified prior to dissection, it can be injured easily during rhytidectomy and neck lifting because of its superficial location just deep to the platysma. After its formation, the great auricular nerve crosses the sternocleidomastoid muscle, traveling from its posterior aspect 6 to 7 cm below the mastoid process and then coursing behind the external jugular vein to the ear.

The facial (VII) nerve provides motor innervation to most of the muscles of facial expression, while the spinal accessory nerve supplies motor innervation to the sternocleidomastoid and trapezius muscles. The occipital nerve is a sensory nerve that also originates from the cervical nerve roots. The trigeminal (V) nerve is a mixed cranial nerve; it provides motor innervation to the primary muscles of mastication while carrying sensation from the skin and mucosal surfaces of the face.

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117

Which of the following is the most common late complication reported following alloplastic malar augmentation?

(A) Bone resorption
(B) Fibrosis
(C) Infection
(D) Malposition
(E) Sensory loss

The correct response is Option D.

Complications associated with alloplastic malar implantation frequently result from the use of an inappropriately sized implant or from malpositioning of the implant. These problems can be avoided by correctly identifying the type and degree of malar deficiency seen in each patient prior to surgery. In order to achieve this, the surgeon should determine whether the deficiency lies in the lateral, middle, or medial third of the midface horizontally. Alternately, the face can be divided vertically, and the deficiency can be classified as anteromedial, posterolateral, or combined. This evaluation is used to determine the type of implant that is best for augmentation of the malar region.

Bone resorption and demineralization have not been observed on radiographs of patients who underwent malar augmentation. Implant fibrosis is also not a concern. Several studies have reported an associated incidence of infection of 2% to 4%. Although transient sensorimotor nerve dysfunction has been seen, permanent sensory loss is rare.

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118

Which of the following is the mechanism of action of ultrasound-assisted lipectomy?

(A) Cavitation
(B) Division of fibrous septae
(C) Piezoelectric effect
(D) Thermal effect
(E) Tumescence of the adipose layer

The correct response is Option A.

The mechanism of action of ultrasound-assisted lipectomy is based on the phenomenon of cavitation, in which fat cells are liquified so that they can then be aspirated. During the lipectomy procedure, piezoelectric quartz crystal or ceramic transducers are used to transform electrical energy into mechanical vibrations, producing ultrasound waves. The fat is then liquified, leaving the fibrous septae intact. Tumescent fluid is infiltrated to decrease the density of subcutaneous tissue, promote cavitation, and minimize the resultant thermal effects.

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119

In patients undergoing topical tretinoin therapy, which of the following complications is most frequently reported?

(A) Erythema
(B) Hyperpigmentation
(C) Hypopigmentation
(D) Infection
(E) Scarring

The correct response is Option A.

The most common complications reported in patients undergoing topical therapy with tretinoin are erythema, scaling, and xerosis. These adverse effects result from the agent's mechanisms of action, which include induction of epidermal hyperplasia, thickening of the granular layer, induction of mitotic activity, and compaction of the stratum corneum. Tretinoin is commonly applied prior to chemical peeling to produce a more even peel and prevent the development of hypopigmentation. Topical corticosteroids can be used adjuvantly to decrease the risk for development of erythema, or the tretinoin can be prescribed as alternate-day therapy.

Tretinoin does not cause pigment changes and, as mentioned above, has been used to prevent them. Infection and scarring have not been reported with the use of tretinoin.

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120

During brachioplasty, permanent suturing of the skin flaps to which of the following anatomic structures will decrease the risk for contour deformities and unfavorable scarring?

(A) Axillary fascia
(B) Latissimus dorsi muscle and fascia
(C) Pectoralis major muscle
(D) Subclavius muscle and overlying fascia
(E) Triceps muscle

The correct response is Option A.

During brachioplasty, the risk for contour deformities and unfavorable scarring will be reduced if the skin flaps are permanently sutured to the axillary fascia. Brachioplasty is frequently performed for correction of soft-tissue ptosis in middle-aged patients. In young persons, the soft tissues of the posteromedial arm are firmly attached to the fascial system of the arm, which gains its strength from the clavipectoral and axillary fasciae; however, the axillary fascia loosens with aging, resulting in laxity of skin and soft tissues. Fluctuations in weight and the pull of gravity can also contribute to this process. Securely anchoring the arm flap to the superficial fascia system via the axillary fascia will decrease the risk for contour deformities or unsightly scarring of the medial arm.

The skin flap should not be anchored to the latissimus dorsi muscle and fascia, the pectoralis major muscle, the subclavius muscle and overlying fascia, or the triceps muscle during brachioplasty.

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A 45-year-old woman seeks correction of deep nasolabial creases. Aspirated fat from the buttocks is to be injected into the creases. Assuming healing is uncomplicated, the amount of original fat remaining six months after the procedure will be closest to

(A) 10%
(B) 25%
(C) 50%
(D) 75%
(E) 90%

The correct response is Option C.

Use of injected autologous fat aspirates for improvement of facial aesthetics has not gained widespread acceptance because of concerns about maintenance of fat volume following their injection. Several long-term, well-controlled studies have shown the loss of volume to be as high as 49% three months after injection, with total loss at six months ranging from 55% to 59%. Newer techniques of fat harvest, which have been associated with higher volume

retention because of a decrease in the amount of damaged adipocytes transferred within the fat, hold promise for use in the correction of aesthetic deformities. These include transplantation of en-bloc fat specimens or harvest of fat using careful methods to maintain its intracellular structure.

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122

In a 55-year-old man who desires aesthetic facial surgery, prominence of which of the following features is LEAST likely to be improved by rhytidectomy and neck lifting combined with submental dissection and tightening of the submuscular aponeurotic system (SMAS) and platysma as a separate layer?

(A) Jowls
(B) Nasolabial folds
(C) Neck wrinkles
(D) Submental bands
(E) Submental double chin

The correct response is Option B.

In this patient, the prominent nasolabial folds are least likely to be improved by rhytidectomy and neck lifting combined with submental dissection and tightening of the SMAS and platysma as a separate layer. This combination of procedures is effective for improvement of prominent jowls, neck wrinkling, submental platysmal bands, and a "double chin"-like appearance caused by excess submental fat and skin. Although some initial improvement in the nasolabial folds may be seen immediately following surgery, long-term or permanent improvement is unlikely.

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123

Each of the following is a favorable indication for performing suction lipectomy of the neck EXCEPT

(A) age younger than 30 years
(B) normal skin elasticity
(C) pinch test results greater than 2 cm
(D) supraplatysmal fat
(E) vertical skin wrinkling

The correct response is Option E.

The primary indication for performing suction lipectomy of the neck is the presence of excess supraplatysmal fat. This can be determined on pinch testing; a patient who has a fat volume of greater than 2 cm is a good candidate for this procedure. The supraplatysmal fat can be easily suctioned through small stab incisions in the neck. In addition, patients younger than age 30 years will often experience excellent results following suction lipectomy because of better skin elasticity, which diminishes with age. These patients are more likely to have contraction of the skin to a decreased volume following surgery. As a result, cervical suction lipectomy is frequently performed as a single procedure with good success in patients aged 20 to 40 years.

Vertical skin wrinkling is not a favorable indicator for performing suction lipectomy. Patients with vertical skin wrinkling have decreased skin elasticity and will therefore have suboptimal results following cervical suction lipectomy.

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124

Hair follicles are found in which of the following layers of the scalp?

(A) Epidermis
(B) Papillary dermis
(C) Reticular dermis
(D) Subcutaneous layer

The correct response is Option D.

The hair follicles are located within the subcutaneous layer of the scalp. Human hair is primarily composed of the keratin protein; the hair shaft is produced by the matrix, which is in turn produced by the follicle. Hair follicles are indentations of the epidermis located within the subcutaneous layer of the scalp. It is important to know the anatomy of the hair follicle in order to successfully harvest and transplant scalp hair, which can be retained with some degree of permanence following transplantation. Because successful punch grafting depends on meticulous technique, the grafts should be harvested at the appropriate depth while avoiding trauma to the hair follicles.

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125

A 1-year-old child with Pierre Robin sequence has normal mandibular growth. His jaw deformity is best described as

(A) brachygnathia
(B) hypoplasia
(C) microgenia
(D) micrognathia
(E) retrognathia

The correct response is Option E.

Retrognathia, which is defined as posterior displacement of the chin with normal mandibular dimensions, is best used to describe the findings seen in this patient with Pierre Robin sequence. Other terms such as brachygnathia, micrognathia, congenital mandibular atresia, mandibular hypoplasia, and mandibular hypotrophy have been used in the description of this condition. However, because all of these terms denote abnormalities in mandibular growth, they are frequently used incorrectly; instead, normal mandibular growth is a classic finding of Pierre Robin sequence. In addition, the surgeon should be aware that the growth potential in patients with retrognathia and posterior displacement of the chin on external manipulation is excellent. Pierre Robin sequence is also characterized by respiratory obstruction and glossoptosis.

Microgenia is defined as abnormal development in the region of the mental symphysis. However, this term can be differentiated from micrognathia because all of the mandibular components do not have to be involved; instead, some patients have an isolated small chin deformity with normally-sized jaw components. Microgenia can also occur in conjunction with mandibular hypoplasia or mandibular prognathism.

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126

Which of the following is the most likely result following the intralesional injection of corticosteroids for treatment of keloids?

(A) Absence of adverse effects on the surrounding tissues
(B) Decreased risk for malignant degeneration
(C) Decreased risk for recurrence
(D) Lack of effectiveness on the connective tissue composition of the keloid
(E) Symptomatic relief of itching and burning

The correct response is Option E.

Intralesional corticosteroid injections are among several therapies used for treatment of keloids. Other therapeutic modalities include application of occlusive silicone dressings, use of compressive pressure earrings or dressings, interferon therapy, radiation therapy, cryosurgery, and laser or surgical excision. None of these treatments have been shown to be totally effective; however, corticosteroids have been shown to relieve the itching and burning symptoms associated with the keloids, as well as to decrease the collagen content of the keloids and subsequently decrease their size. Excision performed concomitantly with injection of corticosteroids will reduce the rate of recurrence to 30% to 50%. Low-dose radiation therapy administered postoperatively is associated with a similarly reduced rate of recurrence.

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127

A 2-year-old child is being evaluated because he has deformities of the eyelids and upper face. Examination shows large epicanthal folds of the lower eyelids with epicanthus inversus, horizontal shortening of the eyelids, and 5 mm of ptosis bilaterally. Levator excursion is 4 mm. These findings are most consistent with

(A) blepharochalasis
(B) blepharophimosis syndrome
(C) blepharospasm
(D) congenital epicanthus
(E) epiblepharon

The correct response is Option B.

Blepharophimosis syndrome, which is classified according to three types, is a form of congenital ptosis. Patients with blepharophimosis syndrome, type 1 have large epicanthal folds with epicanthus inversus, horizontally shortened eyelids, and severe ptosis. Patients with type 2 have telecanthus, absence of the epicanthal folds, severe bilateral ptosis, absence of levator function, and skin shortage involving all four lids. Blepharophimosis syndrome, type 3 involves absence of epicanthal folds, telecanthus, an antimongoloid slant of the palpebral fissures, severe ptosis, mild orbital hypertelorism, and skin deficiencies. As with many congenital syndromes, the malformations are isolated. Forehead and ear anomalies are also common. Although epicanthus and epiblepharon comprise a portion of this patient's condition, the presence of severe congenital ptosis leads to a diagnosis of blepharophimosis syndrome type 1.

Surgical correction of blepharophimosis syndrome involves repair of the epicanthal folds and correction of eyelid ptosis. Levator resection, medial canthoplasty, and fascial suspension techniques have all been used in combination to correct the abnormalities. A five-flap technique that combines double Z-plasties and a Y-to-V flap is most often used for repair of the epicanthal folds. Ideally, the canthus should lie halfway between the pupil and the center of the nasal bridge following all repair procedures.

Blepharochalasis and blepharospasm are not seen in patients with blepharophimosis syndrome.

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128

A 43-year-old woman who recently lost 45.5 kg (100 lb) has severe skin laxity of the arms with moderate fat deposition. The most likely cause of her current findings is loosening of which of the following fascia?

(A) Clavipectoral
(B) Colles'
(C) Deltoid
(D) Pectoralis major
(E) Scarpa's

The correct response is Option A.

This patient's skin laxity is most likely caused by a loosening of the clavipectoral fascia. Anatomic studies have shown that in youth the soft tissues of the posteromedial arm are firmly suspended to a tough yet dynamic fascial system sling that ultimately gains its strength from the clavicular periosteum by means of the clavipectoral and axillary fasciae. The clavipectoral fascia lies deep to the pectoralis major muscle and extends from the clavicle to the dome of the axillary fascia. Loosening of these connections, combined with relaxation of the fascia itself with age, weight fluctuations, and gravitational pull, results in significant ptosis of the posteromedial arm. Other mechanisms contributing to arm ptosis include relaxation and stretching of the skin and superficial fascial system of the arm, as well as flaccidity of the posterior arm muscles resulting from age and lack of exercise. Fascial anchoring brachioplasty is used to correct this deformity.
Fascial anchoring and suspension of the superficial fascial system can be used in body contouring of other sites in the trunk and extremities, including Colles' fascia in the medial thigh lift and Scarpa's fascia in abdominoplasty. The deltoid and pectoralis major fascia have no effect on upper arm laxity.

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129

A 23-year-old man who has the blue-green tattoo shown in the above photograph wishes to undergo tattoo removal. Which of the following is the most appropriate management?

(A) Carbon dioxide laser ablation
(B) Serial excision
(C) Excision and full-thickness skin grafting
(D) Multiple treatments with the Q-switched Nd:YAG laser
(E) Dermabrasion

The correct response is Option D.

The Q-switched Nd:YAG and alexandrite lasers are best used for removal of blue-green tattoo pigments. In contrast, the Nd:YAG laser works best for red, brown, and orange pigments, while the Q-switched ruby laser is used to remove tattoos with violet and purple pigments. Because professional tattoos often extend deep within the dermis, multiple treatments are required.

Because it causes minimal damage to adjacent tissues, the carbon dioxide laser is effective for ablation (skin resurfacing), cutting, and coagulation. Although serial excision can be used in the treatment of traumatic tattoos, scarring is a common sequela. Dermabrasion is recommended for small traumatic tattoos.

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130

Which of the following structures provides sensation to the upper cranial surface of the ear?

(A) Anterior branch of the great auricular nerve
(B) Arnold's branch of the vagus nerve
(C) Auriculotemporal nerve
(D) Lesser occipital nerve
(E) Posterior branch of the great auricular nerve

The correct response is Option D.

Branches of the lesser occipital nerve supply sensation to the upper cranial surface of the ear and skin of the anterior and superior surfaces of the external auditory canal. The anterior branch of the great auricular nerve (which forms from branches of cervical nerve roots C2-3 within the cervical plexus) supplies sensation to the lower half of the lateral surface of the ear, while the posterior branch innervates the lower portion of the cranial surface of the ear. The auriculotemporal nerve provides sensation to the anterosuperior surface of the external ear. Arnold's nerve, which is a branch of the vagus nerve, supplies sensation to the skin of the concha and posterior ear canal.

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131

The dorsal nasal flap is most appropriate for coverage of which of the following defects of the nose?

(A) A 1-cm defect of the alar base
(B) A 1-cm defect of the columella
(C) A 2-cm defect of the medial canthus
(D) A 2-cm defect of the nasal tip
(E) A 3-cm defect of the lateral wall

The correct response is Option D.

The dorsal nasal flap was first described in 1967. Flap transfer usually involves rotation and caudal advancement of the entire skin of the nasal dorsum and the glabella. It also can be accomplished in a single-stage procedure while the patient is receiving local anesthesia. Since its introduction, the dorsal nasal flap has been modified by many surgeons. For example, the pedicle can be back-cut to the angular artery, and the glabellar portion of the flap need not be used.

The dorsal nasal flap provides an excellent color, texture, and thickness match, which is its greatest advantage. It is predominantly used to cover defects that occur following excision of lesions of the nasal tip. Defects as large as 2 cm may be covered with this flap. A potential disadvantage associated with use of this flap is the violation of other aesthetic subunits of the nose.

A dorsal nasal flap will not reach a columellar defect. A medial canthal defect is easily reconstructed using a skin graft or small local flap. A nasolabial flap is best used for coverage of a defect of the alar base. A 3-cm defect is beyond the limits of a dorsal nasal flap; a flap that provides additional tissue (such as a forehead flap) would likely be needed to close this defect.

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132

A 68-year-old woman seeks correction of drooping eyelids and impaired upward gaze. Physical examination shows excessive hooding of the upper eyelid skin; visual field testing confirms obstruction in the upper fields. Levator excursion is 14 mm bilaterally. There is 2 mm of ptosis of the left eyelid; the right eye is unaffected.

In addition to blepharoplasty, which of the following is the most appropriate management?

(A) Division of Müller's muscle
(B) Fasanella-Servat procedure
(C) Fascial sling
(D) Levator advancement
(E) Resection of the levator muscle

The correct response is Option D.

Bilateral blepharoplasty with fat pad removal and ptosis repair using levator advancement will address this woman's visual field defect and mild ptosis. These procedures are used for patients with normal levator function (defined as greater than 10 mm). Bilateral upper eyelid blepharoplasty alone or in conjunction with fat pad removal would not correct the ptosis, while repair of the ptosis only would not address the visual field obstruction.

This patient has a common problem that requires thorough preoperative evaluation. Visual field obstruction is evaluated clinically and verified using standard visual field testing. Examination of levator function involves stabilizing the brow and measuring the excursion of the upper eyelid margin from downward gaze to upward gaze with the eyes fixed on a distant point. The normal distance between the upper and lower limbi across the pupil is 11 mm. The upper limbus should rest 2 mm below the superior edge of the iris and 2 mm above the superior edge of the pupil.

Division of Müller's muscle would not correct the ptosis.

The Fasanella-Servat procedure is used to correct minimal ptosis but is a more difficult, complicated procedure than levator plication. Accessibility to involved structures is limited with this procedure.

Bilateral blepharoplasty combined with fat pad removal and ptosis repair using a fascial sling is recommended to correct congenital ptosis, defined as ptosis of more than 4 mm and levator function of less than 5 mm.

Resection of the levator muscle is excessive and unnecessary in patients with minimal acquired ptosis.

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133

A 13-year-old boy has a pigmented, slightly raised nevus on the thigh. He has no history of malignant tumors and there is no family history of melanoma. Histologic examination of an excisional biopsy specimen of the lesion shows findings consistent with juvenile melanoma; the surgical margins are free of tumor.

Which of the following is the most appropriate next step?

(A) No additional treatment
(B) Referral to an oncologist for chemotherapy
(C) Interferon therapy
(D) Isolated limb perfusion
(E) Wide local excision

The correct response is Option A.

Benign juvenile melanoma is referred to by many terms, including Spitz nevus, spindle cell nevus, and epithelioid nevus. This solitary tumor is typically pink to red in color and is most likely to appear on the face in childhood. Although it can be initially mistaken for melanoma, histologic examination of a biopsy specimen will show giant spindle cells; it is believed to be a histologic variant of the compound nevus. Because it is benign, conservative treatment or complete excision is recommended. In this patient, no further treatment is required.

Chemotherapy, interferon therapy, limb perfusion, and wide excision are all options for management of malignant melanoma confirmed by histology.

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134

The above photographs are of a 34-year-old woman who is disappointed with the aesthetic result 18 months after undergoing primary rhinoplasty. She says that her lower nose looks pointy and that she has nasal obstruction with deep breathing. On examination, she has alar collapse with inspiration.

Which of the following is the most appropriate operative management?

(A) Cartilage grafting to increase tip support
(B) Cephalic trimming of the lower lateral cartilages to increase nasal projection
(C) Osteotomies to narrow the upper nose
(D) Weir resections to decrease alar flare
(E) Trimming of the dorsal septum to correct the polybeak deformity

The correct response is Option A.

This patient has a polybeak deformity caused by excessive reduction during the primary rhinoplasty procedure, combined with poor projection of the nasal tip. The obstruction with inspiration is suggestive of alar collapse; the nasal tip is pinched and lacks support. The most appropriate next step in management is cartilage grafting of the nasal tip and alae to increase support.

Although the alae appear flared because of the absence of tip support, the lower lateral cartilages have already been trimmed excessively, and their appearance would only worsen with further trimming. In the same way, the upper nose appears wide because of the tip deficiency, but is instead an appropriate width, as demonstrated by the smooth curve from the rim of the brow to the nose, and would not benefit from osteotomies. Weir resections would only accentuate the pinched nasal tip. Because this patient's problems have resulted from excessive reduction of the dorsal septum, any further reduction would only worsen the deformity.

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135

Which of the following is the most common complication of performing full abdominoplasty in combination with suction lipectomy?

(A) Infection
(B) Nerve injury
(C) Seroma formation
(D) Skin necrosis
(E) Wound dehiscence

The correct response is Option C.
The most common complication of a full abdominoplasty performed in conjunction with suction lipectomy is the formation of seromas. Although this remains a serious problem, steps that can be taken to reduce the potential risk for the development of seromas include avoiding electrocoagulation for dissection, limiting the quantity of local anesthetic used, securing the flap with quilting sutures, and maintaining adequate wound drainage.

Infection, nerve injury, skin necrosis, and wound dehiscence are all less common complications. The prophylactic use of antibiotics and antibiotic irrigation will help to minimize the potential for wound infection. The risk for skin necrosis and skin slough is increased when abdominoplasty procedures are combined with suction lipectomy; a history of smoking or diabetes mellitus, as well as the presence of abdominal scars, can also increase the patient's risk for necrosis. Wound dehiscence can result from inferior surgical techniques, excess wound tension, and insufficient placement of deep dermal sutures.

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136

A 50-year-old woman has right eyelid ptosis of 2 mm two days after undergoing uncomplicated four-eyelid blepharoplasty under local anesthesia. On physical examination, there is moderate edema of the upper and lower eyelids. Which of the following is the most appropriate next step in management?

(A) Reassurance and continued follow-up examinations
(B) Eyelid massage and stretching exercises
(C) Administration of phenylephrine eyedrops
(D) Immediate operative exploration of the eyelid
(E) Levator plication seven days after the initial procedure

The correct response is Option A.

Ptosis of a mild to moderate degree is a common finding following blepharoplasty; common causes include postoperative edema of the eyelids and hemorrhage into Müller's muscle. Because these complications generally resolve spontaneously over time, reassurance and observation with frequent follow-up examinations are most appropriate.

Eyelid massage and stretching exercises are effective for management of early ectropion of the lower lids. Phenylephrine eyedrops are only indicated if the ptosis is caused by Horner's syndrome. Although operative exploration is warranted in patients who have eyelid discrepancies following blepharoplasty, it would not be useful in this patient who did not initially undergo repair of the levator mechanism. Instead, surgical treatment in this patient should be delayed for two to six months to allow for spontaneous recovery.

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137

A 55-year-old man who has had stable hair loss for the past several years wishes to undergo hair transplantation. Conservative management with administration of finasteride has not been successful. On examination, he has Hamilton's class 6 male pattern alopecia that extends from the anterior hairline to the vertex. He has dense, curly hair in the parieto-occipital region of the scalp and excellent scalp vascularity and elasticity.

Which of the following is the most appropriate initial management?

(A) Psychological profile and screening
(B) Trial therapy with minoxidil
(C) Establishing the anterior hairline with punch grafts
(D) Establishing the anterior hairline with scalp flaps
(E) Sagittal scalp reduction

The correct response is Option E.

Scalp reduction is currently the most appropriate management of male pattern alopecia. This technique is simple and associated with few complications. Surgical removal of the hairless scalp will diminish the total area that requires grafting and will assist with conservation of donor sites. Although various excision patterns can be used based on baldness pattern, sagittal excision patterns are preferred because they will remove the greatest amount of bald skin due to the excess of scalp laxity seen in the sagittal plane. The surgeon should perform scalp reduction before surgically re-establishing the anterior hairline.

Minoxidil is an antihypertensive drug that has been shown to increase hair growth when applied to the scalp of men who have thinning hair. However, this drug does not work in patients who have extensive hair loss, such as those with Hamilton's class 6 or class 7 male pattern alopecia. Although the exact mechanism of action resulting in hair growth is not completely known, local vasodilation may be causative.

Psychological screening is not routinely performed in patients who request treatment of male pattern alopecia.

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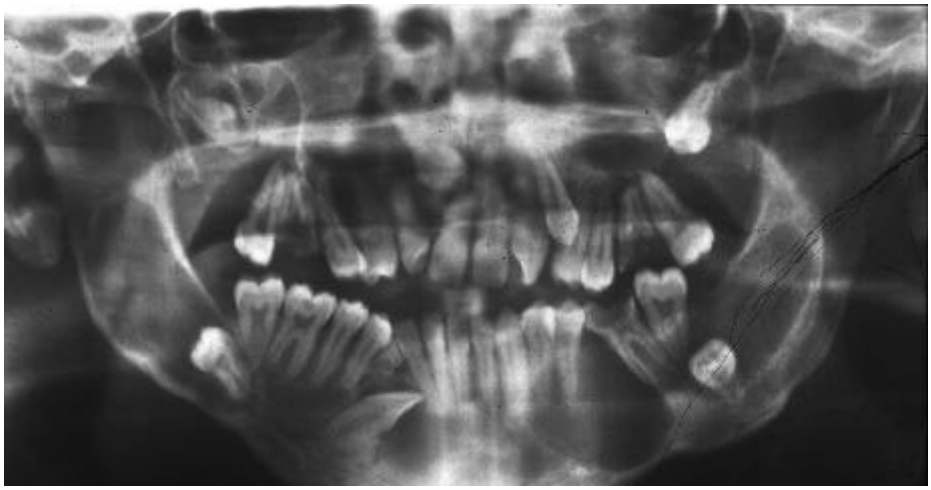

A 56-year-old man has the findings shown in the above panoramic radiograph. He has a history of malignant skin tumors since childhood. These findings are most consistent with

(A) Bazex syndrome
(B) dermatofibroma protuberans
(C) multiple seborrheic keratoses
(D) nevoid basal cell carcinoma syndrome
(E) xeroderma pigmentosum

The correct response is Option D.

This patient has findings consistent with nevoid basal cell carcinoma syndrome, also known as Gorlin's syndrome. This autosomal dominant disorder initially presents during childhood as multiple basal cell epitheliomas; other findings include odontogenic mandibular cysts, palmar pits, bifid ribs, vertebral abnormalities, and intracranial calcifications. The scalp, face, neck, and back are affected most frequently. Management consists of simple excision of the lesions and frequent follow-up examinations to monitor for recurrence.

Manifestations of Bazex syndrome, an X-linked disorder, include kinky hair, hypohidrosis, hypotrichosis, and multiple basal cell carcinomas. Dermatofibroma protuberans involves the development of a hard, raised, fibrous tumor in patients ages 20 to 40 years. Although local recurrence is frequent, metastasis is rare. Seborrheic keratoses are sharply circumscribed, benign, waxy papillomatous lesions that have a "stuck on" appearance. Xeroderma pigmentosum is an extremely rare autosomal recessive disorder first seen in childhood; it is characterized by epithelial neoplasms, photophobia, premature aging, and freckling. This condition is caused by a defect in the DNA repair mechanism of ultraviolet photodamage.

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139

A 45-year-old woman who underwent bilateral augmentation mammaplasty with silicone gel implants 20 years ago has developed capsular contracture involving one of her implants. She is concerned about the integrity of the implants. Ultrasonography suggests intracapsular rupture of the implant.

Which of the following is the most appropriate next step in management?

(A) Observation
(B) Level-two ultrasonography
(C) Mammography
(D) MRI
(E) Surgery

The correct response is Option E.

This patient who has probable intracapsular rupture of one of her 20-year-old silicone gel implants requires surgery to remove the ruptured implant and periprosthetic capsule. Test characteristics (sensitivity and specificity) and implant rupture prevalence have been used to calculate the probability of rupture for various patient scenarios. In asymptomatic patients, the pretest rupture prevalence is estimated at 6.5%. Ultrasonography should be used as an initial diagnostic test because of its relatively low cost. If screening ultrasonography shows no rupture, the probability of rupture drops to 2.2%. No further work-up is necessary. If ultrasonography suggests rupture, the relatively low probability (37.8%) of true rupture requires a confirmatory test using MRI.

In symptomatic patients (ie, patients who have breast asymmetry or capsular contracture), the high prevalence of rupture markedly raises the probability of rupture after positive findings on ultrasonography. In symptomatic patients whose implants are no more than ten years old, the prevalence of rupture is estimated to be 31%. Positive ultrasonography increases the probability of true rupture to 79.7%, and this probability is increased to 97.5% if a follow-up MRI shows rupture. In this woman and other symptomatic patients whose implants are more than ten years old, the high probability of true rupture (94%) after positive findings on ultrasonography obviates the need for any further diagnostic testing such as MRI.

Observation is inadequate because implants that are known or suspected to be ruptured should be removed. Mammography is recommended for screening of benign and malignant diseases. However, evaluation of implant status by routine mammography is limited, particularly in cases of intracapsular rupture. Not all of the implant and surrounding breast tissue can be visualized, and patients with severe capsular contracture and painful breasts may not be able to undergo the compressive technique required to execute the study. Only when the silicone has migrated away from the fibrous capsule (extracapsular rupture) can mammography offer accurate diagnosis.

Level-two ultrasonography is a diagnostic maneuver used to evaluate a fetus in the obstetrical setting.

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140

A 25-year-old man has complete loss of the upper two-thirds of the right ear two years after sustaining a burn injury to the ear. On examination, the ear lobe and lower part of the conchal cartilage are viable and have adequate skin coverage; the ear canal is open. Scarred skin surrounds the ear remnant.

Which of the following is the most appropriate operative procedure for correction of this patient's deformity?

(A) Creation of the upper ear with a rib cartilage framework and coverage with a local skin flap
(B) Creation of the upper ear with a rib cartilage framework and coverage with a pre-expanded local skin flap
(C) Creation of the upper ear with a rib cartilage framework and coverage with a temporoparietal fascial flap and a split-thickness skin graft
(D) Creation of the upper ear with a Silastic framework and coverage with a local skin flap
(E) Creation of the upper ear with a Silastic framework and coverage with a temporoparietal fascial flap and a split-thickness skin graft

The correct response is Option C.

The most appropriate surgical procedure for correction of this patient's deformity is creation of the upper ear using a rib cartilage graft and coverage with a temporoparietal fascia flap and a split-thickness skin graft. These procedures will most likely result in a satisfactory outcome for this difficult reconstructive problem. The rib cartilage can be carved into an appropriate framework and covered with a thin temporoparietal fascia flap; a thin split-thickness skin graft can be used to create the intricate detail of the external ear. When successful, this reconstruction will be durable and long-lasting.

Local skin is the coverage material of choice in classic microtia reconstruction; however, when the ear remnant is surrounded by scarred skin, as in this patient with a burn injury, it will not stretch adequately to cover the framework and show detail. Skin expansion will fail because scarred skin expands poorly.

Silastic frameworks can give good early results but are not long-lasting. Because even the most minor trauma or wound problem can lead to total loss of the reconstruction, Silastic frameworks are not a good choice for reconstruction.

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141

The Fitzpatrick skin classification stratifies patients according to

(A) actinic skin damage and fine wrinkle formation
(B) the potential for pigmentary changes following chemical peeling
(C) their risk for cardiac toxicity associated with phenol peeling
(D) their risk for hypertrophic scarring following skin resurfacing
(E) thickness and laxity of facial skin

The correct response is Option B.

Fitzpatrick's system is the most widely used method for classifying patients according to skin type in order to stratify their risk for the development of postinflammatory hyperpigmentation following chemical peeling and laser skin resurfacing. This method of classification is based on the patient's skin pigmentation and subsequent response following exposure to ultraviolet light. A table representing this classification system is shown below.

Skin Type	Skin Color	Characteristics
I	White	Always burns, never tans
II	White	Usually burns, tans less than average
III	White	Sometimes mildly burns, tans about average
IV	White	Rarely burns, tans more than average
V	Brown	Rarely burns, tans profusely
VI	Black	Never burns, deep pigmentation

Patients who have Fitzpatrick type I, type II, or type III skin have the lowest risk for development of hyperpigmentation following chemical peeling. In contrast, patients with type IV, type V, or type VI skin are at increased risk for pigmentary changes.

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142

A 42-year-old woman who desires correction of perioral and periorbital rhytids begins therapy with 0.025% tretinoin. Which of the following responses is most likely to be seen in this patient?

(A) Hypertrichosis
(B) Increased type III collagen
(C) Partial-thickness burn
(D) Subcutaneous atrophy
(E) Thinning of the dermis

The correct response is Option B.

Histologically, long-term application of tretinoin results in the formation of new type III embryonic collagen; this process is believed to be caused by activation of fibroblasts. This derivative of vitamin A, also known as retinoic acid, results in obliteration of atypia and microscopic actinic keratoses when applied once daily at a strength of 0.025% to 0.05%. Improvement of rhytids is not immediate, occurring instead over six to 12 months. During this time, the dermis becomes markedly thickened and the elasticity of the skin greatly increases; the latter is due to an increase in collagen levels of as much as 80%. Adverse effects are frequent and may include erythema, peeling, xerosis, pruritus, and the onset of a sunburn sensation.

Use of retinoic acid does not affect hair growth or loss. A partial-thickness burn is never associated with tretinoin therapy.

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143

A 50-year-old woman has pruritus and irritation of the upper eyelids and is unable to close her eyes two weeks after undergoing blepharoplasty and coronal browlifting. On examination, Bell's phenomenon is observed during attempted closure with the upper eyelids open 4 mm. Which of the following is the most appropriate next step in management?

(A) Schirmer's testing
(B) Slit-lamp examination
(C) Corneal lubrication
(D) Skin grafting
(E) Tarsorrhaphy

The correct response is Option C.

In this patient who has developed lagophthalmos after blepharoplasty and browlifting, the most appropriate next step in management is corneal lubrication. This can be accomplished by applying a bland ointment before bedtime and using saline solution and/or artificial tears during the day. This regimen may be required for weeks to months before the eyelids return to their natural state during sleep.

Schirmer's testing can be used to measure the quantity of tear production, while slit-lamp examination will indicate any ulceration on the cornea or conjunctiva. Both tests may be necessary for evaluation of this patient's condition but are not the logical first step. Ophthalmologic consultation may also be indicated at a later date.

Skin grafting would not be the next best step but may be required in the future if the amount of skin shortage is excessive and corneal dryness leads to keratitis and ulceration. Although lateral tarsorrhaphy was used in the past to treat lagophthalmos associated with facial paralysis, it is rarely indicated in patients who develop the condition following eyelid surgery. If surgery is required, horizontal eyelid shortening and medial or lateral canthoplasties would be more appropriate.

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144

Six months after undergoing bilateral otoplasty for correction of prominent ears, a 27-year-old man has recurrent prominence of the upper half of the left ear. At follow-up examination one month after surgery, the ears appeared symmetric. Which of the following is the most likely cause of this patient's recurrent deformity?

(A) Disruption of the conchal-mastoid sutures
(B) Disruption of the sutures used to create the antihelical fold
(C) Inadequate excision of cartilage from the concha
(D) Inadequate excision of skin from the posterior ear
(E) Incorrect placement of the postoperative dressing

The correct response is Option B.

The most likely cause of this patient's recurrent prominence of the upper half of the left ear is inadequate placement of sutures used in the creation of the antihelical fold. Lack of formation of the antihelical fold is one of the most common causes of prominent ears. Surgical creation of the fold can be accomplished with permanent sutures alone, cartilage incision or resection combined with sutures, or abrasion of the lateral ear cartilage with or without sutures. When used alone, sutures are usually very effective in the creation of the antihelical fold in children because their ear cartilage is soft and pliable. In adults, who have less pliable cartilage, sutures can be used alone to create a fold, but frequently other techniques must be performed to allow the cartilage to bend. When sutures are used alone, they must be permanent and precisely placed, or relapse can occur.

Excision of conchal cartilage, skin resection, placement of conchal-mastoid sutures, and placement of the postoperative dressing, while all vital aspects of otoplasty for prominent ears, are less likely to be involved in recurrence of the deformity than the inadequate creation of the antihelical fold, which is most commonly associated with recurrence of the deformity.

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145

In the upper eyelid, the fat pads are found directly anterior to which of the following structures?

(A) Anterior lamella
(B) Levator aponeurosis
(C) Müller's muscle
(D) Orbicularis
(E) Orbital septum

The correct response is Option B.

Two fat pads (nasal and central) are found in the upper eyelid. The preaponeurotic fat pads are located anterior to the levator aponeurosis and posterior to the orbital septum. The three fat pads in the lower eyelid are located anterior to the inferior retractors. In the lower eyelid, the inferior oblique muscle separates the nasal (medial) and central (middle) fat pads, while a fascial sheath separates the central and temporal (lateral) fat pads. In general, the nasal fat pad in the upper and lower eyelids is more pale in color than are the central or temporal fat pads.

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146

A patient develops a supraumbilical bulge after undergoing full abdominoplasty and suction lipectomy of the abdomen and flanks. Which of the following is the most likely cause?

(A) Failure to plicate the rectus muscle
(B) Inadequate skin resection
(C) Inadequate suction lipectomy
(D) Loose fascial suspension
(E) Umbilical malpositioning

The correct response is Option A.

In this patient who has developed a supraumbilical bulge after undergoing a combined full abdominoplasty and suction lipectomy procedure, the most likely cause is a failure to plicate the rectus muscle. In standard abdominoplasty procedures, a low horizontal or W-shaped skin incision is made. The rectus diastasis is typically marked and then directly plicated both above and below the umbilicus and tapered superiorly toward the xiphoid. Alternately, the surgeon can create an incision into the fascia and then plicate the muscle in the same manner. If neither of these techniques is performed, a relative laxity of the upper abdominal region can develop, resulting in the appearance of a supraumbilical bulge.

Fixation of the skin flap to the umbilicus will relieve tension in the lower portion of the flap. Telescoping of the umbilicus is performed in the midline at the level of the anterosuperior iliac spine. Suction lipectomy is typically used for reduction of redundant fat deposits along the flanks, waistline, and iliac regions. The suctioning should be adjusted on a patient-by-patient basis. Repair of the superficial fascial system will diffuse tension on the skin flap, lift areas of soft-tissue excess more effectively, and provide lasting support. This technique is now considered critical to the success of body contouring procedures involving the trunk and extremities.

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147

A 73-year-old farmer with severely sun-damaged skin has 15 scaly lesions smaller than 1 cm on the face. He reports that the lesions have progressively increased in size and number over the past six months. Which of the following is the most appropriate management?

(A) Phenol peeling
(B) Cryosurgery
(C) Topical 5-fluorouracil therapy
(D) Topical tretinoin therapy
(E) Surgical excision

The correct response is Option C.

This patient has findings consistent with multiple actinic keratoses, or rough, scaly, discrete lesions of the epidermis that are premalignant precursors of squamous cell carcinoma. If the lesions are few and/or isolated, appropriate management can consist of cryosurgery, curettage, or surgical excision. However, these therapies are impractical in patients who have numerous, diffuse nevi on the face or upper extremities. Therefore, in patients such as this one, topical treatment with 5-fluorouracil for three weeks will effectively remove the keratoses. Any remaining lesions should then be excised surgically due to the patient's risk for development of invasive carcinoma.

Phenol peeling can also be used to remove keratoses but is an invasive procedure with a longer and more difficult recovery phase. Tretinoin is substantially less effective than 5-fluorouracil and would exert only minimal effects in patients with diffuse keratoses.

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148

A 34-year-old woman desires an improved aesthetic appearance of the chin. On physical examination, she has a bony chin deformity characterized by sagittal deficiency and vertical mandibular excess. She has class I occlusion. Which of the following genioplasty procedures should be performed in this patient?

(A) Asymmetric genioplasty
(B) Interposition genioplasty
(C) Jumping genioplasty
(D) Sliding genioplasty
(E) Silastic implantation

The correct response is Option C.

This 34-year-old woman who has a bony chin deformity should undergo jumping genioplasty. In this procedure, the transverse osteotomy is performed initially, decreasing the vertical dimension of the chin; following this, the osteotomized segment is transposed anteriorly with its attached suprahyoid musculature to augment the sagittal deficiency.

Asymmetric genioplasty involves adjusting the lines of osteotomy in multiple vectors in order to correct a misshapen chin. Interposition genioplasty can be performed to increase the vertical and sagittal dimensions of the chin; autogenous bone or hydroxyapatite can be grafted to the osteotomy site. Although sliding genioplasty can be used for correction of a sagittal deficiency or an excessively large chin, the change in vertical chin dimension seen following this procedure is only minimal. Silastic implantation will correct the sagittal deficiency but not the vertical excess.

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149

In a 46-year-old woman who is scheduled to undergo browlifting, the highest brow peak should be positioned vertically above which of the following points in order to obtain the preferred aesthetic result?

(A) Lateral canthus to lateral orbital wall
(B) Lateral limbus to lateral canthus
(C) Medial canthus to medial limbus
(D) Medial limbus to midpupil
(E) Midpupil to lateral limbus

The correct response is Option B.

Both the position and shape of the brow may be changed following browlifting. Careful preoperative discussion can delineate the patient's aesthetic sense and operative desires.

In one study of 11 aesthetic plastic surgeons and 9 cosmetologists who studied photographs of faces altered by computer graphics, both groups of evaluators preferred eyebrows that had a lateral apex rather than medially based apex or a flattened shape. Interestingly, this study also reviewed postoperative pictures of 100 patients in the literature and found that browlift surgery does not usually produce these ideal results. Brows are often too high and medially elevated following surgery.

In another study, computer imaging was used to alter the eyebrows of fashion models, and then plastic surgeons and patients were surveyed. The eyebrow preferred by both groups began in a lower position medially and peaked from the lateral limbus to the lateral canthus, beginning its descent by the lateral orbital wall.

The aesthetics of male brows were found to be different from the aesthetics of female brows. The male brow is lower, generally at the orbital rim, and the brow is usually horizontal without significant peaking.

Familiarity with ideal eyebrow aesthetics will aid in the differential elevation and shape needed in browlifting procedures.

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150

A 54-year-old woman has a 1.75-cm cutaneous defect of the alar skin after undergoing excision of a basal cell carcinoma. The alar cartilage and nasal lining are intact. Which of the following flaps is most appropriate for reconstruction of the defect?

(A) Banner flap
(B) Cheek advancement flap
(C) Forehead flap
(D) Frontal nasal flap
(E) Nasolabial flap

The correct response is Option E.

The nasolabial flap is most appropriate for coverage of this patient's defect, which involves the lateral nasal ala and is positioned inferior to the alar crease and adjacent to the margin of the alar rim. This flap has the necessary size, color, texture, and thickness matches for reconstruction of the external nasal skin, and has excellent vascularity. The superiorly based nasolabial transposition flap would be best for this patient; nasolabial flaps can also be designed as advancement or subcutaneous flaps.

The banner flap is the best choice for coverage of nasal tip defects. This flap can be expanded to cover defects as large as 1.2 cm; a bi-lobe design can be used for defects larger than 1.2 cm, and primary closure of the donor site is still possible. The cheek advancement flap is a good choice for repair of defects of the lateral nose above the alar crease. The frontal nasal flap can be used to resurface central defects involving the caudal third of the nose. This flap can be modified and extended to reach defects of the lateral nose. The forehead flap provides excellent coverage of the nasal tip but is aesthetically less pleasing for replacement of the alar skin.

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151

A 45-year-old man desires cosmetic improvement of skin ptosis of the posteromedial arms. He has lost 50 lb over the past year, but is currently 20 lb above his ideal body weight. Which of the following is the most appropriate management?

(A) Continued weight loss
(B) Exercise program
(C) Brachioplasty
(D) Suction-assisted lipectomy
(E) Ultrasound-assisted lipectomy

The correct response is Option C.

The most appropriate next step in the management of this patient with arm ptosis is brachioplasty. Brachioplasty is most effective in patients with extensive skin ptosis of the arm. This condition is caused by loosening of the connections of the superficial fascial system of the arm to the axillary fascia. It may occur in conjunction with the aging process or with gravitational pull and/or fluctuations in body weight. During the surgical procedure, the arm flap is securely anchored to the axillary fascia. Complications following this procedure are minimal.

Instead of helping to resolve the ptosis, further weight loss can actually worsen it. In the same way, suction-assisted lipectomy can worsen the ptosis by creating further laxity in the overlying skin. A regimented exercise program is only effective for patients with minimal skin and soft-tissue laxity. The thermal effect of ultrasound-assisted lipectomy will tighten the skin but will not correct the underlying ptosis.

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152

A 26-year-old woman who desires cosmetic rhinoplasty is scheduled to undergo rasping of the nasal hump and reshaping and grafting of the nasal tip followed by Weir excisions. Which of the following factors, if present, will decrease the likelihood of an optimal result in this patient?

(A) Mediterranean heritage
(B) Presence of a bony rather than cartilaginous hump
(C) Smoking history of one-half pack of cigarettes daily
(D) Thickened skin with prominent sebaceous glands
(E) Use of an open technique

The correct response is Option D.

Careful preoperative planning is an essential part of cosmetic rhinoplasty and will vary from patient to patient, depending on each patient's anatomy and desired result following surgery. A patient who primarily desires a smaller or defined nasal tip but has thick skin and prominent sebaceous glands will not experience the postoperative shrinkage necessary to fit the altered nasal cartilage framework; consequently, the nasal tip may still be larger than is desired by the patient. Consequently, the skin thickness should be assessed during preoperative evaluation and discussed with this patient in order to ensure that her expectations are appropriate.

Although people of different heritages have different anatomic traits and possibly different desires for aesthetic outcomes, a successful rhinoplasty can generally be accomplished with adequate planning and input from the patient, whatever his or her ethnicity.

The congenital dorsal hump is often comprised of 50% bone and 50% cartilage. Although the variation from patient to patient can be significant, either type of hump may be successfully reduced; however, different methods of reduction may be required. A small bony hump may be rasped, while larger humps may require the use of a saw or chisel.

A mild-to-moderate smoking history has not been shown to affect rhinoplasty, most likely because of the excellent blood flow within the nasal plexus.

Both open and closed rhinoplasty techniques can be successfully used in cosmetic rhinoplasty. Open rhinoplasty offers better visualization of the tip cartilage but is associated with greater postoperative edema and the potential development of an external scar. However, the type of exposure should not affect the outcome of the rhinoplasty.

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153

A 25-year-old man has ectropion and excessive scleral show one year after sustaining a chemical burn of the lower right eyelid, which was allowed to heal without surgical intervention. He currently uses ocular ointments daily. Which of the following is the most appropriate management?

(A) Scar massage and intralesional injection of a corticosteroid
(B) Full-thickness skin grafting
(C) Insertion of a gold eyelid weight
(D) Lateral canthoplasty
(E) Lateral tarsal wedge excision

The correct response is Option B.

Ectropion involves eversion of the eyelid margin; it frequently occurs in the lower eyelid as a result of the pull of gravity on the unsupported eyelid tissue. It is usually the result of mechanical (involutional or senile), cicatricial, or neurogenic causes.

This patient has classic cicatricial ectropion, which has resulted from abnormally healing burn wounds. The ectropion has occurred as a result of scar contracture of the anterior lamella of the lower eyelid, leading to excessive scleral show and exposure keratopathy. Full-thickness skin grafting is recommended to replace lost tissue and prevent secondary contracture. In addition, complete release of contracted soft tissues and use of added supporting materials such as cartilage should be considered.

Scar massage and intralesional injection of a corticosteroid would not improve a fixed, foreshortened lower eyelid.

Neurogenic ectropion is best treated by correction of the associated upper eyelid lagophthalmos using inserted prosthetic devices (eg, gold eyelid weights).

In patients with involutional ectropion, there is progressive laxity of the lower eyelid; the lower eyelid retractors or capsulopalpebral fascia becomes disinserted from the inferior border of the tarsal plate. Corrective surgical procedures include lateral canthoplasty, lateral wedge excision, and the Kuhnt-Szymanowski technique, which involves excision of a full-thickness wedge from the region of the lateral canthus. The skin excision is then hidden under a subciliary incision.

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154

When performing a transverse thigh/buttock lift, which of the following operative techniques has been shown to decrease the frequency of complications, including widening and inferior migration of scars, traction deformity of the vulva, and early recurrence of thigh ptosis?

(A) Direct undermining of the distal flap
(B) Performing suction lipectomy in conjunction with transverse thigh/buttock lift
(C) Suspension of the superficial fascial system
(D) Use of an anterior medial skin resection pattern

The correct response is Option C.

Suspension of the superficial fascial system of the inferior skin flap has decreased the incidence of unfavorable scars, vulvar traction, and ptosis deformities previously associated with the transverse thigh/buttock lift. Anchoring the skin flap to Colles' fascia anteriorly has lead to more consistent, reliable results following lifting. Other refinements such as direct undermining of the distal flap, performing adjunctive suction lipectomy, and using an anterior medial skin resection pattern have been associated with an improvement in overall results in those patients undergoing transverse thigh/buttock lifts but have not specifically decreased scar widening, traction deformities, and recurrent ptosis. Direct undermining, 3 to 4 cm beyond the planned line of resection, releases the superficial fascial attachments distally and allows for a greater lift. Suction lipectomy addresses fatty contour deformities that do not lie within the planned resection areas of the lift. The anterior medial skin resection pattern addresses skin laxity at the junction of the anterior and medial thigh and eliminates the need for incisions within the posterior buttock folds.

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155

In order to make the diagnosis of Poland's syndrome, which of the following findings must be present?

(A) Absence of the nipple
(B) Absence of the sternal head of the pectoralis major muscle
(C) Brachysyndactyly
(D) Hypoplasia of the latissimus dorsi muscle
(E) Skeletal abnormalities of the chest wall

The correct response is Option B.

All patients diagnosed with Poland's syndrome, a congenital abnormality associated with unilateral findings, have absence of the sternal head of the pectoralis major muscle on the affected side. Some patients with Poland's syndrome have absence of the entire muscle, hypoplasia or absence of the latissimus dorsi or serratus muscles, and/or complete absence of the breast. Other chest wall anomalies also occur unilaterally and can include axillary banding, aplasia or hypoplasia of the nipple, and hypoplasia of the scapula or ribs. Brachysyndactyly of the ipsilateral upper extremity is seen in some patients.

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156

A 62-year-old woman has visual obstruction of the right eye. On examination, she has ptosis of 3 to 4 mm of the right upper eyelid and an elevated supratarsal crease. These findings are most consistent with which of the following conditions?

(A) Dehiscence of the levator aponeurosis
(B) Facial nerve injury
(C) Horner's syndrome
(D) Myasthenia gravis
(E) Periorbital fat atrophy

The correct response is Option A.

The findings in this patient are most consistent with dehiscence of the levator aponeurosis, which is the most common cause of ptosis in elderly persons. Attenuation of the levator aponeurosis typically results. Levator advancement is performed for correction.

Facial nerve injury is a sequela of trauma and may be characterized by eyebrow ptosis.

Horner's syndrome occurs as a result of sympathetic denervation of the superior cervical ganglion. It is characterized by ptosis, myosis, and anhidrosis. The eyelid creases and levator muscle are typically unaffected.

Unilateral or bilateral ptosis secondary to myasthenia gravis is exacerbated with fatigue and can present in young women and elderly men. Neostigmine testing is used to establish the diagnosis.

Periorbital fat atrophy results in pseudoptosis and enophthalmos of the globe.

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157

Which of the following is the most common complication of rhytidectomy?

(A) Facial nerve injury
(B) Hair loss
(C) Hematoma
(D) Infection
(E) Skin slough

The correct response is Option C.

The risk for development of hematoma following rhytidectomy has been reported in various studies to range from 0.3% to 8.1%; however, it is generally reported to occur in approximately 4% of rhytidectomy patients. Male gender and a previous history of hypertension are risk factors. Facial nerve injury is less common, occurring in approximately 1% of patients; hair loss occurs in 1.2% of those undergoing rhytidectomy. Infection is exceedingly rare (0.18% of patients) and is almost always caused by *Staphylococcus* organisms. Skin slough occurs in approximately 2% of rhytidectomy patients and is more common in those who smoke cigarettes.

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158

A 27-year-old man has traumatic absence of the lateral third of the right eyebrow one year after sustaining avulsion and laceration injuries to the forehead and cheek. On current physical examination, there is an avulsion scar in the supraorbital region and a laceration extending from the lateral canthus directly posterior to the temporal scalp, both of which are well healed. The patient would like to undergo reconstruction of the avulsed eyebrow.

Which of the following is the most appropriate reconstructive option?

(A) Composite scalp graft containing hair follicles
(B) Median forehead flap containing hair-bearing tissue from the anterior scalp
(C) Temporal scalp flap based on the ipsilateral superficial temporal artery
(D) Washio flap
(E) Microplug hair transplantation

The correct response is Option A.

In this patient who has absence of the lateral third of the eyebrow resulting from trauma, composite grafting from the scalp is the most appropriate reconstructive option. This technique would be associated with the greatest chance for hair growth in this patient; in addition, the donor scar would be inconspicuous.

Reconstruction with a median forehead flap is a procedure that requires multiple stages and would result in an unsightly donor site scar. Both the temporal scalp flap and Washio flap would be based on the posterior temporal branch of the superficial temporal artery; however, this artery was most likely transected when the patient sustained the facial laceration, eliminating the possibility of using these flaps. Microplug hair transplantation is unreliable over scar tissue, especially traumatized soft tissue and radiated scars.

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159

The deep division of the supraorbital nerve provides sensation to which of the following areas?

(A) Central forehead
(B) Central scalp
(C) Nasal radix
(D) Temporal forehead
(E) Temporal scalp

The correct response is Option B.

Knowledge of the anatomy of the supraorbital nerve is crucial for minimizing the risk for nerve injury and subsequent numbness during endoscopic forehead lifting. The supraorbital nerve is a branch of the ophthalmic division of the trigeminal nerve (V_1). This nerve arises from a foramen or notch along the superior orbital rim, and then divides immediately into deep and superficial branches. The deep division courses laterally toward the superior temporal line of the skull, and then continues to the coronal suture to supply sensation to the central frontoparietal scalp. In contrast, the superficial branch divides into multiple branches, each of which courses cephalad into the frontalis muscle to supply sensation to the central forehead and hairline.

Sensation to the nasal radix is supplied by the supratrochlear and infratrochlear nerves, while the maxillary and mandibular branches of the trigeminal nerve (V_2 and V_3) supply sensation to the temporal forehead. Sensation to the temporal scalp is supplied by the occipital nerve.

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160

Which of the following is associated with reduction mammaplasty using the vertical scar (Lejour) technique?

(A) Central vertical glandular excision
(B) Inferiorly based blood supply to the nipple
(C) Keyhole-pattern skin excision
(D) Precision in determining the endpoint of resection
(E) Wide periareolar skin excision

The correct response is Option A.

Features of the vertical (Lejour) mammaplasty include central vertical glandular excision to improve postoperative shape (by narrowing the breast while maximizing breast projection) and excision of skin in one direction only to decrease scar burden. Vertical mammaplasty is a technique of central breast reduction with undermining of the lower skin, as well as use of adjustable markings and an upper pedicle to maintain the blood supply to the areola.

Keyhole-pattern and wide periareolar resections are not features of the vertical mammaplasty; therefore, circumareolar scar quality is not compromised by excess skin tension. However, because of the central and posterior resection used with this technique, it is more difficult to determine the endpoint of resection.

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161

A 25-year-old woman has numbness of the nasal tip two years after undergoing cosmetic rhinoplasty through an endonasal approach. Which of the following is the most likely cause of the numbness?

(A) Division of the descending branches of the infratrochlear nerve
(B) Division of the supratrochlear nerve
(C) Injury to the external nasal branch of the anterior ethmoidal nerve
(D) Injury to the external nasal branch of the supraorbital nerve
(E) Retraction injury to the branches of the infraorbital nerve

The correct response is Option C.

This patient has sustained an injury to the external nasal branch of the anterior ethmoidal nerve, a structure that is particularly vulnerable to damage during endonasal rhinoplasty procedures. The nerve emerges from between the nasal bone and lateral nasal cartilage, supplying sensation to the skin of the distal nasal dorsum and tip.

The infraorbital nerve supplies sensory innervation to the lower lateral half of the nose and columellar skin, while the infratrochlear nerve supplies the cephalic portion of the nasal side walls and the skin overlying the radix. The supraorbital nerve also innervates the skin of the radix. The supratrochlear nerve supplies sensation to the forehead skin.

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162

A 43-year-old woman is unable to depress the left side of her lower lip after undergoing submental suction lipectomy. On follow-up examination three months later, she has persistent weakness of the lower lip. Which of the following is the most appropriate next step in management?

(A) Reassurance and continued observation
(B) Surgical exploration and nerve repair
(C) Injection of botulinum toxin into the unaffected side
(D) Nerve grafting
(E) Innervated free muscle transfer for facial reanimation

The correct response is Option A.

In this patient who has persistent weakness of the lower lip following submental suction lipectomy, the most appropriate next step is reassurance of the patient and continued observation. Submental suction lipectomy is considered to be a safe procedure as long as the cannula is passed superficial to the platysma; however, if the cannula is placed beneath the platysma, injury to the marginal mandibular branch of the facial nerve may result. According to one study, 81% of dissections found the marginal mandibular branch to be positioned above the inferior border of the mandible, while in 19% of dissections the nerve was positioned 1 cm below the mandible. Large studies of suction lipectomy patients have reported a rate of nerve injury of less than 1%. Because nerves and blood vessels are typically not transected during suction lipectomy, any resulting injuries are likely to be neurapraxias, which in most patients will completely resolve within three months.

Surgical exploration is unnecessary in a patient who has only a slight risk for nerve transection. Injection of botulinum toxin may result in facial symmetry but may also worsen symptoms or make common tasks (such as applying lipstick) more difficult. Nerve grafting and muscle transfers for facial reanimation are not indicated because the deficit will most likely resolve spontaneously. These procedures are typically reserved for correction of a significant facial nerve defect.

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163

The photograph shown above is of a 56-year-old man who underwent open reduction and internal fixation of a malar complex fracture on the right and cranial bone grafting of the right orbital floor three months ago after sustaining bony injuries in a motor vehicle collision. He had no skin lacerations at the time of injury.

Which of the following is the most likely cause of the lower eyelid deformity?

(A) Entrapment of Lockwood's ligament
(B) Inferior displacement of the orbital floor
(C) Loss of skin elasticity
(D) Periorbital fat atrophy
(E) Shortening of the posterior lamella

The correct response is Option E.

This patient's lower eyelid deformity is most likely caused by shortening of the posterior lamella. The lower eyelid is formed by the anterior, middle, and posterior lamellae. The anterior lamella consists of skin and orbicularis oculi muscle. The orbital septum comprises the middle lamella. The posterior lamella, or capsulopalpebral fascia, is comprised of the tarsus muscle, lower lid retractors, and conjunctiva. Injury or scarring of any of these structures can result in malpositioning of the lower eyelid, as seen in this patient. Shortening and scarring of the posterior lamella and septum are most common.

Entrapment of Lockwood's ligament would lead to a loss of globe support, and inferior displacement of the cranial bone grafts and orbital floor would result in dystopia. Scleral show and ectropion resulting from excess skin excision are more typical of cosmetic blepharoplasty than internal fixation. Periorbital fat atrophy can result in scleral show and a change in globe position but rarely causes ectropion in patients with traumatic orbital injuries.

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164

A 24-year-old woman has worsening pain and swelling of the right breast 24 hours after undergoing subpectoral augmentation mammaplasty with smooth, round saline-filled implants. On physical examination, the right breast appears significantly larger and is more firm to palpation than the left breast. There are no signs of erythema or ecchymosis.

Which of the following is the most appropriate next step in management?

(A) Observation
(B) Application of an external compression bandage
(C) Percutaneous needle aspiration
(D) Ultrasound-guided drainage
(E) Surgical exploration

The correct response is Option E.

This patient has findings consistent with a hematoma, which has been shown to develop in 1% to 3% of patients who have undergone breast augmentation. Hematomas can be seen as late as 14 days postoperatively. The most appropriate next step in management is prompt surgical exploration to evacuate the hematoma and ensure careful hemostasis. The implant can be replaced if there is no evidence of infection; the contralateral implant should only be removed if it is affected.

Observation or application of an external compression bandage will only delay the diagnosis and increase the risk for infection or development of capsular contracture. Percutaneous needle aspiration or ultrasound-guided drainage will not completely evacuate the hematoma and will increase the risk for implant perforation.

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165

Ten years after undergoing primary rhytidectomy, a 65-year-old woman is scheduled for a secondary rhytidectomy procedure. Which of the following complications is more likely to occur with this procedure than with the primary procedure?

(A) Distortion of the hairline
(B) Hematoma
(C) Hypertrophic scarring
(D) Skin laxity
(E) Skin slough

The correct response is Option A.

The most likely complication associated with secondary rhytidectomy is distortion of the hairline. Hairline shifts, especially in the temporal region, can result in difficulties with incision placement. Redraping of the facial skin superiorly can result in recession of the temporal hairline with elevation of the sideburn above the helical attachment. When planning a secondary rhytidectomy procedure, the anatomy of the hairline, ear lobes, and tragus should be analyzed.

The risk for hematoma is lower following a secondary procedure than following the initial surgery, as flap dissection and undermining are easier and associated with less blood loss. Because the facial skin is delayed following primary rhytidectomy, the vascular supply to the cervicofacial skin is usually healthy at the time of secondary rhytidectomy, and the risk for hypertrophic scarring or skin slough is minimal. Secondary skin flaps are also able to endure greater tension. Most of the contouring performed during secondary rhytidectomy involves tightening of the lax superficial fascia and not the already tightened facial skin. Therefore, the amount of excess skin removed during the repeat procedure will be less, and skin laxity will not be seen.

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166

The cosmetic result of a 1.5-cm full-thickness skin nasal defect allowed to heal by secondary intention is most acceptable in which of the following locations?

(A) Alar margin
(B) Central nasal tip
(C) Dorsal bridge
(D) Medial canthal area
(E) Soft triangle

The correct response is Option D.

Healing by secondary intention is most acceptable for nasal defects involving the medial canthal area. Although spontaneous healing is mostly overlooked in the management of nasal defects, it should be a consideration in patients with concomitant medical conditions or previous radiation therapy, or in the management of those patients who have developed infection following Mohs' surgery or who refuse to undergo surgery. According to one study of 282 patients, the size and location of the nasal defect best predicted the cosmetic outcome. Defects of the medial canthal area, glabella, philtrum, and nasolabial fold showed good cosmetic results in more than 90% of patients who underwent healing by secondary intention; in contrast, defects of the ala, rim, soft triangle, and nasal tip showed the greatest contracture and rim distortion when allowed to heal by secondary intention. Large defects, involving one subunit, also healed unacceptably. Defects of the nasal dorsum and sidewall had a moderate acceptability rate of 70% to 80%; depressed scars and distortion of the cheek groove were the most commonly sited adverse sequelae. Another study

of patients who underwent healing by secondary intention following radiation therapy for basal cell carcinoma reported an 80% acceptability rate among patients and their physicians. Lesions of the nasal tip were again associated with the poorest aesthetic results.

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167

Aesthetic surgical procedures can be performed in patients who have which of the following disorders of excess skin laxity?

(A) Cutis laxa
(B) Ehlers-Danlos syndrome
(C) Elastoderma
(D) Hutchinson-Gilford syndrome
(E) Werner's syndrome

The correct response is Option A.

Aesthetic surgical procedures can be performed in patients who have cutis laxa, a genetic disorder with variable expressivity that results from a nonfunctioning elastase inhibitor or premature degeneration of elastin fibers. Affected patients have coarsely textured, drooping skin. Because this condition is not associated with wound healing problems, rhytidectomy may be considered if the patient is otherwise healthy.

Ehlers-Danlos syndrome, or cutis hyperelastica, is an inherited disorder of abnormal molecular collagen cross-linking, and is thought to result in a deficiency of the lysyl oxidase enzyme. It is characterized by hyperextensibility and excessive thinness of the skin and hypermobility of the joints. Cosmetic surgery is contraindicated in patients with Ehlers-Danlos syndrome because wound healing is poor and subcutaneous hemorrhages are common.

Elastoderma is a disorder of unknown cause characterized by pendulous skin laxity initially involving the trunk and extremities that progresses to encompass the entire body. Elective surgery is contraindicated because wound-healing mechanisms are unknown.

Progeria, also known as Hutchinson-Gilford syndrome when seen in adults, is an autosomal recessive disorder of unknown cause and is characterized by growth retardation, craniofacial malformations, cardiac disease, and auricular abnormalities, as well as skin laxity, loss of subcutaneous fat, and findings similar to premature aging. Aesthetic surgery is contraindicated because wound healing is poor; in addition, premature death is associated.

Werner's syndrome is a rare autosomal recessive disorder of unknown cause. Associated features include premature aging, cataracts, pigmentary abnormalities, and diabetes mellitus. Because these patients have arteriosclerosis and microangiopathy, cosmetic procedures should not be performed.

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168

A 36-year-old woman desires breast reconstruction one year after undergoing right modified radical mastectomy followed by radiation therapy. She is 5 ft 4 in tall, weighs 135 lb, and is otherwise healthy. The left cup size of her bra is 32B. Which of the following is the most appropriate reconstructive option in this patient?

(A) Reconstruction with a latissimus dorsi flap and a saline-filled implant
(B) Reconstruction with a TRAM flap
(C) One-stage reconstruction with a silicone gel-filled implant
(D) Two-stage reconstruction with a tissue expander and a saline-filled implant
(E) Two-stage reconstruction with a tissue expander and a silicone gel-filled implant

The correct response is Option B.

Reconstruction with a TRAM flap is the most appropriate choice for this 36-year-old woman. Transfer of autologous tissue alone is the best method in any patient who has previously undergone radiation therapy. Use of an implant, whether saline- or silicone gel-filled, is associated with a significant increase in capsular contracture and other complications in previously irradiated patients. The latissimus dorsi flap is reserved for those patients who are not good candidates for TRAM flap reconstruction or as a salvage technique following periprosthetic contracture in patients who underwent implant reconstruction following radiation therapy.

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169

Prior to breast augmentation, management of milky discharge in a regularly menstruating woman should include which of the following?

(A) Observation
(B) Massage
(C) Measurement of serum prolactin level
(D) Administration of antibiotics
(E) Ovarian biopsy

The correct response is Option C.

Although breast discharge is rare in regularly menstruating women who have never been pregnant, it has been shown to occur in 25% of women who have been pregnant in the past. Complete evaluation of galactorrhea should include measurement of the serum level of prolactin (a lactogenic hormone required for milk production), thyroid function studies to rule out hypothyroidism, and a history of all medications, as tricyclic antidepressants and fluoxetine have been shown to contribute to breast discharge. Women who have increased serum prolactin levels should then undergo MRI evaluation to rule of the possibility of pituitary tumor. According to a series of four studies involving more than 500 patients with galactorrhea, a pituitary tumor was the underlying cause in 25%; in contrast, 50% of those studied had idiopathic causes. Appropriate management of idiopathic galactorrhea includes administration of bromocriptine to suppress the release of prolactin.

Observation is inadequate management because of the risk for pituitary tumor in these patients. Breast massage is not appropriate and will instead maintain or even initiate galactorrhea in women with prior pregnancies. Because galactorrhea is not associated with infection, antibiotics should not be administered; however, if the discharge is bloody or has brown or green discoloration, the patient should be evaluated for possible infection or tumor. Ovarian biopsy is only indicated if evaluation shows ovarian pathology.

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170

A 40-year-old man sustains a complete amputation of the right ear at the level of the external auditory canal in a motor vehicle collision. Which of the following surgical procedures will provide the best aesthetic result?

(A) Delayed total ear reconstruction with rib cartilage grafting
(B) Attachment of the ear as a composite graft with surface cooling
(C) Dermabrasion, followed by burying the ear in a postauricular skin pocket with subsequent reconstruction
(D) Removal of the skin of the amputated ear, attachment of the ear cartilage, and immediate coverage with a temporoparietal fascia flap and skin graft
(E) Microsurgical ear replantation

The correct response is Option E.

Microsurgical ear replantation should be performed in this 40-year-old man who has sustained a complete amputation. Although this technique is technically challenging, requiring reattachment of small, obscure vessels, it provides an optimal aesthetic result.

Delayed reconstruction will yield only modest aesthetic improvement.

Primary nonvascularized replantation of the ear typically includes primary reattachment of the avulsed portion with surface cooling, dermabrasion of the ear, followed by partial or complete burial in a postauricular skin pocket with subsequent reconstruction, and coverage of the filleted cartilage using a temporoparietal fascia flap and skin graft. Although survival of the avulsed cartilage is excellent, late distortion of the ear is a frequent finding.

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171

The photograph shown above is of a 52-year-old woman who is undergoing nasal reconstruction one year after excision of a large basal cell carcinoma. Approximately 75% of the septum was resected at the time of the initial procedure. Turnover flaps will be used for reconstruction of the nasal lining, and cantilevered cranial bone will be grafted for structural support.

Which of the following flaps is most appropriate for coverage of the wound?

(A) Forehead flap
(B) Nasolabial turnover flaps
(C) Radial forearm free flap
(D) Scalping flap
(E) Sickle flap

The correct response is Option A.

In this patient who requires nasal reconstruction following excision of a basal cell carcinoma, the most appropriate management is coverage with a forehead flap. Because the forehead flap provides reliable tissue and a good color

and skin thickness match, it is still the standard for nasal reconstruction. It is based on the supratrochlear artery and not associated with an unsightly donor site defect, as primary closure of the remaining forehead skin is acceptable.

Nasolabial turnover flaps are used for reconstruction of resected alar lining. Transfer of distant flaps, such as the radial forearm free flap, is a complicated procedure that provides a poor color and thickness match and is typically only used when the forehead flap is not available. Although the scalping flap provides ample tissue for total nasal reconstruction, harvest of this flap involves the entire forehead and requires coverage of the donor site defect using a split-thickness skin graft. The sickle flap places its donor sites along the temporal forehead; however, a delay procedure is necessary because of the random nature of its blood supply.

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172

A 7-year-old girl has conchal valgus and underfolding of the antihelix. The cranioauricular angle is 45 degrees. Which of the following is most appropriate for correction of this patient's deformity?

(A) Conchoscaphoid suturing
(B) Customized splinting
(C) Flag flap transfer
(D) Helical release with skin grafting
(E) Posterior scoring of the antihelical cartilage

The correct response is Option A.

Prominent ear deformities affect 5% of the general population and are characterized by conchal valgus with a cranioauricular angle greater than 40 degrees and underfolding of the antihelix. Conchal hypertrophy is a rare finding. Several options exist for management of prominent ears during childhood, including conchoscaphoid (Mustardé) or conchomastoid suturing, anterior scoring of the cartilage at the antihelical fold, resection of the concha, and resection of postauricular skin.

Although a customized splint can be applied for management of minor deformities of the auricular cartilage, including prominent, lop, cup, and Stahl's ears, it is only effective during the neonatal period unless the deformity is associated with hypoplasia.

Flag flap transfer is useful for correction of a lop ear deformity.

Helical release with split-thickness skin grafting is appropriate management for cryptotia. In this technique, the superior portion of the auricle is buried beneath the skin.

As mentioned above, anterior, not posterior, scoring of the antihelical cartilage is a recognized technique for management of prominent ears.

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173

A patient requests bovine collagen injection for correction of glabellar frown lines. Following administration of the required test dose, this patient should be observed for potential development of adverse effects for how long?

(A) 1 hour
(B) 1 day
(C) 1 week
(D) 1 month
(E) 1 year

The correct response is Option D.

Following injection of a test dose of bovine collagen (Zyderm/Zyplast), the patient should be observed for one month in order to note the development of any adverse effects. Clinical studies have reported hypersensitivity reactions in 3% of otherwise healthy persons who undergo skin testing. A hypersensitivity reaction is defined as the onset of erythema, induration, or swelling at the test site. Approximately 70% of these reactions occur within 72 hours, 10% occur within one week, and the remaining 20% occur within four weeks. If the patient has no signs of hypersensitivity at that time, the bovine collagen can then be injected into the glabellar frown lines.

It should be noted that 1% to 4% of patients who have nonreactive skin tests subsequently develop hypersensitivity reactions following treatment with injectable bovine collagen.

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174

Which of the following is the most common complication of periareolar mastopexy?

(A) Dehiscence
(B) Excessive breast projection
(C) Nipple discharge
(D) Recurrent ptosis
(E) Widening of the areola

The correct response is Option E.

Widening of the areola is the most common complication following periareolar mastopexy. Techniques developed to minimize the occurrence of areolar dilation include the use of nonresorbable purse-string sutures and creation of an excessively small areola at the time of surgery to compensate for postoperative widening.

Less common complications include dehiscence and recurrent ptosis. Excessive projection is rarely seen with periareolar mastopexy; flattened or globular breast shapes are more commonly reported. Nipple discharge is not associated with mastopexy.

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175

A 23-year-old woman has the onset of fever, generalized weakness, and erythroderma of the extremities eight hours after undergoing septorhinoplasty for reduction of a fracture of the nasal bones. Intranasal splints and packing were left in place following the procedure. These findings are most consistent with which of the following?

(A) Acute gastroenteritis
(B) Kawasaki disease
(C) Stevens-Johnson syndrome
(D) Toxic shock syndrome
(E) Urosepsis

The correct response is Option D.

This patient's findings are most consistent with toxic shock syndrome. This condition should be suspected in any patient who has fever, hypotension, and erythroderma following surgery, trauma, or infection of structures related to the skin or nares. Symptoms include a temperature greater than 38.9EC (102EF), a diffuse macular rash, and a systolic blood pressure of less than 90 mmHg in adults or less than the fifth percentile for children younger than 16 years. Syncope and orthostatic hypotension are also common. Desquamation of the palms and soles typically occurs one to two weeks after the onset of illness. Appropriate management should include supportive treatment for multisystem organ involvement, antibiotics effective against *Staphylococcus aureus,* and identification and treatment of the focus of bacterial toxin production. Although the *Staphylococcus* organisms that produce toxic shock syndrome toxin typically do not produce purulent wounds and the surgical wound may appear normal, an undrained focus of infection may be present in the wound. Therefore, the wound should be debrided to locate any potential source of toxin-producing organisms and to provide tissue for bacterial culture.

Acute gastroenteritis is associated with the abrupt onset of hypotension and abdominal symptoms such as nausea and diarrhea. Erythroderma is not an associated finding.

Kawasaki disease is a multisystem disease typically seen in children younger than 7 years and characterized by prolonged fever, lymphadenitis, conjunctivitis, and erythema of the mucous membranes. Thrombocytosis and

desquamation of the distal digits occur during the recovery phase. Hypotension is rare. Infection with *Staphylococcus aureus* and/or *Streptococcus pyogenes* is not associated.

Patients with Stevens-Johnson syndrome have a systemic, widespread rash that also affects the mucous membranes. This condition can result from infection, illness, or an allergic reaction to medication. Systemic symptoms are typically severe.

In patients with urosepsis, the onset of septic shock can be typically distinguished from toxic shock syndrome by the absence of erythroderma. Profuse watery diarrhea is uncommon in patients with urosepsis but occurs frequently in patients with toxic shock syndrome.

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176

Pseudoherniation of the buccal fat pad results from weakening of which of the following structures?

(A) Buccinator muscle
(B) Buccopharyngeal membrane
(C) Levator labii superioris
(D) Parotid fascia
(E) Zygomaticus major muscle

The correct response is Option B.

Pseudoherniation of the buccal fat pad results from a weakening of the buccopharyngeal membrane in which the fat pad is encased. The fat pad, which aids in suckling during infancy and has metabolic characteristics that differentiate it from subcutaneous fat, typically becomes less prominent with facial growth. However, in patients who develop pseudoherniation, there is a visible outpocketing of the fat. Affected patients have a well-demarcated walnut-sized mass in the lower cheek that can be manually reduced into the buccal space. Numerous factors including previous facial surgery, diabetes mellitus, or administration of corticosteroids can lead to a loss of strength of the buccopharyngeal membrane. In patients who have these findings, salivary gland tumors, hemangiomas, abscesses, and lymphadenopathy should first be ruled out. Once this is accomplished, intraoral excision should be performed.

The buccinator muscle lies deep to the fat pad and is unaffected. The levator labii superioris and zygomatic muscles are not weakened in patients with pseudoherniation of the buccal fat pad. The parotid fascia lies posterior and superior to the fat pad and also demonstrates normal strength.

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177

Which of the following is the most common cause of death following suction lipectomy?

(A) Abdominal perforation
(B) Anesthetic complications
(C) Fat embolism
(D) Infection
(E) Thromboembolism

The correct response is Option E.

The incidence of fatalities associated with suction lipectomy performed in the outpatient setting is one in every 5000 procedures. According to a recent study of deaths associated with suction lipectomy procedures, in those patients in whom a cause of death was definitively established, 23% of the fatalities were shown to have resulted from thromboembolism. In contrast, 15% of fatalities resulted from abdominal wall perforation (with or without organ perforation), 10% involved anesthetic complications, 8% involved fat embolism, and only 5% were due to infection. Because lidocaine screening is rarely performed, any potential link between lidocaine toxicity and the development of the complications listed above was undetermined. Many of the reported deaths occurred during the first 24 hours following patient discharge. Other risk factors associated with suction lipectomy include aspiration of large amounts of tissue, increased volume of tumescent injection, and concomitantly performed procedures.

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178

A 45-year-old woman has had severe epiphora on the right side for the past four months. She sustained a comminuted naso-orbital ethmoid fracture when she was struck in the face by a softball six months ago; open reduction and internal fixation were performed immediately after injury. Dacryocystography shows obstruction of the nasolacrimal duct.

Which of the following is the most appropriate operative management?

(A) Conjunctivodacryocystostomy
(B) Conjunctivodacryocystorhinostomy
(C) Conjunctivorhinostomy
(D) Dacryocystorhinostomy
(E) Dacryocystostomy

The correct response is Option D.

This patient has developed nasolacrimal duct obstruction as a complication following open reduction and internal fixation of a comminuted naso-orbital ethmoid fracture. The level of obstruction must be determined in order to correctly bypass the stricture or damaged portion of the lacrimal system. This can be accomplished by various methods, including canalicular injection and/or intubation, fluorescein staining of the eye, and radiologic testing.

Dacryocystorhinostomy is used for correction of nasolacrimal duct obstruction. Many methods of dacryocystorhinostomy have been described. The single lacrimal flap technique, as well as other techniques that do not involve flaps, has produced long-term patency rates of 90%.

Conjunctivodacryocystostomy and conjunctivodacryocystorhinostomy are procedures used for reconstruction in a patient who has obstruction at the canalicular level. Conjunctivorhinostomy is used in patients who have absence or obliteration of the tear sac. Dacryocystostomy involves intubation of the tear sac, which would not be beneficial in this patient.

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179

The patient shown in the photograph above will be at increased risk for development of which of the following complications following four-eyelid blepharoplasty?

(A) Diplopia
(B) Dry eye syndrome
(C) Entropion
(D) Hematoma
(E) Ptosis

The correct response is Option B.

The patient shown in the photograph has minimal exophthalmos and moderate scleral show. Such clinical findings, as well as proptosis, hypotonia of the lower eyelids, and maxillary hypoplasia, are significant predictors of dry eye syndrome, while low tear film is less predictive of dry eye syndrome. Therefore, appropriately cautious management is critical in patients who have these anatomic findings and are considering blepharoplasty. Surgery can still be performed with the necessary modifications and adequate ocular protection. One study reported that 65% of patients who developed dry eye syndrome following blepharoplasty had normal findings on preoperative Schirmer's testing.

This patient would not be at risk for diplopia, which is more closely related to edema, hematoma, and wound infection. Entropion occurs as a result of damage to the ciliary margins of the eyelid resulting from an excessively close incision (leading to angulation of the upper border of the tarsal plate) or spasm of the upper portion of the orbicularis oculi muscle. However, this patient's findings are not indicative of postoperative entropion. Development of hematoma is rarely predictable. The findings are not consistent with ptosis, which can be worsened postoperatively if it is not identified before the procedure.

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180

A 39-year-old woman desires correction of deep frown lines between the eyebrows and at the bridge of the nose. Five injections of botulinum toxin (2.5 units per injection) are administered. Three days later, the patient says that she has not experienced improvement of the frown lines.

Which of the following is the most likely cause of the current findings?

(A) Excessively superficial level of injection
(B) Inactive toxin
(C) Inadequate dose of botulinum toxin
(D) Inadequate time for onset of action
(E) Prior immunity to botulinum toxin

The correct response is Option D.

Although botulinum toxin, an exotoxin of *Clostridium botulinum* bacteria, is currently only approved by the FDA for use in patients with strabismus and blepharospasm, it is increasingly being used for temporary eradication of facial wrinkling. Its neuromuscular mechanism of action occurs by preventing acetylcholine uptake. It must be reconstituted just prior to use, refrigerated, and then used within 48 hours (before the potency diminishes). Small doses (2.5 U) per

site are injected directly into the muscle belly, with paralysis occurring within three to seven days and lasting for four to six months.

Because this patient has only waited three days since injection, the most likely explanation for the absence of paralysis at the treatment site is that the time for onset of action has been inadequate.

Complications resulting from botulinum toxin use are typically related to inadvertent diffusion of the toxin to the surrounding musculature. Potential diffusion can be minimized by using highly concentrated doses of the toxin, localizing the injection to the involved muscle, and instructing the patient to avoid any bending or straining following injection. Systemic and immunologic side effects may also be seen but are uncommon.

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181

In patients undergoing brachioplasty, which of the following is the most common long-term unfavorable result?

(A) Intermittent sharp pain in the arm
(B) Lymphedema of the hand and forearm
(C) Numbness of the medial arm
(D) Seroma of the upper arm
(E) Widening of the scar

The correct response is Option E.

Widened scars are the most common long-term complication following brachioplasty. These scars, which are typically located on the posteromedial upper arms, are red and visible for a minimum of one year and in fact may never completely fade. Patients should be informed of the potential for widened, visible scars prior to undergoing the procedure.

Intermittent sharp pain, lymphedema, numbness, and seromas can be complications of brachioplasty but are most likely to be temporary and to resolve within one to four weeks.

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182

The photographs shown above are of a 58-year-old man who has recurrent painless edema of the eyelids. Three upper eyelid blepharoplasty procedures over the past 30 years have not resolved this condition. On physical examination, the skin of the upper eyelids is thin, and results of snap testing are poor.

These findings are most consistent with which of the following?

(A) Blepharochalasis
(B) Dermatochalasis
(C) Dry eye syndrome
(D) Pachydermoperiostosis
(E) Senile ptosis

The correct response is Option A.

This 58-year-old man has findings consistent with blepharochalasis, a condition of unknown cause that results from a developmental deficiency of elastic tissue within the eyelids. It most often occurs during early adulthood. Patients with blepharochalasis, or dermatopysis palpebrum, have recurrent episodes of mild to moderate, painless edema of the eyelids. Over time, the episodes become more frequent, resulting in a permanent "baggy" appearance of the eyelids with thinning and wrinkling of the eyelid skin. Herniation of orbital fat occurs, leading to an exacerbation of symptoms. Excision of redundant tissue is indicated for management of visual obstruction.

Patients with dermatochalasis have occasional episodes of visual obstruction resulting from excess eyelid skin. Dry eye syndrome is caused by corneal exposure following blepharoplasty and manifests as pain, dryness, and blurred vision. Pachydermoperiostosis, or idiopathic hypertrophic osteoarthropathy, is a familial condition of unknown cause characterized by progressive enlargement of the eyelids, hands, feet, and toes. The conjunctivae are covered by hypertrophic papillae. Ptosis and visual obstruction are common. Senile ptosis results from progressive attenuation of the levator aponeurosis. Levator advancement is appropriate management.

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183

A 35-year-old man with male-pattern alopecia undergoes punch grafting for reconstruction of the anterior hairline. Which of the following best describes the pattern of hair growth seen in the grafted area postoperatively?

(A) Immediate normal growth
(B) No growth for one month followed by immediate normal growth
(C) Immediate hair loss followed by new normal growth after three months
(D) Growth for one month, followed by no growth for three months, and then resumption of new normal growth
(E) Growth for one month, followed by hair loss, and then new normal growth after three months

The correct response is Option E.

Following punch graft transplantation, the patient has hair growth for one month, followed by hair loss, and then new normal growth after three months. Once grafting is completed, there is an initial period of false growth lasting three to four weeks. The hair follicles then pass into the telogen phase, and this newly grown hair is shed. The telogen phase lasts two to three months; following this, normal permanent hair growth begins at a rate of 1 cm monthly. Therefore, a total of approximately six months is required for the onset of permanent hair growth in the grafted area.

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184

Which of the following is the most appropriate management of a 1-year-old boy who has isolated microtia on the left?

(A) Fabrication of a costal cartilage framework at age 3 years
(B) Implantation of a Silastic framework at age 4 years
(C) Placement of a bone-conduction hearing aid at age 5 years
(D) Creation of an ipsilateral ear canal at age 6 years
(E) Autologous ear reconstruction at age 7 years

The correct response is Option E.

Although the recommended age of surgery may vary among individual patients with microtia, autologous ear reconstruction is typically performed once the child reaches 5 years of age; most children are between the ages of 6 and 7 years at the time of surgery, at which time there is typically sufficient rib cartilage for reconstruction. The ear attains 85% of its total growth by age 3 years and has almost fully developed by ages 5 to 7 years; however, minimal changes in the width of the ear and its distance from the scalp can be seen until age 10 years.

Hearing in the affected ear should be assessed as soon as possible. When necessary, a bone-conduction hearing aid, whether external or implantable, should be initially used by age 1 year.

Implantation of a Silastic framework is not the first choice for management of congenital microtia. Creation of an ear canal is typically performed for unilateral microtia when the patient is age 13 to 19 years and should not be initiated until reconstruction of the external auricle has been completed.

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185

A 21-year-old woman desires surgical correction because her left breast has an abnormal appearance. On examination, the diameter of the left breast is more narrow at the base than at the midportion, and there is superior displacement of the inframammary fold. The areola is disproportionally enlarged, and the breast tissue appears to be herniating into the areola. The left cup size of her bra is 32B, and the right cup size is 32C. The right breast is normal.

Which of the following is the most appropriate management?

(A) Right-sided vertical breast reduction
(B) Pedicled TRAM flap reconstruction of the left breast
(C) Wise-pattern breast reduction on the right with lowering of the inframammary fold
(D) Augmentation mammaplasty on the left using a saline-filled implant
(E) Augmentation mammaplasty on the left with radial scoring and areolar reduction

The correct response is Option E.

This patient has a tuberous, or constricted, breast deformity. Affected patients have unilateral narrowing of the breast; the breast tissue appears to be herniating into the areola. In order to adequately correct this deformity, implant augmentation mammaplasty should be combined with repositioning of the inframammary fold, radial scoring of the breast parenchyma, and reduction of the herniated tissue and areola. This will correct the size and shape discrepancies, resulting in a left breast that appears similar to the unaffected right breast.

The right breast should not be reduced by any method to match the size and shape of the abnormal left breast. TRAM flap reconstruction is associated with significantly higher morbidity and should not be performed as initial management. Implantation alone will enlarge the left breast but will not correct the abnormal shape of the breast.

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186

A 20-year-old man has severe right ear pain 24 hours after undergoing bilateral otoplasty. Which of the following is the most likely cause?

(A) Chondritis
(B) Excessively tight dressings
(C) Hematoma
(D) Nerve injury
(E) Otitis externa

The correct response is Option C.

Severe unilateral pain in the ear occurring within the first 24 hours after surgery is most consistent with the development of a hematoma resulting from increased pressure on the surrounding soft tissue. If the hematoma is not evacuated urgently, more severe complications, such as pressure necrosis of the overlying skin or underlying cartilage and fibrosis of the soft tissues, may result.

Chondritis, an uncommon complication of otoplasty, is characterized by pain, swelling, and tenderness of the affected ear. This condition initially presents several days after surgery and is best managed with intravenous antibiotic therapy. Surgical exploration is indicated in those patients diagnosed with suppurative chondritis.

Excessively tight dressings and head wraps would be detected soon after surgery, as the effects of the anesthesia dissipate, and would be associated with bilateral pain.

Patients who sustain injuries to the great auricular nerve during otoplasty would experience paresthesia and dysesthesia of the involved ear several weeks following surgery.

Otitis externa would not develop as soon as 24 hours after surgery.

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187

Which of the following best describes the mechanism of action of retinoids on the skin?

(A) Decreased activation of metalloproteases resulting from inhibition of AP1 transcription
(B) Decreased free radical-mediated damage to the skin
(C) Increased desquamation resulting from diminished corneocyte cohesion
(D) Increased gene transcription of collagen types I and III
(E) Inhibition of the conversion of dopamine to melanin

The correct response is Option A.

The mechanism of action of retinoids involves decreased activation of metalloproteases through inhibition of AP1 transcription. Retinoic acid has been shown to reverse the effects of photoaging, while use of tretinoin results in thinning of the stratum corneum, thickening of the epidermis, reversal of atypia, and increasing collagen synthesis within the dermis, with angiogenesis and a more even dispersion of melanin granules. One report that studied the continuous use of retinoids for longer than four years showed improvement of rhytids and hyperpigmentation and increased skin smoothness. The mechanism of action of retinoids has been shown to occur through binding to a DNA receptor. The activated receptor then inhibits AP1 transcription factor, which inhibits the activation of such metalloproteases as collagen, gelatinase, and stromelysin.

Topical vitamin C is an experimental agent that has demonstrated promising results in limited studies. It has been shown to decrease the free radical-mediated effects of UVB radiation in mouse models, as well as to stimulate cultured fibroblasts, resulting in increased production of collagen types I and III through an increase in gene transcription. The mechanism of action of alpha-hydroxy acids, which gradually reduce fine rhytids, is thought to occur through increased desquamation resulting from diminished corneocyte cohesion immediately above the granular layer in the epithelium. Hydroquinones are commonly used bleaching agents that block the conversion of dopamine to melanin through inhibition of the tyrosinase enzyme.

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188

In a 21-year-old woman considering augmentation mammaplasty with saline-filled implants, which of the following is appropriate advice concerning potential complications of the procedure?

(A) Breast implants do not affect mammographic visualization of all breast tissue
(B) Capsular contracture requiring revision occurs in 2% of patients
(C) Infection is more common than hematoma
(D) Revision procedures are performed in 25% of patients within the first 10 years
(E) The risk for deflation is approximately 10% annually

The correct response is Option D.

Potential complications of augmentation mammaplasty include the development of infection, deflation of the implant, capsular contracture, breast asymmetry, and visible rippling in patients who have saline implants. One study of 884 women who underwent augmentation mammaplasty reported that 31% developed implant changes, leakage, or capsulotomy; another study of 450 mammaplasty patients showed that approximately 25% underwent at least one additional procedure during the 13-year follow-up period. Because parturition, aging, and weight gain or loss typically result in changes in the breast parenchyma, it is likely that the appearance of the implants will also change over time and that further surgery will be required.

Even though specialized views are required for mammography screening in patients with breast implants, it is estimated that approximately 5% of the breast parenchyma is not fully visible on a mammogram. The two studies described above reported rates of significant capsular contracture ranging from 20% to 25%. Hematoma occurred in 3% of implant patients, but only 1% of patients developed infection. Deflation occurred in 1% of patients annually.

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189

A 45-year-old woman is being evaluated after undergoing upper eyelid blepharoplasty. Examination shows persistent fullness involving the lateral third of the upper eyelids. These findings are most consistent with which of the following?

(A) Descending lacrimal glands
(B) Eyebrow ptosis
(C) Lateral compartment fat
(D) Subcutaneous fat deposits
(E) Supraorbital bony prominences

The correct response is Option A.

In this patient who has undergone upper eyelid blepharoplasty, the persistent upper eyelid fullness is most likely a result of descending lacrimal glands. Appropriate management of this condition can include resuspension of the glands, which has been advocated by some surgeons. However, excision of the glands is not recommended because it may result in the development of keratoconjunctivitis sicca.

Eyebrow ptosis would most likely be seen over the entire eyebrow, not just the lateral third. Lateral fat compartments are found in the lower eyelids but not in the upper eyelids. Although subcutaneous fat deposits can cause lateral fullness of the eyelids, they typically pass beyond the region of the canthus. Bony prominences would most likely involve the entire eyebrow.

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190

A 2-week-old neonate has bilateral prominent ears with lopped superior poles. Which of the following is the most appropriate management?

(A) Observation
(B) Molding the ears using tape and splinting
(C) Injection of a corticosteroid
(D) Otoplasty at age 2 years
(E) Otoplasty at age 6 years

The correct response is Option B.

In this neonate with bilateral prominent ears, immediate management should include molding of the ears with tape and splinting. Circulating maternal estrogens are still present until the age of 6 months, allowing for successful molding of the soft, malleable ear cartilage in infants with cryptotia and prominent ears. Molding can also be performed in newborns with lop ear and Stahl's ear during the neonatal period. Complete correction without surgery is a realistic expectation.

Because the concept of body image typically begins to form at about school age, ear reconstruction, if required, should ideally be performed between the ages of 5 and 6 years. The normal ear is within 6 to 7 mm of its full vertical height by the age of 6 years, allowing for the construction of an ear that is symmetrical to the normal ear.

Observation alone is inadequate in a child with ear deformities, and injection of a corticosteroid is inappropriate management. Otoplasty should not be performed at the age of 2 years because ear growth is not complete.

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191

A 30-year-old man has the sudden onset of weakness of the right eyebrow and cheek and the right side of the mouth. There is no history of trauma or disease; physical examination is otherwise unremarkable. Which of the following is the most appropriate initial step in management?

(A) Observation
(B) EMG
(C) MRI
(D) Facial nerve decompression
(E) Right eyelid tarsorrhaphy

The correct response is Option A.

This patient most likely has Bell's palsy, an idiopathic form of facial paralysis that is the most common diagnosis in persons with facial paralysis (approximately 80%). Diagnosing this condition involves excluding other causes, such as trauma, stroke, and tumor, and thus should be preceded by a thorough evaluation of the patient. Bell's palsy is often associated with diabetes mellitus and pregnancy.

Eighty-five percent of patients who have Bell's palsy will begin to have spontaneous recovery of neurologic function within three weeks. In 15% of affected patients, however, it may take three to six months before some recovery of function is experienced. But because Bell's palsy is rarely permanent, at least some recovery is expected.

Observation for three weeks is indicated prior to performing extensive diagnostic studies. Many of the tests used in the diagnosis of Bell's palsy are expensive and give limited information. Positive findings on electromyography will not be seen until 14 to 21 days after the onset of paralysis. CT scan or MRI may be appropriate after a three-week observation period, if the condition persists. Surgical decompression is not frequently recommended because it increases the risk for injury to the inner ear as well as to the nerve itself; moreover, it has not been clearly shown to be helpful in all cases. Ocular symptoms can generally be managed with artificial tears, use of ointments, and taping until function returns, so eyelid tarsorrhaphy is not necessary.

Although electroneurography (ENOG) will show nerve conduction defects immediately and objectively and is the most accurate and reproducible test currently available to determine the return of facial nerve function, it is generally considered to be prohibitively expensive and time-consuming.

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192

A 37-year-old man has partial airway obstruction on inspiration and a "caved-in" alar rim after undergoing cosmetic rhinoplasty for correction of a bulbous deformity of the nasal tip. Which of the following is the most appropriate management?

(A) Placement of transdomal sutures anchored to the caudal septum
(B) Septoplasty
(C) Use of alar grafts
(D) Use of cranial bone grafts, morselized and placed subcutaneously
(E) Use of middle nasal vault spreader grafts

The correct response is Option C.

In this patient who has a pinched nasal tip, the most appropriate surgical technique is insertion of alar grafts. A pinched nasal tip can result from excessive resection of the lower lateral alar cartilages and may lead to airway obstruction secondary to compromise of the external nasal valve. To correct the deformity, alar cartilage can be obtained from the auricle or nasal septum and then placed between and deep to the remaining lateral crura to oppose the forces leading to nasal valve collapse.

Transdomal sutures can be used to decrease nasal projection and transdomal width but not to correct a pinched nasal tip. Septoplasty would not typically improve this patient's deformity. Cranial bone grafts are used for correction of saddle nose deformity. Spreader grafts are stick-like strips of cartilage placed in the middle nasal vault following resection of cartilage and bone to prevent internal nasal valve collapse.

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193

An 8-year-old boy has a third crus, flattening of the antihelix, and malformation of the scaphoid fossa. These findings are most consistent with which of the following?

(A) Constricted ear
(B) Cryptotia
(C) Prominent ear
(D) Stahl's ear
(E) Telephone ear deformity

The correct response is Option D.

This child has findings consistent with Stahl's ear, a rare congenital anomaly of unknown cause characterized by the presence of a third crus, flattening of the antihelix, and malformation of the scaphoid fossa. This condition is often difficult to correct surgically.

Constricted ear manifests as hooding of the helix and scapha. In patients with cryptotia, the upper pole of the ear cartilage is buried beneath the skin, and the superior auriculocephalic sulcus is absent. Prominent ears can be associated with several factors, including incomplete development of the antihelix, enlargement of the concha, widening of the conchoscaphal angle (ie, greater than 90 degrees), and protrusion of the ear lobe. The telephone ear deformity results from either excessive reduction of the concha or inadequate correction of prominent upper and lower poles of the ear during an otoplasty procedure.

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194

A 43-year-old woman has miosis, anhidrosis, and blepharoptosis measuring 2 mm. On examination, the eyelid crease is normal and function of the levator muscle is good. Which of the following is the most likely diagnosis?

(A) Blepharophimosis syndrome
(B) Congenital ptosis
(C) Horner's syndrome
(D) Involutional ptosis
(E) Myasthenia gravis

The correct response is Option C.

This 43-year-old woman has Horner's syndrome, which is caused by sympathetic denervation of the superior cervical ganglion. Typical findings include ptosis, miosis, and anhidrosis. The eyelid creases and levator muscle are typically unaffected.

Blepharophimosis syndrome is a congenital condition consisting of ptosis, telecanthus, and phimosis of the upper eyelid fissure.

Congenital ptosis is a developmental dystrophy that affects the levator muscle. In patients with congenital ptosis, eyelid creases are poorly defined and levator function is poor. These patients are at increased risk for the development of strabismus and amblyopia.

Involutional ptosis is the most common type of acquired ptosis. This condition results from progressive thinning of the levator aponeurosis and subsequent downward shifting of the tarsal plate. The function of the levator muscle is good despite its progressive thinning. The eyelid creases are typically raised.

Patients with ptosis due to myasthenia gravis frequently have unilateral or bilateral ptosis that is exacerbated with fatigue. This disorder is most frequent in young women and elderly men. Neostigmine testing is used to establish the diagnosis.

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195

Dermabrasion is most appropriate for the treatment of which of the following conditions?

(A) Actinic keratoses on the cheeks
(B) Decorative tattoo on the upper back
(C) Hypertrophic burn scar of the shoulder
(D) Ice-pick acne scars
(E) Traumatic tattoo of the chin

The correct response is Option E.

Dermabrasion, which is a method of skin resurfacing involving abrasion of the epidermis, is especially useful for treatment of perioral rhytids and traumatic tattoos. Because traumatic tattooing involves the embedding of particulate matter within the superficial epidermis, dermabrasion can be used to uproot and remove the debris. Unlike chemical peeling and laser resurfacing, dermabrasion is an imprecise technique that can result in the development of complications if the abrasion is performed at a level deeper than the upper third of the dermis. These complications, which include hypertrophic scarring, hypopigmentation, and an enhanced, porous look to the skin, are more common in areas more distal to the head and neck because these regions have a decreased density of adnexal structures, which lie within the dermis and supply basal keratinocytes for skin resurfacing.

Options for treatment of sun-induced actinic damage of the cheeks include laser resurfacing, trichloroacetic acid peeling, and topical application of 5-fluorouracil. The use of dermabrasion for the removal of decorative tattoos is

associated with a high incidence of postoperative scarring; again, a laser is the choice for removal. Dermabrasion will not effectively remove hypertrophic scars or keloids. Excision is preferred for management of ice-pick acne scars.

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196

A 40-year-old woman has steady, lancinating pain in the globe and orbit and episodes of vomiting six hours after undergoing blepharoplasty of the lower eyelids. She says that she sees sparkles and flashes and has the sensation similar to a "window shade" closing over the lower half of her range of vision.

These findings are most consistent with which of the following?

(A) Acute glaucoma
(B) Adverse effects of anesthesia
(C) Migraine
(D) Retrobulbar hematoma
(E) Transient ischemic attack

The correct response is Option D.

This patient has findings consistent with retrobulbar hematoma, a complication of blepharoplasty that, if untreated, can result in loss of vision. Retrobulbar hematoma is most frequently characterized by steady, severe, lancinating pain in the globe and orbit (mimicking symptoms of acute glaucoma), which can occur alone or with scintillating scotomas (ie, sparkles and flashes, mimicking the symptoms of severe migraine) and hemianopsia or amaurosis fugax (ie, findings similar to a "window shade" pulled over the lower half of the visual field, mimicking a transient ischemic attack). Other symptoms associated with the development of hematoma following blepharoplasty include early discharge from the eye, perioperative and postoperative vomiting, and coughing. The use of aspirin-containing products has also been associated. A positive finding on Valsalva's maneuver may be diagnostic.

Appropriate management includes surgical exploration and lateral canthotomy, with ophthalmologic consultation. Mannitol and carbonic anhydrase inhibitors can also be administered to decrease intraocular pressure and reestablish blood flow.

Although eye pain following surgery may result from abrasion of the cornea during anesthesia, scotomas and loss of vision would not be associated.

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197

A 55-year-old woman is scheduled to undergo right mastectomy for management of breast carcinoma. She has a 30 pack/year history of cigarette smoking. She would like to undergo breast reconstruction using a free TRAM flap at the time of the mastectomy procedure.

This patient would be at significantly increased risk for development of which of the following complications?

(A) Anastomotic thrombosis
(B) Fat necrosis
(C) Mastectomy skin flap necrosis
(D) Partial TRAM flap loss
(E) Wound infection

The correct response is Option C.

When compared with nonsmokers, patients who smoke are at increased risk for necrosis of the mastectomy skin flap or abdominal flap and hernia development after breast reconstruction using a TRAM flap. Patients who have a smoking history of greater than 10 pack/years are at particularly high risk for the development of these complications. However, the risk can be decreased significantly if a delay procedure is performed or if the patient stops smoking at least four weeks before the procedure.

TRAM flap reconstruction is not associated with an increased risk for vessel thrombosis, fat necrosis, TRAM flap loss, or wound infection in patients who smoke.

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198

Which of the following nerves is NOT at risk for injury during abdominoplasty?

(A) Genitofemoral
(B) Iliohypogastric
(C) Ilioinguinal
(D) Intercostal

The correct response is Option A.

During abdominoplasty, there is an increased risk for nerve entrapment or injury to the iliohypogastric and ilioinguinal nerves because of their anatomic location. Although the intercostal nerves are less prone to injury, they still lie in the region of the abdominoplasty. Because of the potential for injury, patients who have localized pain, paresthesias, and/or tenderness in the distribution of any of these nerves should undergo complete evaluation.

The genitofemoral nerve originates from L1-2 and courses deep in the abdominal wall. It pierces the fascia below the inguinal ligament and supplies sensation to the skin of the femoral triangle and pubis. Because this nerve lies inferior and deep to the abdominoplasty incision, it is not at risk for injury during an abdominoplasty procedure.

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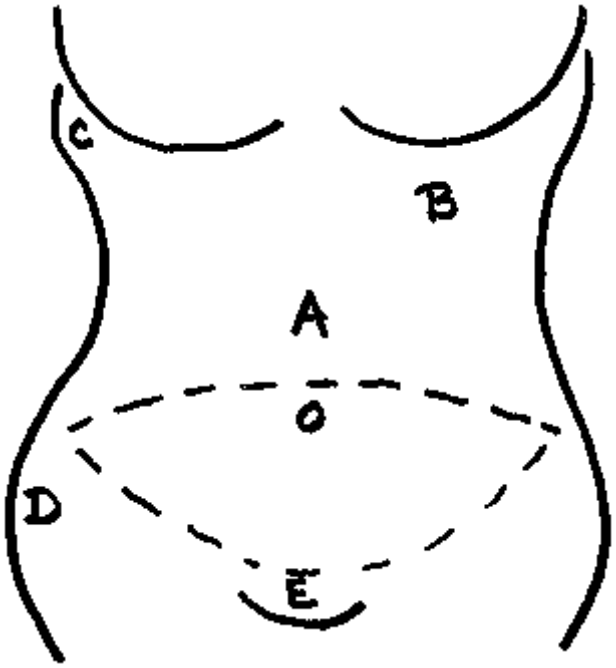
199



A 39-year-old woman is scheduled to undergo full abdominoplasty with adjunctive suction lipectomy for management of laxity and fat deposition of the abdomen and flanks. Which of the following areas labeled in the diagram above should undergo the LEAST amount of suction lipectomy?

(A) A
(B) B
(C) C
(D) D
(E) E

The correct response is Option A.

The vascularity of the abdominal flap used in the full abdominoplasty procedure is derived from the lateral intercostal perforators through the remaining subcutaneous vessels. The central inferior area, illustrated by point A in the diagram, lies in the most distal location of the flap and has the least vascular supply. Applied tension is also greatest in this region following abdominoplasty. Suction lipectomy is often performed in patients undergoing abdominoplasty to remove adipose tissue, blend the area of resection, and provide an additional means of sculpting. However, the risk for infection and subsequent necrosis is increased when these procedures are combined. Therefore, a combined abdominoplasty/suction lipectomy procedure is only recommended as long as the suction procedure is limited centrally (ie, in the area of point A) and the central inferior region is not defatted sharply. Other systemic factors such as a history of smoking, diabetes mellitus, or obesity would warrant a limited suction lipectomy.

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200

A 58-year-old man has had moderate gynecomastia with severe skin redundancy for the past eight years. A photograph is shown above. Complete physical examination and laboratory studies show no other abnormalities. Which of the following is the LEAST acceptable technique for management?

(A) Suction lipectomy with subsequent skin shrinkage
(B) Concentric circle resection
(C) Wise-pattern mastopexy
(D) Glandular resection through an areolar incision with adjunctive suction lipectomy
(E) Breast amputation and free nipple grafting

The correct response is Option C.

Gynecomastia can be classified according to three grades. Grade I gynecomastia involves visible mild breast enlargement without skin redundancy. In grade IIA gynecomastia, there is moderate breast enlargement without skin

redundancy; in grade IIB gynecomastia, there is moderate breast enlargement with skin redundancy. Grade III gynecomastia is characterized by marked breast enlargement with marked skin redundancy. Although most adolescents with gynecomastia have regression within two years (only 7.7% of affected adolescents have duration of symptoms for a longer time), regression is unlikely to be seen in this older patient, who has had severe ptosis for the past eight years.

Suction lipectomy has eliminated the need for skin resection in many gynecomastia patients, especially adolescents. Fibrous enlargement can be managed with glandular resection through an areolar incision with adjunctive suction lipectomy. However, skin resection is still recommended in older patients with grade III gynecomastia who have significant ptosis. Other procedures, such as resection of a concentric circle of skin, pedicled relocation of the nipple with skin resection, or breast amputation with free nipple grafting, may be considered. The Wise-pattern mastopexy is used to create a projecting, conical breast in women undergoing breast reduction and should not be performed in gynecomastia patients who require a breast elimination procedure.

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INTEGUMENT — 1998

1

Which of the following best describes the physiologic response to the immediate tissue expansion that contributes to tissue gain?

(A) Displacement of interstitial fluid into the dermis
(B) Immediately increased circulation
(C) Realignment of collagen fibers
(D) Thinning of the epidermis and microfragmentation

The correct response is Option C.

Tissue gain from immediate tissue expansion results from cutaneous biomechanical factors as well as from recruitment of adjacent tissue. Histology of immediate expanded tissue confirms realignment of collagen fibers as well as displacement of interstitial fluid from the dermis. This realignment of collagen fibers from a random to a more parallel orientation contributes to tissue gain from immediate expansion.

Although displacement of interstitial fluid from the dermis does occur with immediate expansion, the fluid is not displaced into the dermis, which would result in tissue gain.

Circulation increases in a delayed fashion with immediate expansion. Consequently, immediately increased circulation does not exist and cannot contribute to tissue gain.

Microfragmentation of elastic fibers does occur with immediate expansion, but it occurs in the dermis. There are no significant histologic changes (such as thinning) of the epidermis.

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2

In the classic model of burn wound cytology, the intermediate zone of damaged but potentially salvageable cells is called the zone of

(A) coagulation
(B) hyperemia
(C) necrosis
(D) stasis

The correct response is Option D.

The burn wound can be represented as a three-dimensional mass of damaged tissue divided into three distinct zones of injury. The intermediate zone of stasis represents heat-damaged tissue supported by a static microcirculation. Capillary leak from this zone is largely responsible for early burn edema and shock. Progressive circulatory failure in this zone will lead to tissue ischemia and expanded coagulation; however, early aggressive postburn care can reverse the capillary stasis, thereby avoiding further tissue necrosis.

The central zone of coagulation (or necrosis) contains nonviable tissue with no significant circulation. The outermost zone of hyperemia contains transiently affected tissue that will heal over time.

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3

A split-thickness bone graft from the outer table of the cranium is used to reconstruct a posttraumatic saddlenose deformity. Which of the following will be the primary mechanism of bone graft healing?

(A) Endochondral ossification
(B) Osteoconduction
(C) Osteogenesis
(D) Osteoinduction

The correct response is Option B.

Bone grafting promotes the primary healing of fractures and nonunions by replacing lost or destroyed bone and assisting in the immobilization of unstable fractures. There are other more discrete effects of bone grafting that contribute to bone healing, which are related to the various cytophysiologic processes that comprise bone formation.

The primary mechanism of healing of a split-thickness bone graft from the outer table of the cranium is osteoconduction. During osteoconduction (creeping substitution), cells and blood vessels from the recipient bed grow out and into the graft. The graft becomes a template for the deposition of new bone from the recipient bed as the dead bone of the graft becomes resorbed. This process is particularly prominent in the healing of grafts that are chiefly composed of cortical bone (e.g., cranial graft). The neovascularization of such a graft takes between six and eight weeks to complete. As a result, few of the osteocytes transferred with the graft survive, leaving osteogenesis with a very minimal role in healing. While the neovascularization of the graft is taking place, osteoclasts resorb the dead bone and osteoblasts manufacture osteoid in those areas where resorption has occurred. These are all steps in the formation of new bone.

Endochondral ossification is a later process by which the cartilaginous soft callus covering a fracture is transformed into bone.

Osteogenesis is the formation of new bone by cells in the graft that have not died. It is the primary mechanism by which a vascularized bone graft (e.g., a fibula graft) heals. The vascular supply to the graft keeps the bone alive so that healing between the graft and the recipient bed can be accomplished by cells from both sites. This property allows the vascularized grafts to be placed into beds that would not accept a nonvascularized graft and makes them resistant to irradiation. In a cancellous graft, such as that obtained from the iliac crest, osteoconduction remains important as a mechanism of healing. However, because neovascularization occurs much more rapidly (one to two weeks), some of the osteocytes transferred with the graft will survive. In this way, osteogenesis is also active in the healing of cancellous bone grafts. In an irradiated or poorly vascularized bed, revascularization can be delayed, resulting in the death of all transferred osteocytes and imminent graft failure.

Osteoinduction occurs with a demineralized bone implant or some other growth factor inducing the transformation of mesenchymal cells into bone-forming cells. Research has shown it to have promise in the treatment of nonunions.

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4

Local anesthetics block the transmission of nerve impulses by decreasing the permeability of nerve cell membranes to which of the following ions?

(A) Calcium
(B) Hydrogen
(C) Potassium
(D) Sodium

The correct response is Option D.

Local anesthetics block the transmission of nerve impulses by decreasing the permeability of neuron membranes to sodium ions. The transmission of nerve impulses is enabled by cellular transactions known as depolarization and

repolarization. During these two phases of impulse transmission, sodium and potassium ions flux across the semipermeable membrane of the neuron. Sodium is the chief extracellular ion, and potassium is the chief intracellular ion. The ionic gradient across the neuronal membrane is maintained by pumping sodium out of the cell, an active process that requires cellular energy.

When a local anesthetic is injected into body tissue, it binds itself to the sodium channel and decreases the permeability of the neuronal membrane to sodium. This binding prevents depolarization of the membrane and thereby effectively blocks the transmission of the nerve impulse.

Calcium does not play a role in the transmission of nerve impulses and is not involved in the local anesthetic process.

Hydrogen ions indirectly affect the diffusion of anesthesia across the nerve cell membrane. The higher the concentration of hydrogen ions within the infiltrated anesthetic agent, the greater the proportion of anesthesia in cation form. Consequently, local anesthetics are less effective in tissues with a low pH, such as areas of infection.

The outflux of potassium from a neuron is a passive process not requiring the use of cellular energy. Local anesthesia has no effect on the potassium ion.

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5

A 24-year-old man undergoes placement of an onlay cartilage graft to correct a posttraumatic nasal contour depression that occurred when he was struck with a baseball bat. Which of the following operative steps is most likely to result in decreased warping of the cartilage graft?

(A) Maintenance of the vascularity of the recipient bed
(B) Precise fixation of the graft
(C) Preservation of the perichondrium of the graft
(D) Use of a graft with a symmetric design

The correct response is Option D.

This patient is undergoing placement of an onlay cartilage graft to correct a posttraumatic nasal contour depression. The most appropriate surgical management to decrease warping of the cartilage graft is use of a graft with a symmetric design. This type of graft will regulate the tendency of the inner mass of cartilage to expand and distort when it is harvested. This finding was demonstrated in a study in which costal cartilage design was evaluated showing that the compact outer subperichondrial cartilage layer regulated the tendency of the loose inner mass to warp. Therefore, in harvesting cartilage for onlay grafting, the cartilage grafts should be designed symmetrically to distribute stresses.

The 10th (or 11th) rib is useful as a graft material donor site for the nasal dorsum because it is a naturally straight segment and therefore requires minimal trimming and carving. This fact enables natural maintenance of the minimizing effect of a symmetric graft design.

Maintaining the vascularity of the recipient bed is useful to avoid extrusion of the graft as a result of tissue compromise. Since tissue compromise is not an issue in this case, this step is not appropriate for this patient.

Precise fixation of the graft is used to prevent external distortion because of migration or displacement, neither of which has occurred in this case.

Preserving the perichondrium of the graft influences growth and helps preserve chondrocytes. It is particularly useful in the harvesting and fabrication of ear cartilage frameworks in children in whom chondrocyte preservation will allow continued growth of the ear cartilage. It would not lead to decreased warping of this patient's cartilage graft.

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6

Which of the following best explains the adequate venous outflow of the distally based radial forearm flap?

(A) Absence of significant valves in the venae comitantes of the radial artery
(B) Crossover connections between venae comitantes and collateral venous branches
(C) Microarterial venous shunting
(D) Venous valvular incompetence in dilated veins

The correct response is Option B.

Adequate venous outflow in the so-called "reverse" radial forearm flap has been widely observed in clinical settings and appears to occur by retrograde venous drainage through a crossover pattern of communicating branches between the two venae comitantes of the radial artery and by bypass of valves through collateral branches of these vessels.

Anatomic studies of the venous drainage of the radial forearm flap have shown the existence of competent venous valves in the venae comitantes of the radial artery in the distal forearm, with an average of three to four valves in each vein. However, significant arteriovenous shunts have not been demonstrated to exist in this flap. With the degree of venous dilation that occurs during the clinical use of the radial forearm flap, valvular incompetence does not appear to account for a significant amount of outflow from the flap.

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7

A 40-year-old man undergoes coverage of a defect of the lower leg with a medial artery-based fasciocutaneous flap. Which of the following types of ultrasonography will most reliably image and locate vascular perforators preoperatively?

(A) B-Mode
(B) Contrast
(C) Doppler
(D) Duplex

The correct response is Option D.

In this patient, proper design of the flap is critical to its function and survival. Proper design is dependent on accurately locating the recipient vascular perforators. Duplex ultrasonography will most reliably image and locate vascular perforators before surgery. Because some of these perforators are located over major vessels, assessment with more standard techniques may be less accurate. Duplex ultrasonography (color flow duplex) combines Doppler ultrasonography, which measures blood flow within vessels, with conventional B-mode ultrasonography, which visualizes vessels and adjacent anatomic structures.

Contrast ultrasonography is best at measuring perfusion changes in skeletal muscles and relies on contrast injection and videodensitometry calculations to determine perfusion.

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8

A 4-year-old boy has a left-sided capillary malformation of the face and upper eyelid and glaucoma in the left eye. Which of the following is the most likely diagnosis?

(A) Kasabach-Merritt syndrome
(B) Klippel-Trénaunay-Weber syndrome
(C) Maffucci's syndrome
(D) Sturge-Weber syndrome

The correct response is Option D.

This boy most likely has Sturge-Weber syndrome, a complex of deformities characterized by vascular malformations of the face, particularly in the first and second distributions of the trigeminal nerve (V_1 -V_2), and by lesions in the choroid plexus and meninges. Glaucoma in the ipsilateral eye is also a common feature. Venous, capillary, and arteriovenous malformations can be visualized by cerebral angiography.

Enlarging hemangiomas are a clinical manifestation of Kasabach-Merritt syndrome. This syndrome is characterized by acute hemorrhaging in the gastrointestinal tract, central nervous system, and pleura, and a rapid increase in hemangioma size as a result of intralesional bleeding. These hemorrhagic complications are caused by a platelet-trapping coagulopathy.

Klippel-Trénaunay-Weber syndrome is a disorder of mixed vascular malformations. Port-wine stains are common cutaneous manifestations, while venous and lymphatic malformations are found in the limbs. These abnormalities lead to thickening of the skin and subcutaneous tissues, hypertrophy of the muscles, and thickening of the bone. Limb hypertrophy results and is the hallmark of this disease. Gender is not a significant factor and the lower limb is affected in 95% of cases.

Maffucci's syndrome is characterized by vascular malformations and dyschondroplasia. Venous malformations predominate and enchondromas are common. Both sexes are equally affected. Most patients with this disorder develop symptoms by puberty. Sarcomatous tumors occur in approximately 20% of patients.

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9

A 45-year-old woman undergoes surgical replacement of a fully inflated tissue expander with a mammary prosthesis. The surgical scar and a portion of surrounding expanded tissue are excised. Histopathologic examination shows no malignant cells. The most likely additional finding is thickening of which of the following tissues?

(A) Dermis
(B) Epidermis
(C) Muscle
(D) Subcutaneous tissue

The correct response is Option B.

Tissue expansion techniques are commonly used in many reconstructive procedures, including traumatic scalp reconstruction, hair replacement for alopecia, breast reconstruction, and postburn resurfacing. Clinical research, based primarily on the findings of light and electron microscopy, has helped to clarify the histopathology of expanded tissue both during and after the expansion process.

During expansion, the epidermis becomes thicker, while the dermis and subcutaneous tissue become substantially thinner. Skeletal muscle atrophies, and a greater proportion of collagenous fibrous tissue develops. Following removal of the expander, the epidermis, dermis, and subcutaneous tissue gradually return to their pre-expanded morphologies.

In the case of fasciocutaneous flaps, an increase of both vascularity and fascial thickness has been noted during expansion. Postexpansion evaluation has shown that blood vessels in the skin and subcutaneous tissues return to normal.

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10

A 32-year-old man who works in a factory has chronic pain and irritation at the site of a 3.5×7-cm skin graft located on the anterior pretibial surface of the leg, 6 cm above the medial malleolus. Physical examination shows a thin split-thickness skin graft, with considerable depression of the underlying soft tissue and surrounding fibrotic scar. There is no sign of infection.

If resection of the skin graft and surrounding scar tissue to the tibial surface is performed, which of the following techniques should be used for reconstruction?

(A) Dorsalis pedis island flap
(B) Latissimus dorsi muscle free flap and skin grafting
(C) Local fasciocutaneous flap and skin grafting to the donor site
(D) Pedicled distal soleus muscle flap and skin grafting
(E) Tissue expansion and primary closure

The correct response is Option C.

A number of different soft-tissue reconstructive techniques can be used to repair defects of the lower extremity. Primary considerations when selecting the specific technique should include maximizing the functional and cosmetic result and providing successful closure of the wound with the least associated morbidity.

The most appropriate reconstructive technique for this patient with pain and irritation at the site of a skin graft on the anterior pretibial surface of the leg is a local fasciocutaneous flap and skin grafting to the donor site. Fasciocutaneous flaps have been used for reconstruction in all areas of the body but are particularly useful for repairing defects of the distal tibia. In the distal tibia, the blood supply is provided via perforators from underlying muscles, septocutaneous vessels running in connective tissue planes, and axial vessels. In the lower extremity, flaps are designed based on the various systems of muscle perforators, septocutaneous perforators, and axial vessels. The primary advantages of using fasciocutaneous flaps for lower extremity reconstruction include ease of elevation and transfer, reduced operative time and morbidity, improved aesthetic contouring with less bulk, and decreased likelihood of subsequent functional impairment.

The dorsalis pedis island flap is versatile as a local cutaneous flap, but it would not reach this defect and would cause significant donor site complications in this patient, possibly creating a secondary deformity.

Muscle free flaps, such as the latissimus dorsi or rectus abdominis, are useful in the reconstruction of defects of the lower leg, especially in patients with chronic osteomyelitis or in patients who have retained orthopedic hardware or a foreign body. These flaps are also useful when surrounding soft tissue has been severely traumatized or compromised. However, they are bulky, their placement is more time consuming to perform, and they involve more operative time and risk than do local flaps. A fasciocutaneous free flap, such as the radial forearm, could be considered, but it would have the same limitations as free muscle flaps and could involve potential donor site morbidity.

Local muscle pedicle flaps, such as the gastrocnemius and soleus muscle flaps, are useful for repair of deformities of the middle and proximal thirds of the tibia. However, significant defects of the distal third of the tibia usually require fasciocutaneous flaps or microvascular free flaps since the gastrocnemius and soleus muscles do not reach this area.

Tissue expansion for defects of the lower extremity is associated with high rates of infection, expander extrusion, and discomfort. This technique is therefore not generally used for reconstruction.

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11

A 3-year-old boy has a reddish blue mass on the cheek that appeared as a pale pink macule at birth and has not changed in size for a year. Which of the following is the most appropriate management?

(A) Observation until involution is complete
(B) Injection of a sclerosing agent
(C) Photocoagulation with a tunable flash-pumped laser
(D) Excision and closure
(E) Ligation of inflow/outflow vessels

The correct response is Option A.

This patient has a classic hemangioma. This lesion frequently resembles any of the various small red fruits and carries their names (e.g., strawberry, berry, cherry hemangioma). The actual color of the lesion is dependent on its location beneath the dermis and not on its vascular composition. A hemangioma is not a vascular malformation. It is a tumor characterized by a sequestration of large numbers of mast cells and a proliferation of endothelial elements.

Most hemangiomas involute spontaneously after a phase of rapid proliferation. Approximately 50% of all hemangiomas involute by age 5 years; this proportion reaches 70% by age 7 years. Some physicians recommend selective ablation by laser prior to or early in the proliferative phase. However, there is no clinical proof that laser

treatment is more effective than allowing the hemangioma to involute over time. Consequently, observation is the most appropriate management for this patient.

Injectable sclerosing agents, including alcohol, sodium tetradecyl sulfate, and Ethibloc, have been successfully used in the treatment of venous malformations. These lesions, like other vascular malformations, grow commensurately with the child. A venous malformation is characterized by its compressibility and by a propensity to fill with blood when in certain positions. It is usually larger and extends deeper than its superficial structure indicates, and it is frequently intertwined with neurovascular components. Treatment is indicated when the venous malformation is in a cosmetically significant area.

Currently, the tunable flash-pumped laser is the treatment of choice for a port-wine stain. Because the laser's 585-nm yellow-light span is highly selective for oxyhemoglobin, it is able to penetrate below the epithelium and specifically coagulate the malformation with minimal scarring to the facial skin. This procedure is best performed at an early age before the lesion darkens or develops a cobblestoned surface.

Excision and closure procedures have had uniform success in the treatment of lesions such as pyogenic granuloma. Pyogenic granuloma is a common pediatric problem that is usually brought to the attention of a physician after persisting for several months. There is no history of trauma associated with the lesion. Shaving and cauterization is another method used to treat the pyogenic granuloma but is associated with a 43.5% rate of recurrence.

Ligation is an inappropriate treatment procedure for any type of congenital vascular malformation. Ligation is only useful to decrease the vascularity of a lesion in preparation for resection. By itself, it will stimulate neovascular ingrowth and has no clinical utility.

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12

Which of the following steps is most likely to improve survival of the distal portion of a random cutaneous flap?

(A) Designing the flap with its base positioned inferiorly rather than superiorly
(B) Increasing the thickness of the flap
(C) Increasing the width of the flap
(D) Making surgical delay incisions four days prior to flap elevation
(E) Performing immediate tissue expansion prior to flap elevation

The correct response is Option D.

The distal portion of a skin flap survives by perfusion through the dermal-subdermal plexus despite the type of vascular pedicle on which the flap is based. Anatomically, the crucial factor in flap survival is the specific type of vasculature incorporated into its design. In a myocutaneous flap, survival length is determined by the length of incorporated viable muscle; in an arterial flap, survival length is determined by the length of the direct cutaneous artery. In a random cutaneous skin flap, the crucial factor is the number and type of blood vessels located at the base of the flap; therefore its survival can be increased only by augmenting its blood supply, not by increasing its width or the thickness of subcutaneous tissue.

Surgical delay involves the interruption of a portion of the blood supply of the flap at a preliminary stage before transfer. The effectiveness of surgical delay is related to the distal portion of a flap, which might otherwise be compromised by ischemia with flap elevation. Studies have shown that an increase in blood flow is detectable within two days following surgical delay incisions and increases to a maximum by the fourth day after delay incisions where it remains until day 14. An increase in both the number and size of vessels as well as ingrowth of new vessels from surrounding tissue has been observed four to five days postoperatively.

Designing a random cutaneous flap with an inferior base rather than a superior base may have an impact on venous drainage and flap edema but would not likely affect flap vascularity and ultimate survival.

Tissue expansion is a form of delay with histologic features that are similar to those of traditional incisional delay. It results in a considerable increase in survival length over unexpanded skin flaps. Immediate or intraoperative tissue expansion, however, is dependent on the biomechanical characteristics of the skin including creep, dermal fluid displacement, microfragmentation of elastic fibers, and realignment of collagen fibers. Unlike traditional tissue expansion, immediate expansion is traumatic and adversely affects cutaneous circulation.

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13

Healthy skin is predominately composed of which two types of collagen protein?

(A) Type I and type III
(B) Type I and type V
(C) Type II and type IV
(D) Type II and type V
(E) Type III and type V

The correct response is Option A.

Healthy skin is composed of 80% type I collagen and 20% type III collagen. In hypertrophic and immature scars, the ratio of type I to type III collagen may approach 2:1.

In human tissues, there are five known types of collagen. The relative distribution of these proteins in different tissues varies greatly. More rigid, structural types of tissues (e.g., skin, tendon, fascia, bone) are composed primarily of type I collagen. Tissues that exhibit more elastic than structural properties (papillary dermis, blood vessels) are composed of progressively greater proportions of type III collagen. Skin is composed of a 4:1 type I to type III ratio, whereas blood vessels have a 1:4 type I to type III ratio.

During the scar maturation phase of wound healing, collagen synthesis and degradation are accelerated with no resulting increase in collagen content. The scar is transformed from an indurated, raised scar into a soft, flat scar. Both hypertrophic and immature scars have a 2:1 proportion of type I to type III collagen. During the maturation phase, much of the new embryonic type III collagen is increasingly replaced by type I collagen until the normal skin ratio of 4:1 is reached.

Fetal wounds tend to scar significantly less than postnatal wounds, leading some to hypothesize that the healing of wounds in the fetus involves a more efficient process of matrix reorganization than it does in the postnatal period. Extensive research on the healing of fetal wounds has shown that such wounds consist primarily of type III collagen with minimal type I collagen in a matrix that is rich in hyaluronic acid.

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14

Following placement of a split-thickness skin graft, which of the following sensations returns first?

(A) Cold
(B) Heat
(C) Light touch
(D) Pain
(E) Vibration

The correct response is Option D.

Skin grafts are initially insensate. They then gradually assume the sensory pattern of the recipient bed. Studies show that the unmyelinated small fibers carrying pain sensation return first. Subsequently, light touch returns. Cold and warm sensation return later, followed by vibratory sensation.

Sensory recovery begins at four weeks and continues for up to two years. Patients should be warned of insensitivity in a skin graft so that they can avoid recurrent injury or burns to the area.

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15

An otherwise healthy 35-year-old man receives second- and third-degree burns over 40% of the total body surface area. Which of the following immunologic responses will occur?

(A) Decreased complement activation
(B) Decreased function of leukocytes
(C) Decreased function of suppressor T lymphocytes
(D) Increased function of helper T lymphocytes
(E) Increased production of immunoglobulins

The correct response is Option B.

This patient with severe burns over 40% of the total body surface area is most likely to experience decreased function of leukocytes. Alteration of the body's immune response after thermal injury results in overstimulation of some immune system components and simultaneous depression of other components. Leukocyte function as well as production of helper T lymphocytes and immunoglobulins is decreased. Complement activation and suppressor T-lymphocyte function are stimulated by the immunologic response to burns.

In one study, monoclonal antibody prevented leukocyte adhesion to endothelial surfaces and successfully blocked extravascular migration of leukocyte and limited tissue loss from burn injuries.

Circulating complement is generally decreased by 50%, and serum immunoglobulin levels are at 50% of normal in the first week after burn injury, with IgG, IgM, and IgA all being depleted. Leukocytes have been shown to be less effective at intracellular killing of bacteria. There is an increase in suppressor T lymphocyte activity, which leads to decreased B-cell activation. Helper T-lymphocyte function is decreased. Major burn injury alters all physiologic systems in the body. The immune system alteration is characterized by an overproduction of immunosuppressor substances.

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16

A 30-year-old man who repairs electrical lines for a utility company is brought to the emergency department for treatment of an electrical injury to the right upper extremity. Examination shows limited full-thickness burns of the flexor creases of the palm, wrist, and elbow. Doppler flowmetry shows patent palmar arch pulses. Passive motion of the fingers produces an intrinsic minus hand posture with pain.

The most appropriate initial step in management is

(A) continued observation
(B) escharotomy
(C) fasciotomy
(D) burn excision and free flap coverage
(E) burn excision and grafting

The correct response is Option C.

The clinical findings in this patient who sustained an electrical burn injury to the right upper extremity are indicative of compartment syndrome. The most appropriate first step in management is fasciotomy.

The upper extremity is the most common site of entry in patients who sustain electrical burn injuries. In evaluating a patient with such an injury, it is critical to remember that the degree of tissue damage typically exceeds that indicated by cutaneous examination. Intrinsic minus hand posture and a positive passive stretch test are hallmarks of increased compartment pressures in the upper extremity. Extensive myonecrosis, often in the presence of palpable pulses, may occur beneath limited cutaneous electrical injury.

Continued observation in this patient would lead to progression of myonecrosis. Escharotomy would not alleviate the increased compartment pressure induced by subfascial myonecrosis. Cutaneous burn excision and wound coverage are inappropriate initial measures in the management of a patient with compartment syndrome.

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17

A Burrow's triangle is most frequently used in conjunction with which of the following types of flap?

(A) Advancement
(B) Island
(C) Rhomboid
(D) Rotation
(E) Transposition

The correct response is Option A.

A Burrow's triangle is typically used with an advancement flap. An advancement flap moves directly forward into a defect without any lateral movement. The advancement is facilitated by excising a triangle of skin (Burrow's triangle) at each side of the base of the pedicle.

An island flap is taken from a nearby, although not adjacent, donor site and is transposed by its vascular pedicle. A rhomboid flap is a transposition-type flap geometrically designed to facilitate closure of the secondary defect. Rotation and transposition flaps pivot on the base of a pedicle adjacent to the defect; additional length may be gained by using a back cut (not Burrow's triangle) away from the base of the pedicle.

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18

Which of the following muscle flaps is characterized by a segmental (type IV) vascular pattern that limits an extensive arc of rotation?

(A) Gastrocnemius
(B) Gluteus maximus
(C) Latissimus dorsi
(D) Pectoralis major
(E) Sartorius

The correct response is Option E.

The sartorius muscle is supplied by multiple segmental vascular pedicles (type IV), each supplying a limited portion of this long, thin muscle. Type IV vascular anatomy limits an extensive arc of rotation since division of multiple pedicles will not reliably support the distal muscle mass.

The gastrocnemius (type I, single pedicle), gluteus maximus (type III, dual dominant pedicles), and latissimus and pectoralis (type V, single dominant and multiple secondary pedicles) muscles all manifest patterns in which a dominant pedicle will reliably support the entire muscle mass. This pattern allows a flap design based on a dominant pedicle to provide a wide arc of rotation.

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19

A 10-year-old boy has arm pain and muscle cramping. Examination shows a small erythematous wound on the arm. He says he was playing on a woodpile earlier that day. Which of the following is the most likely diagnosis?

(A) Brown recluse spider bite
(B) Black widow spider bite
(C) *Clostridium tetani* infection
(D) Lyme disease
(E) Necrotizing fasciitis

The correct response is Option B.

This 10-year-old boy was most likely bitten by a black widow spider. Black widow spider envenomation introduces a neurotoxin that can cause the onset of neurologic symptoms as soon as 15 minutes after the bite. These symptoms consist of muscle pain and cramps starting in the vicinity of the bite. In more severe cases, patients develop vomiting,

tremors, increased salivation, paresthesias, and even shock. Treatment usually consists of 10% calcium gluconate administered parenterally, parenterally administered methocarbamol, and one dose of parenterally administered antivenin.

Patients who have been bitten by a brown recluse spider develop edema and erythema at the bite site several hours after envenomation occurs. Tissue necrosis can develop in several hours but frequently does not demarcate for several weeks. Systemic reactions including hemolysis and diffuse/disseminated intravascular coagulation (DIC) have been reported. Dapsone has been used to minimize tissue necrosis.

Clostridium tetani infection is most commonly seen in patients with grossly contaminated wounds, especially in persons who have not received tetanus immunization.

Lyme disease is caused by a bite from a deer tick. These parasites are harbored by rodents and other mammals. Ticks are usually acquired by brushing against low vegetation. Erythema chronicum migrans is the most common initial symptom.

Necrotizing fasciitis is an aggressive infection that can start from an apparently innocuous wound. This infection is caused by polymicrobial flora and can occur even in persons without immune system compromise. Rapidly spreading erythema and crepitus are seen in the early stages of this infection.

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20

Two weeks after undergoing fusion of the posterior cervical spine, a patient has a 6 × 10-cm wound at the incision site. Examination shows a slightly exposed cervical spine and purulent exudate. After serial wound irrigation and debridement, which of the following is the most appropriate next step in management?

(A) Closure by secondary intention
(B) Coverage with a fasciocutaneous flap
(C) Coverage with a musculocutaneous flap
(D) Coverage with a random cutaneous flap
(E) Placement of a skin graft

The correct response is Option C.

This patient has a complex wound at the incision site that is associated with significant bacterial contamination involving skin, subcutaneous tissue, muscle, and bone. The most appropriate management is musculocutaneous tissue transfer, either pedicled or free, in conjunction with aggressive debridement. When mobilized on its dominant vascular pedicle, muscle flap circulation is unimpaired. The well-vascularized musculocutaneous flap provides stable coverage

of the defect as well as a delivery system for lymphocytes, oxygen, and antibiotics essential to healing this complex wound.

Closure of the wound by secondary intention is not appropriate because prolonged exposure may lead to osteomyelitis and/or meningitis.

A fasciocutaneous flap provides excellent vascularity after transposition, but it does not provide the same deep surface bacterial resistance seen in muscle-based flaps.

As with muscle flaps, circulation is not impaired in a random cutaneous flap. However, coverage with this type of flap is not appropriate because the size and irregularity of the wound would conform better to a muscle flap.

A skin graft would not provide stable, vascularized coverage of this defect.

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21

The lateral arm flap is supplied by multiple small perforators from which of the following arteries?

(A) Anterior interosseous
(B) Posterior circumflex humeral
(C) Posterior radial collateral
(D) Radial recurrent
(E) Subscapular

The correct response is Option C.

The lateral arm fasciocutaneous flap is based on the posterior radial collateral artery (PRCA), which provides the perforating blood supply to the flap. The profunda brachii artery arises from the brachial artery inferior to the teres major muscle then splits into two branches – the middle collateral and the radial collateral. The PRCA is the dominant of two terminal branches of the radial collateral artery and enters the flap via the lateral intermuscular septum. The lateral arm fasciocutaneous flap is an excellent choice for resurfacing the dorsum of the hand. Advantages of using this flap include maintenance of every major arterial supply to the distal aspect of the arm, primary closure of the donor wound, and ability to harvest from the same extremity that is being reconstructed.

The anterior interosseous artery, a branch of the common interosseous, runs along the intermuscular septum of the forearm. The posterior circumflex humeral artery branches from the axillary artery and runs along the surgical neck of the humerus to the quadrangular space. The radial recurrent artery represents the first branch from the radial artery distal to the antecubital fossa. The subscapular artery arises from the axillary artery; its terminal branches are used to raise the scapular and parascapular fasciocutaneous flaps.

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22

A 19-year-old woman who underwent ovarian cystectomy two years ago has recent onset of persistent burning and itching in the area of the scar. A photograph is shown above. Which of the following is the most appropriate management?

(A) Corticosteroid injection
(B) Pressure application
(C) Radiation therapy
(D) Surgical excision
(E) Topical administration of vitamin E

The correct response is Option A.

The most appropriate management of this 19-year-old woman who has a symptomatic hypertrophic scar of the lower abdomen is intralesional corticosteroid injection. This management strategy is most likely to reduce scar recurrence. Corticosteroids decrease the levels of alpha-globulins, which inhibit collagenase function. Therefore, collagenase activity is increased, leading to a decrease in the amount of collagen synthesized. The recurrence rate of developing a widened, symptomatic hypertrophic scar is 20% to 40% when corticosteroids are used in conjunction with surgical excision.

Application of pressure using a surgical garment is not practical for this patient because it would require a minimum of four to six months to obtain satisfactory results; it would be difficult to apply pressure in the lower abdomen for that length of time. Application of pressure is usually thought to be effective in the treatment of scars because it decreases tissue metabolism and increases collagenase activity within the wound.

Radiation therapy is contraindicated in this 19-year-old woman because the scar is located adjacent to the ovaries. However, when radiation therapy is administered following surgical excision, the recurrence rate of developing a scar is 25%, which is comparable to surgical excision and use of intralesional corticosteroid injections.

Topical application of vitamin E is not useful in the management of hypertrophic scars or keloids. Topical vitamin E actually inhibits wound healing by reducing the number of fibroblasts and by reducing collagen synthesis.

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23

A 34-year-old woman decides to undergo laser removal of a reddish brown and orange pigmented tattoo that was professionally drawn on the thigh. Which one of the following types of laser is most appropriate?

(A) Argon
(B) Carbon dioxide
(C) Copper vapor
(D) Flash lamp-pump pulse dye
(E) Q-switched Nd:YAG

The correct response is Option E.

This patient should undergo removal of her tattoo by a Q-switched Nd:YAG laser. The Q-switched Nd:YAG laser removes red-brown, dark brown, and orange pigment by a process of selective photothermolysis. In general, the Q-switched lasers allow targeting of the tattoo pigments specifically rather than the tissue that holds the tattoo ink, thereby decreasing the risk of scarring. The Q-switched lasers at a cellular level cause the tattoo pigment to fragment. The pigment is then engulfed by macrophages, ultimately resulting in pigment removal. "Q-switch" refers to a small crystal that facilitates the capture of any energy loss, enabling a very high energy laser output with a short pulse duration. Studies have shown the Q-switched ruby laser is best to remove purple and violet pigments, whereas blue and green pigments are most effectively removed by the alexandrite laser, another type of Q-switched laser. Between three and ten treatments are required when undergoing Q-switched laser therapy. Satisfactory results have been reported in 75% to 95% of cases. In general, amateur tattoos responded better than professional tattoos.

The principle risk associated with the Q-switched lasers is transient hypopigmentation, which appears after seven treatments on average in approximately half of patients treated; this risk is most commonly encountered with the Q-switched ruby laser. Another risk is irreversible darkening, which occurs in a small percentage of patients when tattoos containing white, pink-red, and skin-colored pigments are treated. This irreversible darkening is thought to be caused by a chemical reduction of ferric oxide to ferrous oxide during energy transmission.

Persons undergoing tattoo removal with the argon or carbon dioxide lasers have a high incidence of scarring because both lasers are directed at the tissue rather than the tattoo pigment.

The copper vapor laser is used for the treatment of telangiectasias and ectatic port-wine stains.

The flash lamp-pump pulse dye laser is used for the treatment of vascular anomalies and is not appropriate for the treatment of tattoos.

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24

A 47-year-old woman develops induration, redness, and itching of the face two days after receiving a repeat injection of collagen in the glabellar area for treatment of a frown line. The most appropriate next step in management is

(A) retesting for hypersensitivity
(B) topical application of diphenhydramine
(C) injection of cortisone
(D) excision of the collagen
(E) aspiration of the collagen

The correct response is Option B.

Patients should receive skin testing before undergoing collagen injection, since approximately 3% of patients are allergic to injectable collagen. The test is done on the arm of the patient and should be read at 72 hours and again at four weeks. Two thirds of patients who will have a reaction to collagen will react by 72 hours. The remaining third will show a cutaneous reaction by the end of the four-week period. A positive skin test in response to collagen is characterized by a surrounding zone of induration, swelling, and pruritus. A test is considered positive if erythema or induration persists for more than six hours after testing or appears 24 hours after collagen implantation. These allergies are thought to be related to dietary exposure to beef.

Some patients who have a negative skin test and who have previously been injected with collagen may still have an allergic reaction after reinjection. Studies have shown that these reactions are due to delayed hypersensitivity and the development of antibovine collagen antibodies.

This patient is having a delayed hypersensitivity reaction after reinjection of collagen at the treatment site. The most appropriate step to control the itching is topical application of diphenhydramine. The most appropriate management

of the erythema and induration is observation, reassurance, and patience. These signs of the reaction will resolve over several months.

Since this patient has already developed a reaction to the collagen, retesting for hypersensitivity would add no useful information.

Injection of cortisone is not an appropriate treatment because the erythema and induration will resolve over several months. In addition, secondary complications of corticosteroid injection include decreased pigmentation, telangiectasia, and continuous thinning of skin.

Collagen excision is not necessary because the induration and erythema are self-resolving; also, collagen excision will not address the problem of itching.

Aspiration is not appropriate since it will not resolve the itching and is unlikely to accelerate the resolution of the induration and erythema resulting from the reaction.

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25

A 1-month-old male infant has a rapidly enlarging nontender mass on the right cheek. Examination shows a bluish hue of the skin with fine telangiectasias. Which of the following is the most appropriate next step in management?

(A) Observation
(B) Radionuclide red blood cell scan
(C) Needle biopsy
(D) CT scan with contrast
(E) Arteriography

The correct response is Option A.

This 1-month-old infant most likely has a hemangioma. In most cases, hemangiomas can be differentiated from vascular malformations by clinical examination; complicated or invasive diagnostic techniques are not usually necessary. If cellular proliferation begins in the superficial dermis, the skin becomes raised and finely bosselated with a vivid crimson color. If a hemangioma proliferates in the lower dermis and subcutaneous tissue without involving the papillary dermis, the lesion may appear slightly raised with a bluish hue. The overlying skin can also be smooth with normal color, or it may show faint telangiectatic vessels as described in this infant. Therefore, observation rather than further diagnostic studies is the most appropriate management.

Radionuclide red blood cell scan is not used in the diagnosis or treatment of hemangiomas.

Needle biopsy is contraindicated in cases of probable hemangiomas because of bleeding and is unnecessary for the clinical diagnosis.

CT scan with contrast shows a proliferative-phase hemangioma as a well-circumscribed tumor with homogeneous density and enhancement. CT scan of vascular malformations characteristically shows tissue heterogeneity.

Arteriography is rarely indicated in the evaluation of cutaneous hemangiomas. It may be necessary when embolization is being considered for an infant with a giant hemangioma or visceral hemangiomatosis that causes platelet trapping and/or congestive heart failure. Arteriography is also useful for hemangiomas without the typical cutaneous signs that may be difficult to differentiate from a lymphatic or venous malformation.

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26

An emergency medical technician (EMT) contacts the emergency department regarding treatment advice for a 20-year-old man who was bitten by a rattlesnake. She reports that the bite was sustained 35 minutes ago and that transport to the emergency department will take approximately 15 minutes.

The EMT should take which of the following steps?

(A) Transport the patient immediately without intervention
(B) Apply an ice pack to the wound
(C) Apply a venous tourniquet proximal to the wound
(D) Incise the wound and suction out the venom
(E) Administer rattlesnake antivenin

The correct response is Option A.

This patient should be transported to the emergency department immediately without intervention. Because marked morbidity can result from overmanagement of a rattlesnake bite in the field, the patient who can be transported within one hour of the bite should receive no treatment at the scene.

Application of an ice pack or tourniquet will not prevent the dissemination of venom throughout the body and may actually exacerbate any localized necrosis surrounding the bite wound.

Incision of the wound with suction removal of the venom is only effective if performed properly and within 30 minutes of the bite.

Rattlesnake antivenin should only be administered to a patient with signs of severe envenomation. These signs include swelling beyond the site of the wound, vomiting, mental confusion, and cardiovascular abnormalities. The dosage of antivenin is correlated directly to the severity of envenomation. The risk for complications from the antivenin will outweigh the minimum benefits of treatment if the antivenin is administered to a patient who does not meet the criteria of toxicity. Great care must be taken to administer the antivenin only when truly indicated.

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27

The shell of a saline breast implant is composed of which of the following substances?

(A) Crystalline silica
(B) Diphenylsilanediol
(C) Polydimethylsiloxane
(D) Polyurethane
(E) Silicon dioxide

The correct response is Option C.

A breast implant elastomer is composed primarily of polydimethylsiloxane. In addition, amorphous, noncrystalline silica particles are added, providing approximately 30% of the final weight, to give the elastomer increased strength.

Crystalline silica is not used in breast implants. It is found naturally as quartz. Prolonged inhalation of silica dust is fibrogenic and carcinogenic.

Diphenylsilanediol is an anticonvulsant drug used to control grand mal seizures.

Polyurethane is a chain composed of alternating urethane and polyether segments. Breast implants covered with a polyurethane foam shell were used until 1991. The open cell architecture allowed tissue ingrowth and less capsular contracture. The foam, however, also fragmented and degraded to toluene diamines, which has been shown to be carcinogenic in mice but has never been shown to be a human carcinogen.

Silicon dioxide (SiO_2) is a ubiquitous naturally occurring chemical substance. It is used in building materials, ceramics, glass, and optical lens.

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28

An 8-month-old girl has a 1-cm pedunculated lesion arising from a capillary vascular malformation (port-wine stain) on her cheek. The lesion first appeared after she fell and hit her cheek on a table 14 days ago; it bleeds frequently. Which of the following is the most likely diagnosis?

(A) Angiosarcoma
(B) Arteriovenous fistula
(C) Calcifying epithelioma
(D) Infected abscess
(E) Pyogenic granuloma

The correct response is Option E.

This infant most likely has a pyogenic granuloma, a proliferative lesion that is often confused with a hemangioma. These lesions usually appear suddenly; there is seldom a history of trauma. They are most common in older infants or young children. However, they also occur in adults. Most patients seek evaluation because of repeated episodes of bleeding. Pyogenic granulomas typically are located on the eyelids, cheeks, and extremities, as well as the lips, oral mucosa, tongue, and nasal cavity. They can also appear within a port-wine vascular birthmark. These lesions usually heal spontaneously. Treatment may be necessary if the patient has repeated episodes of bleeding. Because the lesion extends into the deep dermis, recurrence usually follows cauterization with a silver nitrate stick. If electrocoagulation or laser coagulation fails, the most appropriate next step in treatment would be surgical excision and primary closure.

An angiosarcoma is a rare tumor that contains multiple vascular channels. Lesions are often multiple. Angiosarcomas are most common in elderly persons. The prognosis is generally poor.

Arteriovenous fistulas are not pedunculated.

A calcifying epithelioma, also known as a pilomatrixoma, is more common in children older than age 8 months. This type of lesion, which is a benign tumor of the hair structures, is hard, located on the face and neck, and not pedunculated.

There is no evidence of an infectious cause in this patient.

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29

Which of the following is the most appropriate immediate treatment of chemical burns caused by white phosphorous?

(A) Application of calcium alginate emulsion
(B) Continuous water irrigation
(C) Irrigation with copper sulfate solution
(D) Irrigation with potassium manganese solution
(E) Subcutaneous injection of copper sulfate solution

The correct response is Option B.

Elemental phosphorous is used in many types of military ammunition, fireworks, and industrial and agricultural products. On exposure to air (or oxygen), it may ignite spontaneously and cause deep thermal tissue injury. It also may cause multiorgan failure because of toxic effects on liver, kidneys, heart, and erythrocytes.

Continuous water irrigation is the most effective modality to control local burn injury and to help prevent systemic toxicity. Phosphorous may become embedded in the skin by the explosive force of fireworks or military ammunition. In rare instances, deeply embedded elemental phosphorus must be removed surgically to prevent continued tissue damage and toxicity. In studies using an animal model, any type of wound closure over remaining buried elemental phosphorous resulted in mortality. White phosphorous has a melting point of about 45EC, and the liquid phase of the compound can be present in clothing or on body areas where it is difficult to identify. Particles remaining in the clothing or on the skin surface must be removed because they may reignite in air when dry. Since phosphorous does fluoresce, ultraviolet light may be used to enhance recognition of embedded particles.

Previous studies have evaluated dilute solutions of various chemical compounds in attempts to neutralize the phosphorous. These solutions have proven ineffective and in some cases have been toxic to the patient as well. In at least one recent prospective evaluation in a laboratory animal model, calcium alginate, copper sulfate, potassium manganese, and water gel dressings were compared with standard tap water irrigation under controlled conditions and found to be less effective.

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30

A 1-month-old infant has dermal dendritic nevomelanocytes in the sacral region. Which of the following is the most likely diagnosis?

(A) Blue nevus
(B) Café au lait spot
(C) Halo nevus
(D) Mongolian spot
(E) Nevus of Ito

The correct response is Option D.

This infant most likely has a Mongolian spot, a dermal dendritic nevus typically found in Asian, Mediterranean, and African American newborns. It usually overlies the sacral region and disappears in early childhood.

A blue nevus is a variant of the intradermal nevus in which histologic study shows elongated dendritic cells and densely aggregated macrophages with phagocytized pigment. This gives a blue/black color to the lesion.

A café au lait spot is a 1- to 5-cm area of increased pigmentation that can be found anywhere on the body. It may be isolated or may be associated with von Recklinghausen's neurofibromatosis. Patients with this condition generally have five or more such spots that are larger than sporadic lesions.

A halo nevus is a central nevus with a rim of hypopigmented skin. Histology shows lymphocytic infiltration, which is an immunologic response that destroys the nevus in one to two years. The "halo" then disappears.

The nevus of Ito is a blue nevus that is found in the distribution of the posterior supraclavicular and lateral cutaneous branches to the shoulder, neck, and supraclavicular skin.

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31

Which of the following forms of basal cell carcinoma is associated with the highest rate of recurrence after surgical excision?

(A) Linear
(B) Morphea
(C) Nodular
(D) Pigmented
(E) Superficial

The correct response is Option B.

Basal cell carcinomas (BCC) are the most common malignancy of the skin. The tumors originate from the pluripotential epithelial cells in the epidermis and hair follicles. Several clinical types of BCC have been described. Superficial BCC is flat, erythematous, and scaly. Nodular BCC is a classical raised lesion with a rolled pearly border; central ulceration can occur. Pigmented BCC is brown and often mistaken for a melanoma. Linear BCC consists of bands of basal cell nodules.

Morphea BCC is also known as fibrosing or sclerosing BCC. It presents as white or yellow plaques with ill-defined borders. Ulceration is rare. These lesions can grow quite large, yet remain minimally elevated above the skin.

Morphea basal cells synthesize type IV collagenase. They also show decreased membrane continuity and amyloid production. DNA is often tetraploid, and tumor fibroblasts and actin is increased. All these features may account for their more aggressive behavior. In one study, morphea BCC had the highest incidence of positive tumor margins after surgery (33%), whereas most other types of BCC are reliably cured by surgical resection.

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32

In the elevation of a radial forearm free flap, the arterial pedicle arises from between which of the following muscles?

(A) Abductor pollicis longus and brachioradialis
(B) Abductor pollicis longus and pronator teres
(C) Brachioradialis and flexor carpi radialis
(D) Brachioradialis and pronator teres
(E) Pronator teres and flexor carpi radialis

The correct response is Option C.

The radial forearm flap is characterized by thin pliable skin, a scant subcutaneous layer, a large diameter artery, and a generous pedicle length that extends from the wrist proximally through the forearm. At the wrist crease, the radial artery lies superficially between the abductor pollicis longus and flexor carpi radialis tendons. As the arterial pedicle is traced towards the elbow, it is seen emerging between the muscle bellies of the brachioradialis and flexor carpi radialis. More proximally, it runs between the brachioradialis and pronator teres muscles The ulnar artery bifurcation penetrates deep to the pronator teres muscle.

Intermuscular septal branches of the radial artery supply the distal forearm skin, while proximally the volar skin is supplied by the inferior cubital artery (a branch of the radial artery); flaps from these areas should be harvested for proximally designed skin flaps. Flaps can be designed to incorporate tendons, muscle, sensory nerves, and bone. In the routine setting, the donor site defect is skin grafted. Postoperative donor site complications are reported in up to one third of individuals and include delayed healing, alteration in superficial radial nerve sensation, cold intolerance, functional restriction, and radius fracture in the event of bone harvest.

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33

To maximize osteocyte survival, the most appropriate method for preserving an iliac bone graft between harvest and placement is wrapping the graft in a sponge soaked in which of the following liquids?

(A) Antibiotic solution
(B) Blood
(C) Lactated Ringer's solution
(D) Saline
(E) Water

The correct response is Option B.

Autogenous bone grafts are standardly used to reconstruct skeletal defects. The presence of viable osteocytes in the donor specimen allows osteogenesis to proceed. Improper handling can kill these needed osteocytes.

A blood-soaked sponge or tissue culture medium containing serum is least toxic to a bone graft. In the time between graft procurement and implantation, the bone will remain viable for four to six hours if wrapped in a blood-soaked sponge and placed in a medicine cup covered by moist saline sponges. Exposure to air for more than 30 minutes will decrease the viability of the graft. Warm temperatures (> 42EC) will also kill osteocytes.

Antibiotic solutions, such as bacitracin and neomycin, have been shown to be lethal to the osteocytes. Even lactated Ringer's solution, saline, and water are toxic to grafts after a long exposure.

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34

Under optimal conditions, the maximum percentage of normal skin tensile strength achieved by a healed wound is

(A) 30%
(B) 50%
(C) 60%
(D) 80%
(E) 100%

The correct response is Option D.

The tensile strength of a wound is defined as the measurement of strength capacity per unit area. It is usually constant for wounds of similar size, independent of skin thickness. Collagen fibers are the structures responsible for the tensile strength of wounds.

All wounds gain strength at about the same rate during the first 14 to 21 days. After this time the healing curves may diverge, depending on the type of tissue. In skin, the peak tensile strength is achieved approximately 60 days after injury. Even under ideal conditions, the tensile strength of the wound approaches but never equals that of unwounded skin, reaching about 80% of normal.

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35

A healthy 25-year-old man sustained a human bite wound to the forearm two hours ago. Examination shows a single penetrating injury. The wound is opened, cleaned, and debrided of all devitalized tissue. Which of the following is the most appropriate next step in management?

(A) No further therapy
(B) Orally administered antibiotic therapy
(C) Intravenously administered antibiotic therapy
(D) Operative debridement
(E) Wound closure

The correct response is Option B.

Human bites have significant potential for morbidity and require prompt treatment. Human saliva contains a wide variety of aerobic and anaerobic bacteria. The majority of resultant infections, however, are caused by staphylococcal and streptococcal species. *Eikenella corrodens,* an anaerobic gram-negative rod, is found on occasion in hand infections. Infections purely from gram-negative rods are uncommon.

This patient has an uncomplicated human bite wound. When there is no delay in treatment, no joint violation, and no tendon injury, such wounds are best treated by outpatient management with attentive local wound care in combination with prophylactic broad-spectrum, orally administered antibiotic therapy. This management protocol requires a motivated and compliant patient, since close follow-up is necessary.

Intravenously administered antibiotic therapy is medically and economically excessive in the uncomplicated setting. When patient compliance is questionable, however, hospitalization is recommended to ensure that antibiotics are administered. More severe infections are often associated with spread along fascial spaces, tendon sheaths, and lymphatics. Consequently, wounds associated with injury to the joint capsule or tendon should be treated aggressively with operative irrigation and debridement, as well as intravenously administered antibiotic therapy.

Wound closure alone is an inappropriate treatment because it does not address the issue of possible infection.

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36

Which of the following is the cause of verruca vulgaris?

(A) Cytomegalovirus
(B) Epstein-Barr virus
(C) Human immunodeficiency virus
(D) Papovavirus
(E) Retrovirus

The correct response is Option D.

Verruca vulgaris is the scientific name for common warts. These lesions are skin tumors caused by papovavirus (more specifically, human papillomavirus) infection of cells in the stratum spinosum layer of the epidermis.

Types of warts are defined by their location and clinical behavior. Verruca vulgaris is a rough elevated skin lesion most commonly seen on the fingers. Plane warts occur on the face, hands, or legs and are flat lesions of varying color. Plantar warts are located on the sole of the foot and are slightly elevated lesions usually covered by a thick callus, removal of which causes the wart to be visible. Treatment of warts includes removal with liquid nitrogen, burning them with salicylic acid, or surgical excision. The choice depends on their location and clinical behavior. Because they are benign lesions that frequently resolve spontaneously, tissue destruction should be kept to a minimum.

Cytomegalovirus is a herpes virus responsible for cytomegalic inclusion disease.

Epstein-Barr virus is a herpes virus originally isolated from Burkitt's lymphomas and is also the etiologic agent of infectious mononucleosis.

Human immunodeficiency virus (HIV) is the etiologic agent of AIDS.

Retroviruses are RNA-containing viruses (such as HIV) that produce reverse transcriptase to produce DNA that is incorporated into the genome of infected cells.

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37

A 35-year-old man undergoes excisional biopsy of a bleeding mole on the right upper back. The pathology report indicates a 2.5-mm thick Clark's level III melanoma. Wide local excision along with right axillary node dissection is performed and reveals two lymph nodes positive for melanoma. Which of the following adjuvant therapies is most appropriate for this patient?

(A) Administration of dacarbazine (DTIC)
(B) Administration of 5-fluorouracil
(C) Administration of interferon alfa
(D) Irradiation of the right axilla
(E) Isolated limb perfusion

The correct response is Option C.

The most appropriate adjuvant therapy for this patient with a melanoma of intermediate thickness and lymph node metastases is administration of interferon alfa. Interferon alfa is the only adjuvant treatment that has been shown to increase the five-year survival rate of melanoma patients with lymph node metastases. This therapy most likely increases the ability of the patient's own immune system to destroy melanoma cells.

Although chemotherapy with drugs such as dacarbazine and 5-fluorouracil has been used in the past to treat patients with metastatic melanoma and has had minimal success, it has never been shown that either single-drug or multidrug regimens lead to increased survival.

Irradiation is a local treatment, not an adjuvant therapy. Adjuvant therapy is given to destroy metastatic cancer cells that are not yet clinically evident in patients who are at high risk for death from metastases. Moreover, in this patient, surgical removal of the axillary lymph nodes has already been performed, so radiation therapy would not be indicated.

Limb perfusion is sometimes used as adjuvant treatment for recurrent melanoma of the limbs but not for melanoma of the trunk.

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38

A 1-year-old boy with a lymphatic malformation on the left side of the neck has a sudden increase in the size of the mass. Which of the following is the most likely cause of the enlargement?

(A) Hemorrhage
(B) Infection
(C) Lymphatic obstruction
(D) Malignant transformation
(E) Skeletal hypertrophy

The correct response is Option B.

In this patient with a lymphatic malformation on the left side of the neck, infection is the most likely cause of its sudden enlargement. This sequela most commonly occurs in association with an upper respiratory tract infection. There may or may not be cellulitis, warmth, or tenderness over the mass. The preferred treatment is administration of an antibiotic, usually penicillin, to destroy gram-positive organisms from the upper respiratory tract. Typically with antibiotic treatment, the malformation will decrease to its preinfection size. Occasionally, sudden enlargement of a lymphatic malformation will lead to a respiratory obstruction that requires emergent tracheostomy.

Hemorrhage can also lead to a sudden increase in the size of a lymphatic malformation but is a less common cause than infection. Lymphatic obstruction contributes to the slow enlargement of these malformations but would not be responsible for sudden enlargement. Malignant transformation of lymphatic malformations has never been reported. Finally, skeletal hypertrophy is associated with these malformations but only gradually leads to malocclusion and deformity.

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39

A 32-year-old pregnant woman comes to the emergency department eight hours after being bitten by her cat. Examination shows an irregular 3-mm wound with erythema around the edges. The patient is allergic to penicillin. The most appropriate management is administration of which of the following drugs?

(A) Amoxicillin-clavulanic acid (Augmentin)
(B) Cephalexin (Keflex)
(C) Ciprofloxacin (Cipro)
(D) Doxycycline (Vibramycin)
(E) Trimethoprim-sulfamethoxazole (Septra DS)

The correct response is Option E.

In general, wounds should be cultured before manipulation and should remain open. Most bite wound infections are multibacterial; *Pasteurella multocida* is present in 40% to 50% of cat bite wounds. Although antimicrobial therapy is indicated for this patient, the choice of agent is somewhat complicated.

Trimethoprim-sulfamethoxazole (Septra DS; trimethoprim 160 mg/sulfamethoxazole 800 mg) at 12-hour intervals is the most appropriate antibiotic to administer to a pregnant woman with an allergy to penicillin. Data exist showing its successful use to treat cat bite wounds.

Amoxicillin-clavulanic acid (Augmentin) is the antibiotic of choice in a person who does not have an allergy to penicillin. Cephalexin (Keflex) should be avoided because many strains of *Pasteurella multocida* have

demonstrated resistance. Ciprofloxacillin (Cipro) is not approved for use during pregnancy. Doxycycline (Vibramycin), 100 mg at 12-hour intervals, is an excellent choice in patients allergic to penicillin but is contraindicated during pregnancy.

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40

A moderately obese 52-year-old woman who has smoked one pack of cigarettes daily for the past 20 years undergoes immediate reconstruction of the left breast with a bipedicled rectus abdominis myocutaneous flap. During application of dressings at the end of the procedure, the flap periphery appears slightly cyanotic; proximal circulation is uncompromised. When the incision is opened, there is no kinking of the vessels and no hematoma. Cyanosis does not improve.

Administration of which of the following drugs is NOT appropriate to improve flap perfusion?

(A) Heparin
(B) Nifedipine
(C) Nitroglycerin
(D) Prednisolone
(E) Streptokinase

The correct response is Option E.

The survival of the compromised portion of the distal aspect of a flap is primarily a function of the microcirculation. Pharmacologic intervention may be helpful in reducing distal flap ischemia in a patient with risk factors that may contribute to a compromise in peripheral microcirculation. In this patient with a bipedicled TRAM flap, the proximal circulation may be adequate, but her obesity and smoking history most likely have affected peripheral microcirculation, resulting in clinical evidence of marginal ischemia at the skin edges.

Anticoagulants such as heparin and dextran have been shown to improve flap survival when administered intraoperatively or perioperatively. The beneficial effect is most likely caused by inhibiting platelet aggregation, decreasing platelet adhesiveness, and maintaining microvascular patency.

Calcium channel blocking agents such as nifedipine are direct smooth muscle relaxants that cause vasodilatation, which has been shown to improve circulation in the flap and therefore may improve distal flap survival.

Potent vasodilators such as topical nitroglycerin appear to have a greater effect on the venous circulation than on the arterial vessels. Improved survival of axial and random flaps with topical nitroglycerin has been reported.

In most studies, anti-inflammatory agents and corticosteroids have been shown to have a beneficial effect on flap survival. With steroidal agents such as prednisolone, the effect appears to be caused by vasodilatation as well as by anti-inflammatory properties. The potential benefit is primarily observed within 48 hours postoperatively when given at doses of 20 mg/kg.

Streptokinase and urokinase have been used for specific intravascular infusion to treat proximal thrombi. However, they have been associated with significant bleeding problems and have not resulted in any demonstrable improvement in patency rates or flap survival.

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41

A 53-year-old woman is scheduled to undergo localized excision of a benign lesion on the upper arm. She has a history of allergic reaction to a local anesthetic. Which of the following is the most likely causative anesthetic?

(A) Bupivacaine
(B) Lidocaine
(C) Mepivacaine
(D) Tetracaine

The correct response is Option D.

This 53-year-old woman has a history of allergic reaction most likely caused by tetracaine, an ester anesthetic. Local anesthetics are categorized as ester or amide compounds, depending on their link between the aromatic portion and intermediate chain. Ester anesthetics have a shorter half-life and a lower toxicity. However, the potential for development of allergic reaction is greater with ester compounds. This may be due to a metabolization of esters to para-aminobenzoic acid. Anesthetics in this class include procaine, chloroprocaine, tetracaine, and cocaine.

Amide anesthetics have greater protein binding, a longer duration of action, and greater toxicity. The names of anesthetics belonging to this class can be identified by an "i" in the prefix before "caine," ie, lidocaine, mepivacaine, bupivacaine, and etidocaine.

This patient who has an allergy to tetracaine (an ester anesthetic) can be given amide anesthetics instead because allergies to anesthetics are class-related. The differences in the metabolism of and allergy to local anesthetics are attributed to the ester/amide nature of these compounds.

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42

A 44-year-old man with paraplegia who often sits in his wheelchair for prolonged periods of time develops a pressure ulcer of the ischium that involves the reticular dermis. Which of the following is the correct clinical staging of this patient's pressure ulcer?

(A) Stage I
(B) Stage II
(C) Stage III
(D) Stage IV

The correct response is Option B.

The National Pressure Sore Advisory Panel Consensus Development Conference has developed a system to classify pressure ulcers according to four stages:

Stage I The skin is intact, but has a red discoloration more than one hour after relief of pressure
Stage II There is a blister or other break in the dermis, with or without infection
Stage III There is subcutaneous destruction into the muscle, with or without infection
Stage IV There is bony or joint involvement, with or without infection

Because this patient's pressure ulcer involves the reticular dermis, it would be correctly classified as stage II.

Staging systems for pressure ulcers address depth only. They do not take into account the presence of osteomyelitis or rates of recurrence. In addition, they do not necessarily reflect the cause of the ulcer.

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43

A 34-year-old woman is scheduled to undergo surgical shaving of a lesion of the right forearm during local anesthesia with a solution containing 1% lidocaine. This corresponds to how many milligrams of lidocaine per milliliter?

(A) 0.1 mg
(B) 1 mg
(C) 10 mg
(D) 100 mg

The correct response is Option C.

A local anesthetic solution containing 1% lidocaine would have 10 g of lidocaine per liter of solution, or 10 mg per milliliter.

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44

An 80-kg 42-year-old factory worker sustains partial-thickness and full-thickness burns over the anterior thorax, lower extremities, and one-half of the left arm. According to the Parkland formula, which of the following is most appropriate for initial fluid resuscitation?

(A) 585 mL/hr during the first 16 hours, followed by 1170 mL/hr during the next eight hours
(B) 630 mL/hr during the first 16 hours, followed by 1260 mL/hr during the next eight hours
(C) 780 mL/hr during the first 24 hours to maintain an adequate urine output of 0.5 mL/kg/hr
(D) 1170 mL/hr during the first eight hours, followed by 585 mL/hr during the next 16 hours
(E) 1260 mL/hr during the first eight hours, followed by 630 mL/hr during the next 16 hours

The correct response is Option D.

During the first 24 hours after a burn injury, acute fluid resuscitation should be performed with administration of crystalloid. The Parkland formula is used to estimate the amount of fluid required. According to this formula, lactated Ringer's solution 4 mL/kg/% total body surface area (TBSA) burned should be administered during the first 24 hours. A total of 50% should be administered during the first eight-hour period and the remaining 50% over the next 16 hours. This 80-kg patient has a 58.5% TBSA burn and requires 18,720 mL of fluid during the first 24 hours: 9360 mL, or 1170 mL/hr, during the first eight hours and the remaining 9360 mL, or 585 mL/hr, over the next 16 hours.

The TBSA involved in a burn can be calculated using the "rule of nines." According to this rule, the anterior trunk, the posterior trunk, and each lower extremity are assigned values of 18%. Each upper extremity and the head have values of 9%, and the neck has a value of 1%. In this patient, only one-half of the left upper extremity is involved; therefore, the total burn area of the upper extremities is 4.5%. The anterior thorax burn is 18% and each lower extremity burn is 18% for a TBSA burn of 58.5%.

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45

An 11-year-old boy with a venous malformation of the right hand is diagnosed as having chondrosarcoma when he undergoes surgical correction of a fracture of the distal phalanx of the ring finger. Which of the following is the most likely diagnosis?

(A) Kasabach-Merritt syndrome
(B) Klippel-Trénaunay-Weber syndrome
(C) Maffucci syndrome
(D) Ollier disease
(E) Sturge-Weber syndrome

The correct response is Option C.

This 11-year-old boy has Maffucci syndrome, which involves multiple enchondromas, most frequently affecting the hand, and venous malformations. Skeletal deformities occur subsequently. Symptoms manifest prior to adolescence. Approximately 20% of patients with Maffucci syndrome develop chondrosarcoma.

Kasabach-Merritt syndrome is a disorder that is initially seen in infants during the first or second month of life. It is characterized by large hemangiomas associated with profound thrombocytopenia, petechiae, ecchymoses, and internal hemorrhage. Infants with Kasabach-Merritt syndrome have a decreased platelet count, which will return to normal after the hemangiomas have regressed. Localized consumptive coagulopathy may lead to depletion of clotting factors, which can be life-threatening.

Klippel-Trénaunay-Weber syndrome is characterized by skeletal hypertrophy of one extremity, most commonly the leg, with associated port-wine stains. Deep soft-tissue involvement, including venous and lymphatic malformations, is also seen.

Ollier disease (multiple enchondromatosis) is caused by abnormal endochondral ossification. Benign cartilaginous tumors in the large and small tubular bones are characteristic of Ollier disease. Multiple lesions of the small bones of the hand may cause loss of function. Malignant degeneration is associated.

Sturge-Weber syndrome is associated with a large vascular malformation, usually a port-wine stain, in the distribution of the first and second branches of the trigeminal nerve. Other findings include focal motor seizures, hemiparesis, and visual field defects, especially glaucoma. Mental retardation may also occur.

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46

A 16-year-old girl has a 2 × 2-cm granulating wound on the central forehead. Which of the following is the most appropriate donor site for skin grafting?

(A) Full-thickness retroauricular
(B) Full-thickness groin
(C) Full-thickness upper eyelid
(D) Split-thickness lateral thigh
(E) Split-thickness supraclavicular

The correct response is Option A.

In this 16-year-old girl who has a wound of the forehead, a full-thickness retroauricular graft should be harvested and used for coverage. This graft will provide the appropriate color and texture match and the required contour. Lack

of hair growth at the donor site is also a consideration. Full-thickness grafts from the supraclavicular and retroauricular areas are often used for defects of the head and neck.

A full-thickness upper eyelid skin graft would not be large enough to cover this patient's wound and would not have the thickness required to match the skin of the forehead. Use of a full-thickness skin graft from the groin may lead to hair growth at the recipient site. Hyperpigmentation of grafted skin is also a common finding. The color and texture of a split-thickness skin graft is unlikely to ideally match the facial skin.

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47

A 30-year-old woman has the progressively enlarging pulsatile lesion shown in the above photograph. Which of the following is the most appropriate management?

(A) Close observation
(B) Intravenous administration of corticosteroids
(C) Flashlamp-pumped pulse-dye laser ablation
(D) Sclerotherapy
(E) Surgical excision

The correct response is Option E.

In this 30-year-old woman who has a high-flow vascular malformation of the upper lip, the most appropriate management is surgical excision of the lesion. Vascular malformations are structural anomalies that exhibit normal

rates of endothelial cell turnover and indicate vascular morphogenesis. They occur most frequently on the head, neck, and extremities. Intracranial extension is common. On examination, the overlying skin is often discolored and feels warm. The lesions are pulsatile and accompanied by a thrill or bruit. Rapid cellular proliferation is not associated. Treatment is often difficult and recurrence rates are high. Surgical excision of the entire lesion is required to remove all residual tissue, lessening the risk for recurrence. Angiograms taken prior to surgery will delineate the multiple feeding vessels and high degree of shunting within the malformations. Embolization should be performed to decrease intraoperative blood loss and allow for easier removal. Soft-tissue reconstruction will adequately restore this patient's facial features.

Observation is not appropriate because vascular malformations do not regress.

Corticosteroids are sometimes used in the treatment of hemangiomas, but would not be appropriate in the treatment of a vascular malformation.

The pulsed-dye (585 nm) laser only allows superficial penetration into the dermis, and will not obliterate the large vessels within this lesion. This laser effectively diminishes port-wine stains.

Sclerotherapy agents, such as polidocanol (Scleravein) and Ethibloc, are appropriate for treatment of venous malformations and telangiectasias to harden the lesions in preparation for surgical debulking, but are ineffective in patients with vascular malformations.

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48

Which of the following is the initial stage of full-thickness skin graft take?

(A) Capillary ingrowth
(B) Contracture of the dermis
(C) Elastic recoil
(D) Inosculation
(E) Plasmatic imbibition

The correct response is Option E.

Plasmatic imbibition allows the graft to survive for the first 24 to 48 hours after transfer. During this phase, the graft receives nutrients from the excess serum that collects between the graft and the recipient site. Inosculation begins after this period, resulting in successful vascular ingrowth into the graft. After approximately 48 hours, capillary ingrowth begins through the creation of new vessels or re-establishment of existing systems.

Contracture of the dermis occurs immediately after graft harvest and is caused by recoil of elastin fibers within the dermis.

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49

In a patient with acute thermal burns, which of the following measurements most effectively monitors adequate fluid resuscitation?

(A) Central venous pressure
(B) Heart rate
(C) Mean arterial blood pressure
(D) Pulmonary capillary wedge pressure
(E) Urine output

The correct response is Option E.

In a patient with acute thermal burns, measurement of urine output is the most effective method to monitor adequate intravenous fluid resuscitation. For the first 24 hours after initial injury, adequate renal perfusion is indicated by a urine output of 30 to 100 mL/hr in an adult or greater than 1 mL/kg/hr in a child. Adequate fluid resuscitation greatly decreases the risk for acute tubular necrosis and subsequent renal failure. Monitoring urine output is not useful in a patient with extensive muscle damage due to electrical burns. Muscle injuries cause the release of hemochromogens and the precipitation of intratubular proteins, resulting in renal dysfunction.

Because heart rate and mean arterial blood pressure vary greatly according to the patient, they are not precise indicators of adequate fluid resuscitation. They may also reflect factors not directly related to intravascular volume. For example, hypotension is a latent sign of hypovolemic shock, not lack of fluids.

Catheterization (Swan-Ganz or central venous) may be helpful in assessing the adequacy of intravenous fluid resuscitation. It is particularly useful in patients with cardiac disease, pulmonary disease or injury, or severe pre-existing systemic disease. However, it is not as reliable as urine output in monitoring fluid resuscitation, and the amount of fluid administered during intravenous resuscitation should not depend on the measurement of central venous pressure or pulmonary capillary wedge pressure.

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50

The above photograph is of a 6-month-old girl who has had soft-tissue growth over the mandibular border and suprapubic region for the past four months. Examination shows firm, noncompressible, nonpulsatile masses. Which of the following is the most appropriate initial step in management?

(A) Observation
(B) Oral administration of corticosteroids
(C) Flashlamp-pumped pulse-dye laser ablation
(D) Radiation therapy
(E) Surgical excision

The correct response is Option A.

This 6-month-old girl has a hemangioma, which is the most common tumor in infants. These tumors typically appear by age 1 year and are three times as likely to occur in girls. Approximately 14% to 20% of affected children have more than one lesion.

Most hemangiomas will spontaneously involute over time and need no treatment other than expectant observation. Careful counseling and reassurance of the parents is often helpful. If a hemangioma causes visual, nasal, laryngeal, or bilateral auditory obstruction, it must be reduced as quickly as possible to prevent permanent impairment.

Corticosteroids can hasten the involution of the hemangioma. Administration of prednisone 2 to 3 mg/kg daily for two to three weeks followed by dosage tapering is recommended. However, some hemangiomas will not respond to treatment and rebound growth may occur. In addition, systemic corticosteroids are associated with adverse effects including growth retardation, immunosuppression, and electrolyte abnormalities.

Treatment using the flashlamp-pumped pulse-dye laser is only recommended for early, superficial lesions or to control bleeding and ulceration. The penetration of the laser is not deep enough to completely ablate the hemangioma, general anesthesia is often required, and deeper vascular channels may be enlarged as a result of the procedure.

Although hemangiomas are extremely sensitive to radiation therapy, this form of treatment is reserved for hemangiomas that are life-threatening and resistant to other treatment modalities. Adverse effects, such as skin changes, burns, epiphyseal damage, ocular lens damage, or altered growth of the breasts, gonads, or thyroid gland may be associated. Malignant changes may also appear in the thyroid, parathyroid, and salivary glands.

Surgical resection of a hemangioma should only be used in patients with significant impairment resulting from obstruction, hemangiomas associated with Kasabach-Merritt syndrome or congestive heart failure, or ulcerated, scarred lesions. Permanent scarring or disfiguration may result. Excision may also be used to improve the patient's appearance following involution. Typical remnants of the involuted hemangioma include an atrophied epidermis, telangiectasias, hypopigmented skin, and a fibrofatty residuum.

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51

A 60-year-old man who is brought unconscious to the emergency department has a large laceration of the arm that he sustained while attempting to clean his lawnmower. The wound is covered with mud, rust, oil, and grass. His wife does not remember if he has ever received a tetanus shot. The most appropriate immediate treatment of this patient is

(A) administration of tetanus immune globulin
(B) administration of tetanus toxoid
(C) administration of tetanus immune globulin and tetanus toxoid
(D) intravenous administration of antibiotics, followed by delayed administration of tetanus toxoid
(E) irrigation with antitetanus wound irrigant, followed by delayed administration of tetanus toxoid

The correct response is Option C.

In patients with wounds susceptible to tetanus and no history of immunization, the recommended initial treatment is administration of 250 mg of tetanus immune globulin and 0.2 mg of tetanus toxoid. This is then supplemented with additional toxoid injections at two- and four-month intervals. Copious high-flow irrigation of the wounds with saline is also recommended.

Tetanus toxoid alone is recommended in tetanus-prone wounds in those patients who have been previously immunized and whose last tetanus shot was administered more than three years ago.
Intravenous antibiotics are not routinely administered to patients with tetanus-prone wounds. Anti-tetanus wound irrigant is not available for use.

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52

In experimental models, the percentage of the initial weight retained in aspirated fat nine months after injection is closest to

(A) 10%
(B) 30%
(C) 50%
(D) 70%
(E) 90%

The correct response is Option B.

Studies of New Zealand white rabbits have shown that approximately 40% of transferred autologous fat was retained six months after injection. The retention rate at nine months was approximately 30% after repeat injection of the fat into the dorsal ear of the rabbit.

In the same studies, the percentage of fat retained following surgical excision and grafting was nearly 100%. Approximately 40% was retained at nine months.

Clinical reports have shown low long-term maintenance rates following injection of aspirated fat at multiple sites.

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53

Which of the following types of biologic dressing has no antigenicity?

(A) Allograft
(B) Amnion
(C) Biobrane
(D) Cultured keratinocytes
(E) Isograft

The correct response is Option E.

Several biologic dressings are available for coverage of wounds in burn patients. Amnion is one effective biologic dressing that is inexpensive, is readily available, and can be obtained from the delivery room by any skilled technician.

Amnion is most effective when covered by an occlusive dressing that will prevent marked evaporation within the tissue.

A human skin allograft is an actual piece of skin harvested from a cadaver and used to cover the wounds of a burn patient. It is the most effective biologic dressing available. However, it has the potential for rejection by the immune system of the recipient. There is also the possibility of transmission of infectious diseases, such as hepatitis and AIDS, from the donor body to the recipient burn patient.

Biobrane is another type of biologic dressing used in the coverage of burn wounds. It is a bilaminate membrane that consists of an outer layer of nylon-knit fabric bonded to a thin film of silicone. This membrane is coated with a layer of type I porcine collagen. Biobrane is an elastic covering that conforms to wound surfaces. It is effective in controlling evaporation of water from tissues.

Cultured keratinocytes are grown in the laboratory from cell populations of human skin. Although they have shown great promise as both temporary and permanent skin coverings, they do not provide durable coverage and are currently available in a limited number of centers.

An isograft is a graft of tissue from the body of the patient or another individual with an identical genotype (ie, monozygotic twin). Because the tissue matches the tissues of the patient exactly, there is no subsequent antigenicity and no risk for recipient rejection.

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54

Which of the following methods of free flap monitoring is most reliable?

(A) Clinical observation
(B) Doppler ultrasound flowmetry
(C) Pulse oximetry
(D) Quantitative fluorometry
(E) Surface temperature probing

The correct response is Option A.

Clinical observation is typically regarded as the best method for monitoring a newly placed flap. Although there are many available technical monitoring systems, physicians cannot reach a general consensus on which of these is the most effective. In spite of increasing technology, clinical observation seems to remain the preferred methodology.

Cutaneous free flaps should be regularly and frequently assessed for skin color, temperature, and capillary refill. Muscle flaps should be assessed for muscle color, turgor, and needle-stick bleeding.

Complications seen following flap transfer may be a manifestation of venous congestion, arterial insufficiency, or other factors. Immediate treatment, consisting of the loosening of overly tight dressings, decongestion via the application of leeches, or surgical exploration, should follow.

Doppler ultrasound flowmetry is the technique most frequently used when assessing flap viability with a mechanical device. Doppler ultrasound permits the assessment of the venous and arterial blood flow of a flap. Although the laser Doppler technique provides continuous monitoring of circulatory flow, it cannot predict future complications that may occur and is not an accurate indicator of the need for clinical intervention.

Transcutaneous oxygen monitoring (pulse oximetry) is used to detect differences in the wavelength of light absorbed by deoxygenated and oxygenated hemoglobin. It continuously monitors both oxygen saturation and pulse, and is particularly useful for monitoring replanted digits and toe-to-thumb transfers.

Quantitative fluorometry (QF) has been shown to be useful in the monitoring of cutaneous flaps and toe transplantations. Transplants that were re-explored on the basis of QF findings had a salvage rate of 87%, while similar microvascular transplants that were not monitored by this method had a salvage rate of only 56%. Care should be taken when using QF, however, because the fluorescein dye has been known to cause nausea or an allergic reaction in some patients.

Monitoring the temperature of the flap is another widely used technique. One large clinical series demonstrated the ability of temperature monitoring to detect with high sensitivity those flaps that were failing. Flaps detected by this method were able to be salvaged successfully. Other studies have shown temperature monitoring to be effective when used for free muscle flaps with overlying skin grafts.

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55

Which of the following flaps receives its motor innervation from the obturator nerve?

(A) Biceps femoris
(B) Gluteus maximus
(C) Gracilis
(D) Rectus femoris
(E) Tensor fascia lata

The correct response is Option C.

The motor innervation of a gracilis flap is shared with the adductor group of muscles and comes from the obturator nerve. The gracilis receives its blood supply from branches of the medial circumflex femoral artery.

The biceps femoris receives its blood supply from perforating branches of the profunda femoris (in addition to direct branches from the superficial femoral artery). The motor innervation of this muscle is derived from branches of the sciatic nerve.

The motor innervation of the gluteus maximus muscle comes from the inferior gluteal nerve. The blood supply to this muscle comes through two large major vascular pedicles: one from the superior gluteal artery and the other from the inferior gluteal artery. These pedicles are derived from the internal iliac system. Either of the vascular pedicles is capable of carrying the entire myocutaneous unit.

The rectus femoris muscle receives its motor innervation from a branch of the musculocutaneous nerve. Blood is supplied by branches of the lateral circumflex femoral artery.

The tensor fascia lata is a small lateral thigh muscle that has a long fascial extension in the iliotibial tract; it is a flexible and useful myocutaneous unit. The motor innervation to the tensor fascia lata muscle derives from the superior gluteal nerve. However, most of the skin over this myofasciocutaneous unit is innervated by the lateral femoral cutaneous nerve, which gives most of its input into the T12 spinal root. Sensory innervation to this unit may be preserved in some paraplegic patients with incomplete cord lesions or cauda equina level injury and in some patients with congenital lesions such as spina bifida. The tensor fascia lata unit has therefore been used as a sensory flap in the area of the gluteal crease and ischium. Its blood supply is also from branches of the profunda femoris artery.

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56

Which of the following is the most common cause of graft failure?

(A) Fluid collection beneath the graft
(B) Infection
(C) Insufficient graft thickness
(D) Poor bed vascularity
(E) Shear

The correct response is Option A.

Collection of blood or serous fluid beneath the graft is the most common complication resulting in skin graft failure. Techniques that will prevent the development of fluid collection include maintenance of hemostasis, perforation or meshing of the graft, and the use of pressure dressings and bolsters.

Infection is the second most common cause of skin graft failure. A thin split-thickness skin graft may not provide the durability necessary for wound coverage. Poor vascularity of the graft bed and graft shear may lead to graft failure but are less common than fluid collection and infection. A well-vascularized bed is required to ensure successful graft take.

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57

A 25-year-old man has a defect of the tip of the nose that is to be covered with a bilobed flap. This is best classified as which of the following types of flaps?

(A) Advancement
(B) Distant
(C) Interpolation
(D) Rotational
(E) Transposition

The correct response is Option E.

A bilobed flap is one type of transposition flap. This flap is rectangular and raised adjacent to its recipient defect. It must be designed to extend well beyond the edges of the defect in order to provide sufficient length and minimal tension to the flap. The Limberg and Z-plasty flaps are other examples of transposition flaps.

Advancement flaps are moved directly forward over the defect without any rotation. A V-Y advancement flap is one example. Distant flaps are so named because the donor and recipient sites are situated distant from each other. Examples include tube and free flaps. Interpolation and rotational flaps are both types of pivot flaps; they are rotated about a central point of fixation. In an interpolation flap transfer, the defect is not directly adjacent to the donor site and the pedicle must pass over or under intervening tissue. One example is a forehead flap used in nasal reconstruction. A rotation flap has a semicircular design and is elevated and rotated to directly reach the defect. The gluteal fasciocutaneous flap is an example of a rotation flap.

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58

1. Collagen synthesis
2. Contraction
3. Polymorphonuclear infiltration
4. Re-epithelialization
5. Vasoconstriction
6. Vasodilation

Which of the following is the correct sequence in the process of normal primary wound healing?

(A) 6, 5, 4, 3, 1, 2
(B) 6, 5, 3, 4, 1, 2
(C) 5, 6, 4, 3, 1, 2
(D) 5, 6, 3, 4, 1, 2
(E) 5, 6, 1, 3, 4, 2

The correct response is Option D.

The inflammatory phase of wound healing begins immediately and lasts approximately five days. Initially, vasoconstriction occurs for approximately 10 minutes, followed by vasodilation to allow blood products, including polymorphonuclear lymphocytes, to infiltrate into the wound. Re-epithelialization begins several hours later and is typically complete within 24 hours. Fibroblasts begin collagen synthesis as early as 72 hours after injury, during the collagen phase of wound healing. Approximately 21 days into the wound healing process, the remodeling phase begins, allowing wound contraction.

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59

Which of the following is the most common type of collagen found in hypertrophic scars?

(A) Type I
(B) Type II
(C) Type III
(D) Type IV
(E) Type V

The correct response is Option A.

Hypertrophic scars are elevated above the surface of the skin and can develop at any location in patients of all ages; regression may occur over time. These scars form within the boundaries of the healing wound. In contrast, keloids extend beyond the site of injury. The excess collagen found in both hypertrophic scars and keloids is due to increased formation or impaired degradation of collagen. Typical findings associated with these abnormal scars include increases in glycolytic enzyme activity, fibronectin deposition, and production of collagen mRNA. Patients with hypertrophic scars have a type I to type III collagen ratio of approximately 2:1 in the healing wound. In contrast, the type I to type III ratio in normal skin is 4:1.

Type I collagen is present in greater than 90% of the body's tissues, including bone, tendon, skin, dentin, ligament, and fascia, as well as in the arteries and uterus.

Type II collagen is predominant in hyaline cartilage and eye tissues. The skin, arteries, uterus, and intestinal wall contain type III collagen. Most fetal wound collagen is type III. Basement membrane is made up predominantly of collagen types IV and V.

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60

Use of which of the following materials is most likely to result in a definitive wound closure?

(A) Amniotic membrane
(B) Biobrane
(C) Cultured epidermal autograft
(D) Cutaneous allograft
(E) Cutaneous xenograft

The correct response is Option C.

A definitive, permanent wound closure can be achieved using cultured epidermal autografts. This material is frequently used in patients with extensive burns. Factors that influence survival following grafting include the total burn size, the status of the recipient bed, and the presence or absence of sepsis. However, cultured epidermal autografts are expensive and fragile, and lack dermis. Their durability becomes less of an issue in the presence of large burns.

Biologic dressings (eg, amniotic membranes, Biobrane, cutaneous allografts, and cutaneous xenografts) are not permanent. Amniotic membranes and cutaneous xenografts do not permanently adhere to wound surfaces. Biobrane is a synthetic dressing consisting of a custom-knit nylon fabric bonded to an ultrathin silicone rubber membrane that

is covalently bonded to collagenous peptides from porcine skin. In patients without adequate available donor sites, cutaneous allografts can be used to limit bacterial proliferation and prevent heat loss, evaporative water loss, and the development of wound desiccation.

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61

A 62-year-old woman has a 1 × 1-cm full-thickness defect of the alar margin. Which of the following is most appropriate for reconstruction of the defect?

(A) Cartilage graft
(B) Composite graft
(C) Expanded forehead flap
(D) Free flap reconstruction of the entire nasal unit
(E) Nasolabial flap

The correct response is Option B.

This 62-year-old woman who has a full-thickness defect involving the alar margin should undergo reconstruction using a composite graft from the ear. This graft provides a good color and texture match along with the cartilaginous support and internal lining necessary to restore the function and aesthetic appearance of the nose.

A cartilage graft can be used in patients who have malar defects to provide support and prevent notching; however, there must be adequate soft tissue for coverage of the defect.

Smaller forehead flaps are often used for reconstruction of nasal defects, but an expanded flap would be too large.

Free flap reconstruction of the entire nose will provide the most attractive reconstruction in a patient whose defect involves a substantial part of the nose and cannot be adequately improved using a smaller flap or graft.

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62

A 23-year-old linesman sustains an electrical burn to the posterior scalp when he touches a high-voltage power line. Following debridement, he has a 10 × 15-cm defect with exposed, devitalized skull. Which of the following reconstructive procedures is most appropriate?

(A) Burring of the skull to the diploë layer and allowing granulation, followed by skin grafting
(B) Coverage with a free flap
(C) Coverage with a vertical trapezial pedicled muscle flap
(D) Split-thickness skin grafting
(E) Tissue expansion of the remaining scalp

The correct response is Option B.

The most appropriate reconstructive procedure for this patient with a large scalp defect is coverage with a free flap. This method of reconstruction will provide sizeable coverage of the defect with the appropriate blood supply to prevent the development of bone necrosis. Emergent elevation of the flap and reconstruction of the devitalized skull will decrease the risk for further untoward complications, such as sequestration and meningitis.

Burring the skull to the diploë layer may not be possible because the diploic cavity may not be intact as a result of the injury. Skin grafting over bony, devitalized skull would lead to sequestration and sloughing.

The vertical trapezial muscle flap derives its vascular supply from the transverse cervical artery. Although its point of axis and rotation would allow the flap to reach the occiput, it would not be large enough to completely cover the defect.

Because tissue expansion is a form of delay, immediate emergent reconstruction with adjacent viable scalp would be traumatic and would adversely affect cutaneous circulation.

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63

A 40-year-old man who has paraplegia to a sensory level of L3-4 has a grade IV ischial pressure ulcer. Which of the following flaps will provide the most sensate coverage of the ischium in this patient?

(A) Gluteal thigh fasciocutaneous flap
(B) Gracilis musculocutaneous flap
(C) Tensor fascia lata musculocutaneous flap
(D) Vastus lateralis musculocutaneous flap
(E) V-Y hamstring musculocutaneous advancement flap

The correct response is Option C.

The most appropriate management of this patient's defect is reconstruction with a tensor fascia lata musculocutaneous flap. In patients with paraplegia, sensate flaps should be used to cover ischial pressure ulcers. This flap has sensation in this patient because it receives cutaneous innervation at the levels of T12 and L2-3, which are above the level of spinal cord transection. Cutaneous innervation can be incorporated into the flap during harvest. Transfer of the entire flap is required to cover the ischium; however, a delay procedure involving the distal aspect of the flap may be considered to prevent the development of complications.

The gluteal thigh and V-Y hamstring advancement flaps are often used for reconstruction of ischial pressure ulcers. However, these flaps derive their sensation from the posterior cutaneous nerve of the thigh, which is innervated by spinal segments S1-3, below the level of injury.

The gracilis musculocutaneous flap is based on the proximal main medial femoral cutaneous arterial pedicle and does not have any cutaneous innervation.

The vastus lateralis musculocutaneous flap is insensate and requires a skin graft for transfer.

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64

A 43-year-old woman has a sudden change in the shape of the right breast 12 years after undergoing augmentation mammaplasty with silicone implants. Implant rupture is suspected. Which of the following is the most likely cause?

(A) Capsular contracture
(B) Fold flaws
(C) Mammography
(D) Myotatic implant compression
(E) Weakening of the silicone shell

The correct response is Option E.

The incidence of implant rupture increases greatly eight to 15 years after augmentation. The most likely cause of this increase in implant failure is the mechanical breakdown of the silicone elastomer shell that occurs with aging of the implant. Lipid infiltration has been proposed as a cause of mechanical weakening but has not yet been documented.

Capsular contracture is common following breast augmentation but is less likely than mechanical weakening to cause implant rupture. Compression mammography and myotatic implant compression are not associated with implant rupture. Fold flaws may result in failure of the implant, but are rarely seen with silicone implants. This complication is more likely associated with the use of saline implants.

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65

A 42-year-old man has a 3-cm scar on the forehead parallel to the resting lines of skin tension. Which of the following is the most appropriate surgical technique for scar revision?

(A) Fusiform excision
(B) Serial excision
(C) W-plasty
(D) Y-V-plasty
(E) Z-plasty

The correct response is Option A.

The most appropriate surgical technique in this 42-year-old man who has a 3-cm scar of the forehead is fusiform excision. This will improve the appearance of the scar by orienting the excision parallel to the resting lines of skin tension with at least a 3:1 length-to-width ratio, undermining the lateral edges of the wound, and using absorbable subcuticular sutures. A properly designed fusiform excision can be closed primarily; in an excision with a 4:1 length-to-width ratio, the development of a "dog ear" deformity (mounds of excessive tissue at the wound ends) is rare.

Serial excision is appropriate in patients who have wide scars that cannot be excised in one procedure without tension.

A W-plasty is indicated for revision of scars outside of the lines of tension. Scars on the forehead, eyebrows, temples, cheeks, nose, and chin, as well as bowstring scars and small depressed scars, can be divided by a W-plasty without adding significant length.

A Y-V-plasty is useful for contracted burn scars. This technique lengthens the scar by adding tissue. Adequate vascular supply is maintained.

The Z-plasty procedure is used for release of a scar contracture or reorientation of a scar more parallel to the resting lines of skin tension. The limbs of a Z-plasty are equal to the central incision and should be performed at 30- to 90-degree angles from the central axis. The appearance of antitension line scars of the face, trap-door and depressed scars, multiple scars, and facial scars situated at an angle of less than 35 degrees to the resting lines of skin tension can be improved with this technique.

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66

An 8-year-old girl has acute suppurative arthritis involving the metacarpophalangeal joint of her index finger 48 hours after being bitten by her cat. Which of the following is the most likely causal organism?

(A) *Aeromonas hydrophila*
(B) *Clostridium perfringens*
(C) *Eikenella corrodens*
(D) *Mycobacterium marinum*
(E) *Pasteurella multocida*

The correct response is Option E.

Pasteurella multocida is the most common cause of infection following a cat bite. In one study, this organism was cultured from 100% of cat bite wounds. Management includes local wound care and administration of penicillin.

Aeromonas hydrophila is associated with the use of medicinal leeches. It is characterized by a rapidly progressive infection with gas in the soft tissues and can resemble clostridial myonecrosis. *Clostridium perfringens* is associated with deep puncture wounds or crush injuries. Clostridial cellulitis or clostridial myonecrosis can occur, both with severe systemic toxicity. *Eikenella corrodens* is present in the human mouth and is associated with infection in human bite wounds. *Mycobacterium marinum* is associated with infection following skin puncture or abrasion in contaminated water, such as swimming pools or tropical fish tanks. Symptoms of infection can mimic gout, rheumatoid arthritis, or low-grade pyogenic arthritis. Histologic examination of infected tissue shows noncaseating granulomas.

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67

A 4-week-old infant has a two-day history of spontaneous bruising of the chest and limbs. Examination shows bleeding gums and a hemangioma of the left leg that covers approximately 60% of the limb. Blood studies are most likely to reveal which of the following?

(A) Granulocytopenia
(B) Macrocytic anemia
(C) Spherocytosis
(D) Thrombocytopenia
(E) von Willebrand factor deficiency

The correct response is Option D.

This patient has Kasabach-Merritt syndrome, a disorder characterized by a large hemangioma and thrombocytopenia, which is a decrease in the total number of platelets. The platelets that do exist become caught in the hemangioma and cause localized clotting. Clotting factors become depleted and diffuse bleeding occurs. Because this diffuse bleeding may occur within the hemangioma itself, the lesion may undergo a rapid increase in size. Additional findings include petechiae, ecchymoses, and bleeding in the peritoneum, gastrointestinal tract, and central nervous system.

A complete blood count will show between 2000 and 40,000 platelets/mm^3. Prothrombin time (PT) and partial thromboplastin time (PTT) will be increased. Fibrinogen and fibrin split products will be abnormal. Appropriate management of Kasabach-Merritt syndrome includes transfusion of platelets, administration of corticosteroids and antibiotics, and resection of the hemangioma if possible.

Granulocytopenia is a decrease in the number of granulocytes in the body. It is not likely to be associated with the signs and symptoms exhibited by this patient. Because the patient has findings that could be interpreted as infection, the number of granulocytes expected is more likely to be normal or increased.

Macrocytic erythrocytes are indicative of pernicious anemia and celiac disease. They are not associated with Kasabach-Merritt syndrome.

Spherocytosis, which is defined as the presence of sphere-shaped erythrocytes in the body, is a sign of familial hemolytic anemia.

A deficiency of von Willebrand factor is associated with hereditary pseudohemophilia. This patient has a lack of platelets, not clotting factors.

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68

Which of the following causes the adherence of a thin split-thickness skin graft to its recipient bed during the first 72 hours after placement of the graft?

(A) Dermal appendages
(B) Elastin fibers
(C) Fibrin bonding
(D) Inosculation
(E) Neovascularization

The correct response is Option C.

Successful vascular ingrowth of the newly grafted skin requires adherence to its recipient bed. Following placement of the graft, a thin layer of fibrin forms, which bonds the graft to the wound bed during the first 72 hours of healing. This layer also prevents infiltration of the wound with bacteria. Development of bleeding, infection, and shear can disrupt the fibrin bonding process and ultimately result in graft failure; protective dressings can be used to prevent this.

Inosculation, or vascular ingrowth into the graft, occurs after the initial stage of fibrin bonding. During this stage, the developing vessels hold the graft in place on the recipient bed. Collagen formation begins at this time, allowing healing.

Dermal appendages and elastin fibers are part of the dermis but do not influence graft adherence.

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69

Which of the following arteries provides the primary blood supply to a cutaneous groin flap?

(A) Deep circumflex iliac
(B) Inferior gluteal
(C) Lateral circumflex femoral
(D) Profunda femoris
(E) Superficial circumflex iliac

The correct response is Option E.

A cutaneous groin flap is based on the superficial circumflex iliac artery, which arises from the anterior aspect of the femoral artery approximately 2.5 cm below the inguinal ligament and courses toward the anterosuperior iliac spine parallel to the inguinal ligament.

The deep circumflex iliac artery supplies blood to the inner lip and cortex of the iliac crest and provides the vascular supply for osteocutaneous flaps.

The inferior gluteal artery travels posteriorly from the pelvis and supplies blood to the gluteal thigh flap.

The lateral circumflex femoral artery arises from the lateral side of the profunda femoris artery. The superior branch of this artery is the vascular supply for the tensor fascia lata flap.

The profunda femoris artery branches from the femoral artery and supplies the muscles of the thigh region.

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70

Which of the following lesions is most commonly located on the sacrum?

(A) Melasma
(B) Mongolian spot
(C) Nevus of Ito
(D) Nevus of Ota
(E) Solar lentigo

The correct response is Option B.

A Mongolian spot is a blue or gray-brown dermal melanosis that overlies the sacral region. These lesions are composed of melanin-producing cells in the mid to lower dermis. They are typically found in Asian, Mediterranean, and African American neonates. Although enlargement and discoloration may be seen, spontaneous resolution typically occurs by age 5 years.

Melasma is abnormal pigmentation occurring on the cheeks, forehead, nose, and lips in women. This pigment is found within the deep layers of the epidermis or the mid to upper dermis. Pregnancy, hormone replacement therapy, and other conditions involving increased levels of estrogen are frequently associated. Superficial melasma is effectively treated with bleaching or peeling agents.

A nevus of Ito is a flat, brownish blue patch occurring in the distribution of the posterior supraclavicular and lateral cutaneous branches to the shoulder, neck, and supraclavicular skin.

A nevus of Ota is similar to the nevus of Ito but is located on the face in the distribution of the trigeminal nerve. Therapy with the Q-switched ruby laser is curative.

Solar lentigo occurs on sun-exposed areas in association with ultraviolet light. These flat, pigmented lesions are initially seen in adulthood. They may be distinguished from lentigo malignant melanoma by their lack of proliferation.

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71

The great toe transfer, the second toe transfer, and the wraparound methods of thumb reconstruction have which of the following properties in common?

(A) Aesthetic result
(B) Donor vessel
(C) Growth potential
(D) Mobility
(E) Stability

The correct response is Option B.

The great toe transfer, the second toe transfer, and the wraparound methods of thumb reconstruction are all based on the same vascular pedicle, the first dorsal metatarsal artery. This vessel is a branch of the dorsalis pedis artery.

The great toe transfer and the second toe transfer permit mobility at the interphalangeal and metacarpophalangeal joints. The wraparound procedure does not have this benefit.

The wraparound procedure takes the soft tissue sleeve of the great toe and wraps it around the already stable peg of bone at the thumb. The result is excellent stability for the thumb and intact skeletal structures for the foot. The wraparound procedure also results in a very close duplicate of the original thumb. The great toe transfer often results in an overly large thumb, the second toe transfer in an overly small thumb. However, because the wraparound procedure provides no bony material and only a limited amount of soft tissue to the thumb, there is restricted mobility and no potential for growth.

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72

A 22-year-old man who has had paraplegia to the level of T10 since sustaining a traumatic transection of the spinal cord two years ago has a 6 × 8-cm grade III pressure ulcer of the ischium. He is otherwise healthy and has had no other pressure ulcers. Which of the following flaps is most appropriate for closure of this wound?

(A) Gracilis myocutaneous flap
(B) Rectus femoris myocutaneous flap
(C) Sartorius flap
(D) Vastus lateralis muscle flap
(E) V-Y posterior thigh flap

The correct response is Option E.

In this patient, a V-Y posterior thigh flap is most appropriate for closure of the ischial pressure ulcer. Because a person with a spinal cord injury may develop multiple, recurrent pressure ulcers in the course of a lifetime, the vascular pedicles to flaps that may need to be harvested in the future must not be compromised when one flap is transferred. In addition, the suture lines should not be located in the area of any pressure points to prevent further ulceration.

Because of the large dimensions of the posterior thigh flap, readvancement is possible in patients with recurrent ulceration. In patients with paraplegia, use of this flap involves transfer of the biceps femoris, semimembranous, and semitendinous muscles as one unit. Transfer of the biceps femoris alone is sufficient in ambulatory patients. The upper limit of the flap is at the level of the gluteal crease, and it extends proximal to the popliteal crease. Perforators from the profunda femoris artery and venae comitantes comprise the vascular supply. The origin and insertion of the hamstring muscles are completely divided prior to flap transfer.

The gracilis myocutaneous flap is only used as a last option in patients with ischial pressure ulcers. The distal half of this flap's skin paddle is unreliable when the pedicle is based on the dominant vascular supply, which is the ascending branch of the medial circumflex artery and venae comitantes, and it is located too proximal to the muscle.

The rectus femoris flap is effective for soft-tissue reconstruction of defects in the lower abdomen, groin, and perineum. Extension of the flap would be required to simply reach the ischium. In addition, it should not be used as a myocutaneous transfer because its distal skin is unreliable. In ambulatory patients, harvest and transfer of this muscle would result in weakness with leg extension.

The skin islands of the sartorius muscle are also unreliable, and the flap's uses are limited.

The vastus lateralis flap is appropriate for reconstruction in a patient with a trochanteric pressure ulcer who requires resection of the proximal femur. Although its arc of rotation is sufficient to reach the ischium, this flap would not be the ideal choice for this patient.

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73

A 45-year-old man is undergoing coverage of an anterior chest wound using a regional muscle flap. Which of the following factors is most likely to increase this patient's risk for total muscle necrosis?

(A) Active cigarette smoking at the time of surgery
(B) History of diabetes mellitus
(C) History of hypertension
(D) Previous irradiation of the chest wound
(E) Previous irradiation of the muscle to be transposed

The correct response is Option E.

Exposure of the donor muscle to radiation is most likely to result in the development of total muscle necrosis. Although there can be many causes of flap failure, a history of radiation is associated with a significant risk for complete necrosis. Previously irradiated muscle should not be used for flap transfer.

A history of smoking is associated with an increased incidence of complications following surgery because microcirculation is affected. This is especially true in a patient who regularly smokes cigarettes at the time of the procedure. However, total muscle necrosis is unlikely; partial muscle necrosis is more common.

Patients with hypertension and/or diabetes mellitus are not at increased risk for development of total muscle necrosis.

Previous irradiation of the wound is not a risk factor for development of muscle necrosis because it does not affect the donor muscle. Complete debridement of all the necrotic and nonviable tissue found in the wound should be performed prior to flap transfer.

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74

Which of the following arteries supplies the dominant vascular pedicle of the lateral arm flap?

(A) Common interosseous
(B) Inferior ulnar collateral
(C) Lateral epicondylar
(D) Radial collateral
(E) Superior ulnar collateral

The correct response is Option D.

Vascularity of the lateral arm flap is predominantly supplied by the posterior branch of the radial collateral artery, which is positioned between the triceps and brachialis muscles in the lateral intermuscular septum.

The superior ulnar collateral artery supplies blood to the medial arm flap. The common interosseous, inferior ulnar collateral, and lateral epicondylar arteries do not provide vascularity for any specific, well-known flap.

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75

An otherwise healthy 32-year-old man who has a severe burn scar contracture at the elbow undergoes contracture release. Which of the following reconstructive methods is most likely to result in recurrent contracture?

(A) Full-thickness skin graft and postoperative splinting
(B) Groin free flap
(C) Parascapular flap
(D) Pedicled radial forearm flap
(E) Split-thickness skin graft

The correct response is Option E.

The focus of burn reconstruction should include the prevention of long-term scar contractures. Severe contractures of the axilla, neck, and elbow can result in significant functional and aesthetic deformities. In this patient, use of a split-thickness skin graft is most likely to result in recurrent contracture at the burn site because contracture is greatest in a thin graft.

The groin free flap, parascapular flap, and pedicled radial forearm flap are all good options for reconstruction following release of the scar contracture. Each flap has the soft, pliable, healthy tissue needed for reconstruction and is not located adjacent to the burn site.

Recurrent contracture may occur following full-thickness skin grafting and postoperative splinting but is less likely than with a split-thickness skin graft.

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76

The number of times a skin graft donor site may be reharvested after healing is primarily dependent on the

(A) blood supply to the region
(B) density of the hair follicle/appendage
(C) dermal thickness
(D) epidermal thickness
(E) Fitzpatrick skin type

The correct response is Option C.

After initial healing, the reharvesting of a skin graft donor site depends primarily on dermal thickness. During harvest, the epidermis and a portion of the dermis are removed. The epidermis regenerates through the migration of epidermal cells from the shaft of the hair follicle and adnexal structures, but the dermis does not regenerate. Following re-epithelialization, reharvesting may be performed any number of times as long as there is adequate dermal thickness.

The blood supply to the donor region does not play a role in potential reharvesting of the skin graft. The density of the hair follicle and appendage directly influences the rate of re-epithelialization but does not affect dermal thickness. The Fitzpatrick classification identifies patients according to their cutaneous sensitivity to ultraviolet radiation, from the most to the least sensitive. For example, a patient with fair skin and red hair would be classified as Fitzpatrick type I, while an African American patient has Fitzpatrick type VI skin. This classification does not influence skin graft harvest.

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77

A 35-year-old man is bleeding from the wound site and has nausea, vomiting, and confusion after sustaining a rattlesnake bite to the distal left leg. Appropriate management includes each of the following EXCEPT

(A) administration of broad-spectrum antibiotics
(B) tetanus immunization
(C) intravenous administration of antivenin
(D) wound suctioning
(E) prophylactic fasciotomy

The correct response is Option E.

Severe envenomation is a life-threatening complication that requires immediate action. Field care should be instituted within 10 minutes of the bite. After placing the extremity in a dependent position, a loose-fitting band should be applied proximal to the wound site to slow lymphatic flow to the wound. A tourniquet should not be applied.

Incision of the wound and suction removal of the venom is useful if performed within the first 15 minutes of the attack, and if the snake (and, therefore, the amount of envenomation) is very large. The incisions should be made linearly across and slightly beyond the fang marks; they should be shallow, not penetrating any deeper than the skin. Suction should be performed only with a commercial snakebite suction cup.

The patient should be transported to emergency facilities immediately and given supportive care, including administration of broad-spectrum antibiotics, intravenous fluids, and tetanus prophylaxis.

Administration of antivenin is warranted only in patients with severe envenomation because the risk for complications from the antivenin will outweigh the minimum benefits of treatment if it is administered to a patient who has only mild symptoms. Hematologic and coagulation abnormalities that result from administration of antivenin may require transfusion of blood products.

Fasciotomy should only be performed in patients who have increased compartment pressures and are likely to develop compartment syndrome.

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78

A 27-year-old man who has paraplegia to the level of T10 develops bilateral pressure ulcers of the ischium. Examination shows necrosis of the skin, subcutaneous fat, and muscle; bone is exposed on the right. Which of the following is the most appropriate surgical management?

(A) Bilateral soft-tissue debridement and flap closure
(B) Bilateral soft-tissue debridement, partial right ischiectomy, and bilateral flap closure
(C) Bilateral soft-tissue debridement, right ischiectomy, and bilateral flap closure
(D) Bilateral soft-tissue debridement, ischiectomy, and flap closure

The correct response is Option B.

In this patient who has bilateral pressure ulcers of the ischium, the most appropriate management is bilateral debridement of the soft tissues, partial right ischiectomy, and bilateral flap closure. Patients with pressure ulcers should undergo initial debridement prior to definitive wound closure to adequately assess the extent of the ulcer and prevent infectious spread. Partial ischiectomy is indicated on the right side only to remove the nonviable, infected bone that is currently exposed.

Total ischiectomy on the right would result in an excessive increase in pressure on the left with the patient in the sitting position; as a result, he would most likely develop a recurrent ulceration on the left. Performing bilateral ischiectomy will shift the patient's body weight onto the perineum, resulting in pressure necrosis and potentially leading to the development of a urethrocutaneous fistula.

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79

In a patient who undergoes coverage of a wound of the dorsal aspect of the hand using a rotational flap, which of the following is the most important factor related to flap survival?

(A) Blood supply incorporated in the base of the flap
(B) Length-to-width ratio of the flap
(C) Thickness of the skin and subcutaneous tissue incorporated in the flap
(D) Vascularity of the recipient bed

The correct response is Option A.

The survival of the skin flap depends primarily on the blood supply incorporated into the base of the flap. For example, an axially patterned flap incorporates both an artery and vein into its flap base. This type of flap is designed along the entire length of the artery as well as an extension beyond the artery.

In the past, the most important factor was believed to be the length-to-width ratio; as a result, flaps were designed according to a length-to-width formula. In this formula, the length of flap that could be elevated safely on its pedicle was determined by the width of the flap base; if the length of the flap was too excessive for its given base width, necrosis of the distal portion of the flap would result. More recently it was determined that there is no set length-to-width ratio regarding flap harvest, although there is a potential for distal necrosis in any excessively long flap that does not have an incorporated blood supply.

The thickness of the incorporated skin and subcutaneous tissue will not affect flap survival as long as the subdermal plexus is included in the flap. The vascularity of the recipient bed is important for timing the division of the pedicle in an interpolated flap; the pedicle can be divided earlier if the recipient bed has good vascularity. However, this factor has no bearing on flap survival.

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80

In a patient with suspected rupture of a silicone gel breast implant, which of the following modalities is most sensitive for confirming implant rupture?

(A) CT scan
(B) Mammography
(C) MRI
(D) Ultrasonography

The correct response is Option C.

In a patient with suspected implant rupture, an MRI of the breast that uses a dedicated breast coil and is interpreted by an experienced radiologist will provide the most accurate information and is the most sensitive method for diagnosis of implant rupture. Several studies have shown a sensitivity and specificity in the 90th percentile with the use of MRI, and exposure of the patient to radiation is not a factor. However, because MRI is a more expensive and invasive diagnostic method, its use should be limited to patients in whom the findings of other, less invasive studies, such as mammography combined with ultrasonography, are inconclusive.

When used in the detection of implant rupture, the sensitivity and specificity of mammography have ranged from 11% to 67% and 50% to 89%, respectively, while ultrasonography has been shown to have a sensitivity of 60% to 70% and a specificity of 80% to 90%.

Although CT scan has been shown in animal studies to have a sensitivity and specificity that is second only to MRI, clinical trials have not been performed in humans. In addition, the associated patient exposure to radiation limits the use of this technique in the diagnosis of implant rupture.

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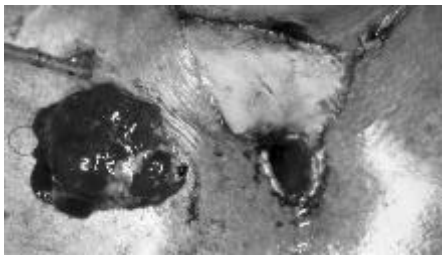
81

After undergoing resection of a circumferential portion of the esophagus for management of recurrent laryngeal carcinoma, a 60-year-old man undergoes reconstruction of the defect with a free jejunal flap. Which of the following is the most effective method of flap monitoring in this patient?

(A) Esophagoscopy
(B) External continuous Doppler ultrasonography probe
(C) Exteriorization of a segment of the jejunal flap
(D) Titrated injection of fluorescein



The correct response is Option C.

In this patient who is undergoing reconstruction of an esophageal defect using a free jejunal flap, exteriorization of a segment of the flap will provide the most effective means for flap monitoring. Because monitoring of this flap following its insertion into the neck can be difficult, some surgeons have suggested using laryngoscopy and Doppler ultrasonography involving buried transducers; however, exteriorization of a segment of the flap is a more simple, direct approach. The segment can be pulled through a separate incision into the mesenteric stalk and then monitored effectively. Ligation of the stalk can be performed at the bedside during local anesthesia seven to 10 days prior to patient discharge.

Esophagoscopy is not practical for frequent flap monitoring. If an external continuous Doppler ultrasonography probe were to be used, the other vessels in the neck could easily be mistaken for flap vessels. Titrated fluorescein cannot be used for continued flap monitoring.

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82

The shell of a saline breast implant is composed of

(A) polyurethane
(B) silicon polymer
(C) silicone rubber
(D) Teflon hydrogel

The correct response is Option C.

The shell of a saline breast implant is composed of silicone rubber, which is a highly polymerized, cross-linked silicone that is vulcanized into elastomer. A fumed amorphous silica filler is added to create an inert durable shell. However, recent studies have shown that the silicone elastomer shell may weaken with time; this may be linked to implant rupture.

Although polyurethane had been used as a coating for silicone elastomer, its use was discontinued during the early 1990s. Silicon polymer is used to create different forms of silicone, which is no longer used in breast implants. Teflon hydrogel has not been used in breast implant shells.

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83

During harvest of a free fibular flap, the periosteal branches of the peroneal artery will be found bordering which aspect of the fibula?

(A) Anterolateral
(B) Anteromedial
(C) Posterolateral
(D) Posteromedial

The correct response is Option D.

While harvesting a free fibular flap, the surgeon will be able to locate the periosteal branches of the peroneal artery entering the periosteum at the posteromedial aspect of the fibula. The lateral border of the fibula, which is triangular in shape, lies beneath the peroneus longus and brevis muscles of the lateral compartment, while the posterior border of the fibula abuts the flexor hallucis longus muscle, with its vascular pedicle coursing along the posteromedial border of the fibula. The inner osseus membrane connects the tibia to the fibula at its anteromedial border and is adjacent to vessels that connect to the posterior tibialis muscle.

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84

Which of the following types of melanoma has equal predilection in Caucasian Americans and African Americans?

(A) Acral lentiginous melanoma
(B) Lentigo malignant melanoma
(C) Nodular melanoma
(D) Superficial spreading melanoma

The correct response is Option A.

Acral lentiginous melanoma, which most frequently occurs on the soles of the feet, has equal predilection in Caucasian Americans and African Americans. This tumor may also arise on the palm or within the nail bed. There is virtually no difference in the incidence of acral lentiginous melanoma of the plantar surface of the foot in Caucasian Americans and African Americans.

Lentigo malignant melanoma is typically found on the face, neck, and dorsal aspect of the hands in elderly persons. This lesion is usually less aggressive than other types of melanoma. In contrast, nodular melanoma is a highly aggressive tumor that initially resembles a blood blister. Superficial spreading melanoma is the most common type. It can arise almost anywhere on the body and often develops within an existing nevus. Each of these types of melanoma is more common in Caucasian Americans than in African Americans.

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85

A 50-year-old man has a wound on the dorsal aspect of the hand that is to be covered with a contralateral groin flap. This is best classified as which of the following types of flaps?

(A) Advancement
(B) Interpolation
(C) Rotational
(D) Transposition

The correct response is Option B.

A groin flap is one type of interpolation flap. This flap is a pivot flap; it retains its pedicle as a central point of fixation while being rotated around and transferred to a distant site. The paramedian forehead flap, scalp flap, and deltopectoral flap are other examples of interpolation flaps.

Advancement flaps are moved directly forward over the defect without any rotation. A V-Y advancement flap is one example. A rotational flap is another type of pivot flap in that it is also rotated around the pivot point; however, unlike the interpolation flap, it is inserted into an adjacent defect. The gluteal fasciocutaneous flap is an example of a rotation flap. Transposition flaps are rectangular pivot flaps raised adjacent to their recipient defects. Examples include the Limberg and Z-plasty flaps.

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86

A 16-year-old girl has had the waxy lesion on the scalp shown in the above photograph since birth. The lesion first became raised at puberty, and she is concerned about its appearance. This patient should be informed that she is at increased risk for development of

(A) basal cell carcinoma
(B) dermatofibrosarcoma protuberans
(C) hidradenitis suppurativa
(D) Marjolin's ulcer
(E) melanoma

The correct response is Option A.

This 16-year-old girl has a nevus sebaceus of Jadassohn, a premalignant lesion comprised of sebaceous glands that is present at birth. In infancy, the tumor is a flat, waxy plaque, but during puberty it becomes raised and hyperplastic. Surgical excision is recommended because 15% to 20% of these lesions develop into basal cell carcinoma. Other malignancies associated with the nevus sebaceus of Jadassohn include anaplastic, apocrine, sebaceous, and squamous cell carcinomas.

Dermatofibrosarcoma protuberans, hidradenitis suppurativa, Marjolin's ulcer, and melanoma are unlikely to develop in a patient with a nevus sebaceus of Jadassohn.

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87

A 23-year-old man with a history of cocaine addiction has a 4-mm perforation of the anterior septum. Which of the following is most appropriate for repair of the defect?

(A) Primary closure
(B) Fat plug graft
(C) Bipedicled septal flaps
(D) Septal hinge flap
(E) Nasal tissue expansion

The correct response is Option C.

This patient who has a 4-mm perforation of the anterior septum should undergo repair of the defect using bipedicled septal flaps. Septal perforation is most often the result of traumatic or iatrogenic causes, but in recent years the number of perforations associated with cocaine and/or methamphetamine use has greatly increased. Determining the appropriate surgical technique usually depends on the size and positioning of the defect. Repair of perforations smaller than 5 mm is best accomplished with transnasal unipedicled or bipedicled septal mucosal flaps; fascia grafts can be added for support. For perforations measuring 5 mm to 2 cm, or for smaller, posteriorly based perforations, the most appropriate management involves an extended external rhinoplasty procedure using bilateral posteriorly based unipedicled or bipedicled intranasal mucosal flaps, with fascia grafts as needed. If a patient has a perforation larger than 2 cm, the surgeon should consider harvesting regional or distant flaps using a lateral rhinotomy or midfacial degloving approach.

Primary closure is nearly impossible because of the lack of nasal mucosa available for use and the loss of tissue elasticity that typically results from substance abuse. Plugging of the septal perforation with either fat or fascia is associated with high long-term failure rates because in many instances the graft does not revascularize. A septal hinge flap is used to provide nasal lining in patients undergoing reconstruction. Harvest of this flap requires creation of a septal perforation. The results of several experimental procedures involving tissue expansion of the nasal lining for repair of perforations have been encouraging; however, this technique has not yet gained widespread acceptance.

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88

A 34-year-old man comes to the emergency department six hours after lacerating his right hand on a broken bottle. Examination shows a clean 4-cm full-thickness laceration of the volar aspect of the hand; the underlying structures are not injured. Following copious irrigation of the wound, debridement and primary closure are to be performed.

Which of the following is the most appropriate additional management?

(A) No antibiotic therapy
(B) Oral administration of amoxicillin-clavulanic acid for two to three days after debridement
(C) Oral administration of cephalexin for two to three days after debridement
(D) Intravenous administration of amoxicillin-clavulanic acid prior to debridement, followed by oral administration of antibiotics for two to three days after debridement
(E) Intravenous administration of cephalexin prior to debridement, followed by oral administration of antibiotics for two to three days after debridement

The correct response is Option A.

In this patient who has a clean full-thickness wound of the volar aspect of the hand, appropriate management should include copious irrigation of the wound, followed by debridement and primary closure. However, because it is an acute injury involving a sharp laceration, antibiotic therapy is not indicated. Several studies of patients who sustained sharp lacerations showed that the administration of antibiotics did not effectively reduce the rate of infection in those patients.

One study of 250 patients, which included those who underwent treatment up to 48 hours after injury, showed a rate of infection of 5% in those treated with antibiotics, compared with an infection rate of 3.2% in the control group. In patients who received adequate wound care, the rate of infection was not affected by the severity of injury to deeper structures, but was affected by the length of the laceration; 9.5% of patients who had wounds larger than 5 cm developed infection, compared with 3.7% of patients who had wounds smaller than 5 cm.

Antibiotic therapy may be beneficial in patients who have avulsion injuries, lacerations affecting the bones or joints, grossly contaminated wounds, or crush injuries involving devitalized muscle. Antibiotics may also reduce the rate of infection in immunocompromised patients or in patients who receive initial treatment more than 48 hours after injury.

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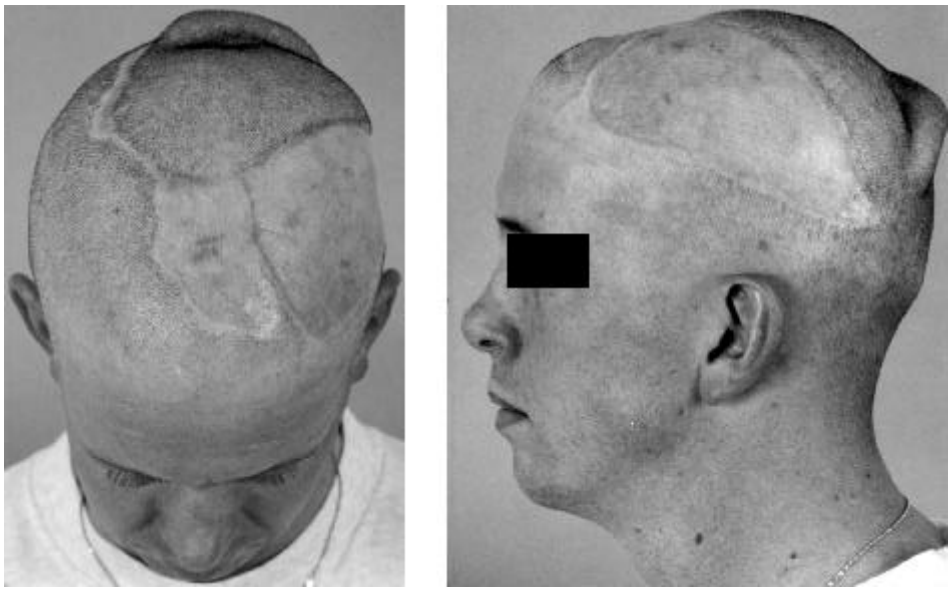
89



A 23-year-old man sustained an electrical injury of the scalp one year ago. At the time of injury, there was a 10-cm area of exposed calvarium; a local rotation flap was used to cover the defect, and the donor site defect was covered using a split-thickness skin graft on periosteum. Photographs are shown above.

Which of the following is the most appropriate next step in management?

(A) Excision and primary closure
(B) Full-thickness skin grafting
(C) Hair transplantation
(D) Re-rotational flap advancement
(E) Tissue expansion

The correct response is Option E.

This 23-year-old man who sustained an electrical injury one year ago should undergo tissue expansion for coverage of his burn scar of the scalp. Because tissue expansion will cover the scalp defect with similar tissue, it is most appropriate for patients who have large defects of the scalp (typically greater than 15%). Donor site scarring is not a factor in most cases, and, if further tissue expansion is required, the expanders can be left in place. In addition, the hair follicles will be oriented correctly; as much as 50% of the scalp can be covered with expanded tissue without altering hair growth. However, the process of tissue expansion involves multiple procedures and frequent office visits over a lengthy period of time. During the expansion process, the patient often expresses displeasure with his/her physical appearance.

Excision and primary closure combined with extensive undermining are only appropriate for patients who have defects measuring less than 5 cm. Patients with small areas of scalp alopecia may undergo multiple staged excisions of the alopecic scalp followed by advancement of hair-bearing tissue. Because this process involves fewer procedures and less follow-up, it can be used as an alternative to tissue expansion.

Although a full-thickness skin graft can be used for temporary wound coverage in a patient who will undergo further scalp reconstruction, it is not an appropriate long-term treatment because many donor sites do not provide adequate hair-bearing skin.

Hair transplantation is currently being used with increasing regularity for treatment of traumatic or age-related alopecia but has not been attempted in burn patients.

Re-rotational flap advancement can provide local hair-bearing tissue but should only be performed if the scalp defect is no larger than 6 cm. In order to advance an adequate length of flap, multiple relaxing incisions must be performed within the galea. If the galea is not carefully divided, injury to the subcutaneous vessels or hair follicles may result, leading to the onset of alopecia.

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90

A 50-year-old man with paraplegia to the level of T4 and a grade IV trochanteric pressure ulcer has the sudden onset of fever. On examination, the wound appears clean. Which of the following is the most effective method for establishing a diagnosis of osteomyelitis?

(A) Bone biopsy
(B) CT scan
(C) MRI
(D) PET scan
(E) Technetium Tc99m bone scan

The correct response is Option A.

In this patient who has suspected osteomyelitis, the most effective method for establishing the diagnosis is bone biopsy. One recent study regarding the use of bone biopsy showed a sensitivity of 73% and a specificity of 96% when used for diagnosing osteomyelitis.

Although CT scan is an important tool in the differential diagnosis of various conditions, it cannot be used with any accuracy to diagnose bone infection. MRI can be used to diagnose osteomyelitis but is less accurate than bone biopsy. Use of a PET scan in the determination of bone disease is associated with a high percentage of false-positive results. Regardless of their disease status, patients with grade IV pressure ulcers will automatically have positive findings on technetium Tc99m bone scan because of inflammation around the affected bone.

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91

A 21-year-old man with keloids affecting both earlobes undergoes excision combined with intraoperative injection of triamcinolone, followed by radiation therapy administered as a single dose of 800 rads 24 hours after surgery. Which of the following is most likely to occur in this patient?

(A) Chondritis
(B) Dermatitis
(C) Neoplasia
(D) Recurrence
(E) Wound breakdown

The correct response is Option D.

In a patient who has undergone multimodality therapy including excision, injection of triamcinolone, and postoperative radiation therapy for management of bilateral keloids, recurrence of the keloids is the greatest possibility. Although excision combined with injection of triamcinolone and tangential therapy is the most commonly used treatment regimen, keloids are likely to recur regardless of the method used for removal. One study of affected patients who underwent corticosteroid injection immediately followed by radiation therapy showed a recurrence rate of at least 50% on follow-up examination.

Even with the use of radiation therapy and/or other aggressive methods of treatment, local wound complications such as chondritis, dermatitis, and wound breakdown are rarely seen. The development of neoplasia resulting from excessive exposure to ionizing radiation is a concern in young patients, but various studies have shown no correlation. In any case, adequate lead shielding should be used during radiation therapy to decrease the likelihood of carcinogenesis.

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92

A 26-year-old man has been hospitalized and is receiving intravenous lactated Ringer's solution 150 mL/hr after touching a high-voltage power line six hours ago. On examination, there is an entrance wound on the right index finger and an exit wound on the right hip. Laboratory studies show the following:

Blood urea nitrogen level	13.0	mg/dL
Serum calcium level	7.9	mg/dL
Serum creatine kinase level	44.2	U/L
Serum creatinine level	1.1	mg/dL
Serum potassium level	3.9	mEq/L
Serum sodium level	136.0	mEq/L

Urine output has been 45 mL/hr over the past four hours; the urine has brown discoloration. Urine dipstick is 4+ heme-positive. Which of the following is the most appropriate next step in management?

(A) Continue intravenous administration of lactated Ringer's solution at 150 mL/hr
(B) Increase intravenous administration of lactated Ringer's solution to 300 mL/hr
(C) Discontinue lactated Ringer's solution and begin intravenous administration of normal saline at 150 mL/hr
(D) Discontinue lactated Ringer's solution and begin intravenous administration of normal saline at 300 mL/hr and calcium gluconate
(E) Discontinue lactated Ringer's solution and begin intravenous administration of normal saline at 300 mL/hr, mannitol, and sodium bicarbonate

The correct response is Option E.

The most appropriate next step in the management of this patient who has sustained a high-voltage electrical injury is discontinuation of lactated Ringer's solution, followed by intravenous infusion of normal saline at 300 mL/hr with additional infusion of mannitol and sodium bicarbonate. High-voltage electrical injuries are often misleading because the mildness of the superficial wounds frequently masks the serious underlying problems. Affected patients typically have severe muscle necrosis hidden under viable skin. If the underlying problems are not detected and treated, life-threatening complications may result.

In this patient, several factors illustrate the extensiveness of his injuries. First, the location of the entrance and exit wounds determines the extent of muscle injury. This patient who has an entrance wound on the finger and exit wound on the hip will have sustained damage to all muscles between these two points. Equally important are his increased serum creatine kinase level and brown-discolored urine that is heme-positive on dipstick testing; these findings are highly suggestive of myoglobinuria. If left untreated, this condition may lead to myoglobin-induced renal failure.

Manifestations of this type of renal failure can range from mild renal dysfunction with transient oliguria to severe renal disease requiring frequent dialysis for several weeks. Other findings on microscopic examination of urinary sediment that are suggestive of myoglobinuria include the absence of erythrocytes and the presence of pigmented brown granular casts and tubular epithelial cells. Excess excretion of myoglobulin in the urine also contributes to further muscle destruction; this phenomenon is known as rhabdomyolysis.

An infusion of sodium bicarbonate and mannitol should be started as soon as possible to minimize the severity of renal failure in this patient; this can be accomplished by attaining a urine output of greater than 100 mL/hr with a pH of higher than 6.5. In addition, vigorous hydration with normal saline will enhance renal perfusion, minimizing ischemic injury and increasing the rate of urine flow when the saline combines with the mannitol. Sodium bicarbonate will alkalize the urine and slow the transformation of filtered myoglobin into a ferrihemate compound. As a result, the risk for nephrotoxicity from accumulation of the ferrihemate compound will be decreased.

Because rhabdomyolysis is characterized by the release of large quantities of intracellular potassium, continued administration of lactated Ringer's solution, which contains both potassium and calcium components, may lead to the onset of hyperkalemia. The patient's condition will be further worsened if renal failure subsequently develops because he will not be able to excrete the excess potassium through the kidneys.

Calcium gluconate should only be administered to a burn patient who has severe hypocalcemia or hyperkalemia. Because the effects of rhabdomyolysis may mimic hypocalcemia due to the accumulation of calcium phosphate in the damaged muscle, findings consistent with hypocalcemia may be seen in this patient. However, affected patients will often develop hypercalcemia during the recovery phase, as calcium is mobilized from the injured muscle. This effect is thought to be mediated by alterations in the metabolism of vitamin D that occur during the recovery phase.

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93

Which of the following local anesthetics has sympathomimetic effects?

(A) Bupivacaine
(B) Cocaine
(C) Lidocaine
(D) Mepivacaine
(E) Tetracaine

The correct response is Option B.

Cocaine is the only local anesthetic that exerts sympathomimetic effects, acting on the sympathetic nerve endings to block reuptake of norepinephrine and epinephrine. When cocaine is used to provide local anesthesia to the nose, the dose should not exceed 300 mg because of the risk for cocaine toxicity at greater doses. Because cocaine toxicity

is associated with excessive stimulation of the cardiovascular, respiratory, and central nervous systems, a patient who develops this condition may experience cardiac arrhythmias, fibrillation, cardiac arrest, respiratory arrest, seizures, and central nervous system depression. If signs of toxicity are observed, the surgeon should focus on providing adequate ventilation, controlling cardiac arrhythmias and hemodynamics, and managing seizures.

In contrast to cocaine, the other local anesthetics cause relaxation of arteriolar smooth muscle, resulting in vasodilation. Bupivacaine, lidocaine, and mepivacaine are amide anesthetics, while tetracaine is an ester anesthetic.

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94

Which of the following mechanisms of action is responsible for the initiation of epithelial cell migration across a healing wound?

(A) Acceleration of mitosis
(B) Contraction of myofibroblasts
(C) Delayed mobilization of epithelial cells
(D) Loss of contact inhibition
(E) Normal cellular differentiation

The correct response is Option D.

The initial sequence of wound healing involves the mobilization of epithelial cells and other cells that lie immediately adjacent to the wound site. The migration of these cells across the wound surface results from a loss of contact inhibition. Once the migrating cells traverse the wound surface and initiate contact with other cells, contact inhibition is re-established and the process of migration is discontinued.

Mitosis occurs at the wound margins during the migration process to allow for replacement of migrating cells. Following re-epithelialization of the wound, cellular differentiation occurs, affecting the basal cells first, then all other layers, up to the stratum corneum.

Myofibroblasts are involved in wound contraction but play no role in epithelialization.

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95

In children, the use of tissue expanders at which of the following anatomic sites is associated with the highest incidence of development of complications?

(A) Head and neck
(B) Scalp
(C) Trunk
(D) Upper extremity
(E) Lower extremity

The correct response is Option E.

In children, the use of tissue expanders in the lower extremities is most likely to be associated with the onset of complications. Overall, the rate of complications following tissue expansion in pediatric burn patients has decreased, but attempts at this process in the lower extremities have been associated with complication rates of 37% to 50%. Tissue expansion of the scalp in children has the lowest incidence of complications (less than 20%), with the rate of complications following expansion in the head and neck being slightly higher. Approximately 25% of pediatric burn patients have complications following tissue expansion of the trunk and upper extremities.

References

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96

An otherwise healthy 3-month-old infant has had the lesion shown in the photograph on the previous page since birth. He has no neurologic symptoms. The risk for malignant transformation of this lesion is closest to

(A) 5%
(B) 15%
(C) 25%
(D) 50%
(E) 100%

The correct response is Option A.

In this infant who has a large congenital melanocytic nevus, the risk for malignant transformation of the lesion is closest to 5%. Large congenital melanocytic nevi are pigmented lesions that are first seen in infancy and grow commensurately with the child; affected adults typically have nevi of 20 cm or larger. Children with these lesions may have an accumulation of melanotic deposits in the brain and internal organs; this finding is associated with an increased risk for development of melanoma within the deeper deposits, and frequent follow-up is necessary to observe for any signs of malignancy. In addition, seizures are frequently seen in these children.

Although the potential for malignancy in patients with large congenital melanocytic nevi has been reported as varying from 2% to 42%, several large, reliable studies have shown the incidence of malignant transformation to range consistently from 5% to 10%. Because of this risk, excision should be performed whenever possible. Tissue expansion may be carried out adjuvantly.

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97

A 70-kg 39-year-old man sustains circumferential full-thickness burns of both lower extremities in a house fire. According to the Parkland formula, this patient's initial fluid requirement during the first eight hours after injury is closest to

(A) 2500 mL
(B) 3300 mL
(C) 5000 mL
(D) 7500 mL
(E) 10,000 mL

The correct response is Option C.

In a patient who has a burn injury that covers more than 20% of the total body surface area (TBSA), acute fluid resuscitation should be performed during the initial 24 hours after injury. The Parkland formula is used to estimate the amount of fluid required. According to this formula, lactated Ringer's solution 4 mL/kg/% TBSA burned should be administered during the first 24 hours. A total of 50% of the solution should be administered during the first eight-hour period and the remaining 50% over the next 16 hours.

The TBSA involved in a burn can be calculated using the "rule of nines." According to this rule, the anterior trunk, the posterior trunk, and each lower extremity are assigned values of 18%. Each upper extremity and the head have values of 9%, and the neck has a value of 1%. This patient has sustained full-thickness burns involving both lower extremities, for a TBSA burn of 36%. Therefore, a 70-kg patient who has a 36% TBSA burn will require 10,000 mL of fluid during the first 24 hours: 5000 mL during the first eight hours and the remaining 5000 mL over the next 16 hours.

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98

Two days after undergoing right total knee arthroplasty, a 62-year-old man with obesity and insulin-dependent diabetes mellitus has attenuation of the skin over the anterior aspect of the prosthesis with threatened exposure. Which of the following is most appropriate for soft-tissue coverage of the wound?

(A) Distally based gracilis flap
(B) Distally based rectus femoris flap
(C) Pedicled medial gastrocnemius flap
(D) Pedicled soleus flap
(E) Tissue expansion

The correct response is Option C.

The most appropriate management of this 62-year-old man who has impending prosthetic exposure is coverage using a pedicled medial gastrocnemius flap. This flap provides stable soft-tissue coverage to prevent the development of infection while allowing for unrestricted range of motion of the prosthetic knee joint. Because the flap is based on the sural artery, it has an adequate arc of rotation for coverage of the knee region. Maximum extension of the flap can be obtained by using the medial head of the flap while releasing the origin of the muscle, which can be found on the medial condyle of the femur. Both the medial and lateral muscle bellies can be used for coverage of a large wound. In addition, use of the medial gastrocnemius flap prevents potential injury to the common peroneal nerve.

The gracilis flap is comprised of one dominant proximal pedicle, which is supplied by either the profundus femoris or medial circumflex iliac artery, and multiple minor distal pedicles, which are supplied by the superficial femoral artery. Because the distal pedicles will not provide adequate vascularization to the proximal segment of the muscle belly, the distally based gracilis flap cannot be used for coverage of this patient's knee defect.

The rectus femoris muscle flap has a proximally based blood supply from the descending branch of the lateral circumflex femoral artery. The proximally based flap can be used for coverage of groin wounds, but the distally based flap is unreliable.

The pedicled soleus flap is best used for coverage of a defect involving the middle third of the leg. The dominant pedicle receives blood from the popliteal, posterior tibial, and peroneal arteries, while the minor pedicle is supplied by more distal branches that extend from the posterior tibial artery. Although the distal pedicles can be divided, the tissue available will be insufficient to allow adequate rotation to the knee. Devitalization of the muscle may result.

Tissue expansion is inappropriate in a patient who requires emergent coverage of an exposed prosthesis.

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99

Histologic examination of a biopsy specimen of an expanding hemangioma is most likely to show

(A) absence of dominant feeding vessels
(B) absence of mast cells
(C) anomalous vasculature
(D) a multilaminate basement membrane
(E) poorly differentiated epithelium

The correct response is Option D.

Hemangiomas are the most common tumors of infancy, with 10% of Caucasian children having at least one hemangioma. These lesions develop shortly after birth and undergo a period of rapid expansion. Histologic characteristics of an expanding hemangioma include extensive endothelial proliferation, highly differentiated epithelial cells, abundant mast cells, and a multilaminate basement membrane. Hemangiomas are true neoplasms characterized by hyperplasia; in contrast, vascular malformations are composed of anomalous vascular structures. Expanding hemangiomas are typically locular and contain large feeding and draining vessels. The production of heparin within the mast cells is thought to stimulate migration of endothelial cells.

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100

During microvascular anastomosis, which of the following is most critical for ensuring arterial patency?

(A) Surgical skill
(B) Systemic administration of anticoagulants
(C) Topical application of anticoagulants
(D) Use of the running continuous suture technique
(E) Use of the simple interrupted suture technique

The correct response is Option A.

During microvascular anastomosis, arterial patency is best ensured by good surgical skill. An experienced surgeon who performs the anastomosis using appropriate atraumatic technique will ultimately determine the level of patency of the vessels.

Because several techniques can be used to successfully create an anastomosis, the suture technique or type of anticoagulant used will not directly affect vessel patency. Several studies have shown no statistically significant differences regarding these factors. Although one arteriotomy design or incident angle may be preferable to another, the overall effects are negligible; for example, an elliptical arteriotomy can allow for better exposure and less interference during suture placement; however, caution should be taken when using this technique in vessels that have a diameter of less than 1.5 mm.

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101

A 23-year-old woman sustains an avulsion injury involving most of the skin of the left upper eyelid in a motor vehicle accident. On examination, the globe is unaffected and the orbicularis oculi muscle is preserved; levator function is intact. Following initial debridement of the wound, the most appropriate management is reconstruction with which of the following?

(A) Full-thickness skin graft from the groin
(B) Full-thickness skin graft from the retroauricular sulcus
(C) Glabellar skin flap
(D) Skin flap from the lower eyelid
(E) Split-thickness skin graft

The correct response is Option B.

Following initial debridement, the most appropriate management in this patient who has sustained an avulsion injury to the left upper eyelid is reconstruction using a full-thickness retroauricular skin graft. Because grafting from the contralateral upper eyelid is often not an option in young patients, it is appropriate to seek an alternate graft to provide optimal long-term function and aesthetics while preventing complications such as scar contracture, lagophthalmos, and corneal ulceration. Full-thickness skin grafts from the head and neck region provide the best color and thickness and are less prone to contracture; grafts from the preauricular, postauricular, and retroauricular regions are preferred for their scar tolerance, optimal color match, and lack of hair. The preauricular and postauricular donor sites are aesthetically better donors but supply less usable skin than the retroauricular area.

Split-thickness skin grafts have a smaller dermal component; as a result, their use is more likely to lead to the onset of significant scar contracture. Full-thickness skin grafts from the groin have minimal morbidity but are usually deeply pigmented and hair-bearing; they are often used instead for areolar reconstruction. Glabellar skin flaps are excessively thick for use in eyelid reconstruction and would cause aesthetic and functional problems. A skin flap from the lower eyelid would provide the appropriate color and thickness match but would be too small to cover this patient's large defect because the maximum amount that can be harvested in a young, healthy patient is 3 mm. Harvest of excess skin would lead to skin shortening and ectropion.

References

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102

Which of the following is the most common cause of death in burn patients?

(A) Burn wound sepsis
(B) Hypovolemic shock
(C) Pneumonia
(D) Pulmonary embolism
(E) Renal failure

The correct response is Option C.

Currently, the most common cause of death in patients with burn injuries is pneumonia. This condition is most likely to be seen in burn patients with inhalation injuries and is also a common cause of death in patients who require intubation and ventilatory support.

Previously, the most common cause of death within the first 24 hours after injury was hypovolemic shock secondary to inadequate resuscitation; after the first 24 hours, wound sepsis was most likely to cause death in burn patients. However, with the improvements seen in burn care and the increasing availability of specialized burn centers, hypovolemic shock is much less likely to be fatal. In addition, the widespread availability of topical antibiotics has contributed to better control of burn wound sepsis.

The risk for pulmonary embolism is not any greater in burn patients than in other hospitalized patients.

Although renal failure can develop following electrical injury and lead to myoglobinuria, myoglobin-associated renal failure is frequently transient. This complication can be prevented by keeping the patient adequately hydrated, administering mannitol, and alkalizing the urine.

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103

A 20-year-old man who works in a computer factory sustains hydrofluoric acid burns to the dominant right index finger. Following copious irrigation of the finger with water, the patient has persistent severe pain at the site of injury. Which of the following is the most appropriate next step in management?

(A) Application of cold packs every two hours until the pain resolves
(B) Irrigation of the wound with sodium bicarbonate
(C) Immersion of the hand in 1% copper sulfate
(D) Injection of the wound with 1% calcium gluconate
(E) Injection of the wound with 1% copper sulfate

The correct response is Option D.

In this patient who has sustained hydrofluoric acid burns of the index finger, the most appropriate management is copious irrigation with water; if severe burning pain persists following irrigation, 1% calcium gluconate should be injected into the wound. The mechanism of hydrofluoric acid burns involves the action of hydrogen and fluoride ions within the acid compound on the skin, which results in tissue necrosis. The affected patient will have intense pain at the wound site. In contrast, the calcium gluconate acts to bind fluoride ions, preventing the further spread of necrosis. Topical calcium gluconate can be used for more superficial burns but is less effective than subcutaneously injected calcium gluconate in preventing deep tissue necrosis.

Applying cold compresses will not neutralize the effects of a hydrofluoric acid burn and may instead exacerbate ischemia, leading to further tissue damage. Sodium bicarbonate neutralizes hydrogen ions but not fluoride ions and thus will not be completely effective in a patient with hydrofluoric acid burns. Copper sulfate is used in the management of white phosphorus burns to identify the areas of skin that contain residual chemicals following water lavage.

References

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104

Mohs' micrographic surgery is most appropriate in the management of which of the following types of basal cell carcinoma?

(A) Cystic
(B) Nodular
(C) Pigmented
(D) Sclerosing
(E) Superficial

The correct response is Option D.

During Mohs' micrographic surgery, the surgeon removes the visible tumor in layers of increasing depth while mapping the exact size and shape of the malignancy. Frozen section "mapping" is performed until there is no longer any microscopic evidence of tumor. Indications for Mohs' micrographic surgery as initial treatment include:

- tumors located in sites that are reported to have relatively high rates of treatment failure (such as the periorbital, periauricular, and perinasal areas, as well as the nose)
- tumors with poorly delineated clinical borders or tumors that arise from scar tissue
- tumors that are larger that 2 cm or have aggressive malignant features
- morpheaform or sclerosing basal cell carcinomas
- tumors in locations in which it is best to preserve as much uninvolved tissue as possible (such as the eyelid)
- squamous cell carcinomas with perineural invasion
- microcystic adnexal carcinomas
- dermatofibrosarcoma protuberans
- desmoplastic melanomas

In addition, recurrent basal cell and squamous cell carcinomas are best treated with Mohs' excision.

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105

A 10-year-old boy has had unilateral facial paralysis since sustaining a temporal bone fracture in an automobile accident five years ago. He has not undergone any type of treatment. Which of the following reconstructive options is most likely to restore spontaneous smiling in this patient?

(A) Cross-face nerve grafting
(B) Cross-face nerve grafting followed by delayed free flap transfer
(C) Hypoglossal-to-facial nerve transfer
(D) Masseter muscle transposition
(E) Temporalis muscle transposition

The correct response is Option B.

In order to restore spontaneous smiling in this patient, the most appropriate reconstruction involves cross-face nerve grafting followed by delayed transfer of a free flap. Because this patient lacks viable facial muscles as a result of his prolonged course of facial paralysis, nerve grafting or transfer alone would not be useful. The cross-face nerve graft, when combined with a delayed free flap transfer, receives innervation from the unaffected facial (VII) nerve on the contralateral side of the face. This will allow for restoration of spontaneous smiling.

As explained above, cross-face nerve grafting alone and hypoglossal-to-facial nerve transfer are not options in a patient who has had facial paralysis for five years because the involved muscles have become atrophied.

Transposition of regional muscles (masseter or temporalis) will not produce spontaneous, symmetric smiling. Instead, voluntary contraction of the muscle is required.

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106

Which of the following local anesthetics is associated with the greatest risk for development of a true allergic reaction?

(A) Bupivacaine
(B) Lidocaine
(C) Mepivacaine
(D) Prilocaine
(E) Tetracaine

The correct response is Option E.

A true allergic reaction is most likely to occur following induction of local anesthesia with tetracaine, an ester anesthetic. Local anesthetics are categorized as ester or amide compounds, depending on their link between the aromatic portion and intermediate chain. Ester anesthetics, which undergo hydrolysis through the actions of pseudocholinesterase within the plasma, have a shorter half-life and a lower toxicity. However, the potential for development of allergic reaction is greater with ester compounds. This may be due to a metabolization of esters to para-aminobenzoic acid. Other anesthetics in this class include chloroprocaine, cocaine, and procaine.

Amide anesthetics have greater protein binding, a longer duration of action, and greater toxicity. Because this type of anesthetic is metabolized in the liver, true allergic reactions rarely occur. This class of anesthetics includes bupivacaine, lidocaine, mepivacaine, and prilocaine.

It is important to be able to distinguish a true allergic reaction to a local anesthetic from local anesthetic toxicity, which is characterized by impairment of the cardiovascular and central nervous systems. Patients with anesthetic toxicity will develop depression of the cortical inhibitory mechanism and concomitant central nervous system excitation. Higher anesthetic doses may cause cardiovascular toxicity, which manifests as a sudden drop in blood pressure.

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107

Which of the following best characterizes a stage III pressure ulcer?

(A) Partial-thickness skin loss involving the epidermis and/or dermis
(B) Full-thickness skin loss involving damage or destruction of the subcutaneous tissue that does not involve the underlying fascia
(C) Full-thickness skin loss involving damage or destruction of the subcutaneous tissue, fascia, and underlying muscle, but sparing the underlying bone
(D) Full-thickness skin loss involving damage or destruction of tissue, including underlying bone or supporting structures
(E) Full-thickness skin loss involving damage or destruction of tissue, including underlying bone but sparing the joint space

The correct response is Option C.

The National Pressure Ulcer Advisory Panel Consensus Development Conference has created a system to classify pressure ulcers according to four stages based solely on the depth of involved tissues. A classification table of this system is shown below.

Stage I	The skin is intact but has a red discoloration more than one hour after relief of pressure
Stage II	There is a blister or other break in the dermis, with or without infection
Stage III	There is subcutaneous destruction into the muscle, with or without infection
Stage IV	There is bony or joint involvement, with or without infection

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108

Which of the following physiologic effects has been shown to be directly attributable to topical therapy with vitamin E?

(A) Decreased incidence of postoperative scar formation following burn reconstruction surgery
(B) Improved tendon healing following zone II flexor tendon repair
(C) Increased incidence of breast implant capsular contracture
(D) Increased incidence of intraperitoneal adhesions
(E) Increased incidence of papular and follicular dermatitis

The correct response is Option E.

Although topically applied vitamin E has been thought to reduce postoperative scar formation, in reality the effects of vitamin E on surgical wounds are ambiguous. Topical application of vitamin E has been shown in animal models to minimally reduce breast implant capsular contracture, diminish tendon healing, and decrease the incidence of intraperitoneal adhesions. However, according to clinical studies, topical application of vitamin E had no effect on scar formation in burn patients. In fact, topical vitamin E has only been shown to increase the incidence of papular and follicular dermatitis in the area of application.

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109

A 46-year-old man has had the lesion shown in the photograph on the previous page since birth. Which of the following is the most likely diagnosis?

(A) Arteriovenous malformation
(B) Capillary malformation
(C) Hemangioma
(D) Lymphatic malformation
(E) Venous malformation

The correct response is Option B.

This 46-year-old man has findings consistent with an intradermal capillary malformation, or port-wine stain, in which the abnormalities are limited to the capillaries in the dermis. These lesions occur in 0.3% of neonates; they are present at birth and do not regress spontaneously. Patients with facial port-wine stains involving the first (ophthalmic) or second (maxillary) divisions of the trigeminal nerve (V_1 and V_2) are at significantly greater risk for ocular or nervous system involvement.
Appropriate management of a port-wine stain involves laser coagulation using the flashlamp-pumped pulsed dye laser at 577 nm. Because this laser targets erythrocytes within the blood vessels, extravascular damage is minimal. If the lesion is left untreated, cobblestoning, ectasia, and progressive darkening may occur. In adults, the lesions are darker and contain deoxyhemoglobin; as a result, port-wine stains are less likely to improve following treatment with the pulsed dye laser.

Arteriovenous malformations are high-flow lesions characterized by rapid blood flow through multiple feeding vessels. Pulsations and temperature changes in the affected area are associated, but dermal involvement is minimal. A bruit or thrill is heard on auscultation.

Hemangiomas typically appear shortly after birth and proliferate for several months before spontaneously regressing. They are characterized by proliferative primitive endothelial cell nests in syncytial masses, with and without vessel lumens.

Lymphatic malformations can be superficial or deep. Superficial lymphatic malformations are comprised of anomalous lymphatic remnants that manifest as clear vesicles. Deep lymphatic malformations appear similar to hemangiomas but are soft and compressible on palpation. Bony overgrowth is associated.

Venous malformations occur more frequently than port wine-stains. A venous malformation is characterized by its compressibility and by a propensity to fill with blood when the patient changes body positions. It is usually larger and extends deeper than its superficial structure indicates, and it frequently intertwines with neurovascular components. When the malformation is associated with thrombosis, pain may result.

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110

A 2-year-old boy is brought to the emergency department after sustaining a 1-cm clean laceration of the forehead. His mother reports that the child's tetanus immunization series is incomplete; he has received only the initial two injections. Which of the following is the most appropriate management?

(A) Closure of the wound without further immunization, followed by completion of the tetanus immunization series according to the primary immunization schedule
(B) Administration of one dose of tetanus toxoid at the time of treatment, followed by delay of the primary immunization schedule
(C) Administration of one dose of tetanus toxoid at the time of treatment, followed by completion of the tetanus immunization series according to the primary immunization schedule
(D) Administration of one dose of tetanus toxoid and one dose of tetanus immune globulin at the time of treatment, followed by delay of the primary immunization schedule
(E) Administration of one dose of tetanus toxoid and one dose of tetanus immune globulin at the time of treatment, followed by completion of the tetanus immunization series according to the primary immunization schedule

The correct response is Option C.

In this child who has not completed his tetanus immunization series, the most appropriate management is administration of one dose of tetanus toxoid at the time of wound treatment; following treatment, the tetanus immunization series should be completed as dictated by the primary immunization schedule. Because this patient has a clean laceration that is not extensive, he will not require any additional treatment, and the immunization series can be completed without delay.

Patients with tetanus-prone wounds (that is, those that are extensive and/or grossly contaminated) should be given one dose of tetanus toxoid and one dose of tetanus immune globulin. Prophylactic administration of tetanus immune globulin is not indicated in patients who have uncontaminated or minor wounds regardless of immunization status, or in patients who have already received more than two injections of tetanus toxoid according to schedule.

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111

Prior to injection of bovine collagen for treatment of facial rhytids, a test dose of the collagen should be injected into the volar aspect of the forearm and the patient should be observed for how long to note any signs of adverse reaction?

(A) 48 hours
(B) One week
(C) Two weeks
(D) Three weeks
(E) Four weeks

The correct response is Option E.

Following intradermal injection of 0.1 mL of bovine collagen (Zyderm and Zyplast) as a test dose, the patient should be monitored for a period of four weeks, as any adverse changes noted at the test site may indicate a delayed hypersensitivity reaction. This is defined as the onset of erythema, induration, tenderness, or swelling to any degree, with or without pruritus, that appears more than 24 hours after implantation and/or persists longer than six hours. Symptoms develop in approximately 3% of patients who receive an intradermal test dose. Injection of bovine collagen is contraindicated in these patients.

An observation period of less than four weeks is inadequate.

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112

Which of the following is the correct sequence of sensory recovery following full-thickness skin grafting?

(A) Light touch, pain, temperature
(B) Light touch, temperature, pain
(C) Pain, light touch, temperature
(D) Pain, temperature, light touch
(E) Temperature, pain, light touch

The correct response is Option C.

According to clinical studies of human grafts, pain is the first sensation to return following skin grafting; light touch returns next, followed by temperature. Because nerves regenerate into grafted skin from the wound margins, the extent of total neural invasion is dependent on the graft's thickness. Therefore, a thicker graft will have more neurilemmal sheaths available to the nerve fibers extending from the graft bed. As such, sensory recovery will be greater in a full-thickness graft than in a split-thickness graft.

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113

A 45-year-old woman has a capillary malformation and hypertrophy of the right leg with underlying arteriovenous malformations. Which of the following is the most likely diagnosis?

(A) Kasabach-Merritt syndrome
(B) Klippel-Trénaunay-Weber syndrome
(C) Maffucci syndrome
(D) Ollier disease
(E) Parkes-Weber syndrome

The correct response is Option B.

This 45-year-old woman has findings consistent with Klippel-Trénaunay-Weber syndrome. This disorder is characterized by skeletal hypertrophy of one extremity, most commonly the leg, with associated capillary malformations, also known as port-wine stains. Deep soft-tissue involvement, including venous and lymphatic malformations, is also seen.

Kasabach-Merritt syndrome is a disorder that is initially seen in infants during the first or second month of life. It is characterized by large hemangiomas that are associated with profound thrombocytopenia, petechiae, ecchymoses, and internal hemorrhage. Infants with Kasabach-Merritt syndrome have a decreased platelet count, which will return to normal following regression of the hemangiomas. Localized consumptive coagulopathy may lead to depletion of clotting factors, which can be life-threatening.

Maffucci syndrome involves multiple enchondromas, most frequently affecting the hand, and venous malformations. Skeletal deformities occur subsequently. Symptoms manifest prior to adolescence. Approximately 20% of patients with Maffucci syndrome develop chondrosarcoma.

Ollier disease (multiple enchondromatosis) is caused by abnormal endochondral ossification. Benign cartilaginous tumors in the large and small tubular bones are characteristic. Multiple lesions of the small bones of the hand may cause loss of function. Malignant degeneration is associated.

Parkes-Weber syndrome is similar to Klippel-Trénaunay-Weber syndrome but is characterized instead by skeletal hypertrophy of one extremity associated with arteriovenous fistulas, not port-wine stains. As a result, the risk for morbidity is significantly greater in patients with this condition.

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114

A 21-year-old woman is brought to the emergency department in shock one week after undergoing elective augmentation mammaplasty. On examination, she has purpura fulminans; the breasts are soft and there is no edema or induration. The incisions are clean and dry. Which of the following is the most likely causative organism?

(A) *Candida albicans*
(B) *Pseudomonas aeruginosa*
(C) *Serratia marcescens*
(D) *Staphylococcus aureus*
(E) *Staphylococcus epidermidis*

The correct response is Option D.

This patient has developed toxic shock syndrome resulting from infection with *Staphylococcus aureus*. Characteristics of toxic shock syndrome include headache, fever, nausea, vomiting, profuse diarrhea, an erythematous rash, and desquamation of the palms and soles. If untreated, multiple organ failure results. Patients who have toxic shock syndrome resulting from *Staphylococcus aureus* organisms typically do not have purulent wounds; instead, the surgical wound may appear normal. Management should include removal of the foreign bodies (which in this patient are the implants), systemic administration of antibiotics, and supportive care in the presence of multisystem involvement.

Each of the other organisms listed produces septic shock, not toxic shock syndrome. Septic shock is similar to toxic shock syndrome but is not associated with gastrointestinal symptoms, macular erythroderma, or desquamation.

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115

Ten days after undergoing mastectomy followed by breast reconstruction using a free transverse rectus abdominis myocutaneous (TRAM) flap anastomosed to the thoracodorsal system, a 45-year-old woman has total necrosis of the flap. In this patient, autogenous tissue reconstruction using a pedicled ipsilateral latissimus dorsi flap requires patency of which of the following arteries?

(A) Circumflex scapular
(B) Lateral pectoral
(C) Lateral thoracic
(D) Serratus branch of the thoracodorsal
(E) Second, third, and fourth anterior intercostal

The correct response is Option D.

Following complete loss of a free transverse rectus abdominis myocutaneous (TRAM) flap, autogenous tissue reconstruction with a latissimus flap can be performed if the serratus branch of the thoracodorsal artery has been

preserved. Because the free TRAM flap provides a large amount of tissue and has a reliable vascular supply from the dominant inferior pedicle, it is often used, even in high-risk patients. However, anastomotic complications may lead to total flap loss. When harvesting a free TRAM flap using the thoracodorsal artery as the recipient vessel, the surgeon should divide the artery and vein proximal to the serratus branch to preserve retrograde perfusion to the latissimus muscle, allowing for potential harvest of the latissimus dorsi flap in the future.

The circumflex scapular artery is a branch of the subscapular artery. It divides into transverse and descending scapular vessels within the triangular space. These vessels supply blood to the scapular/parascapular free flap.

The lateral pectoral artery provides vascularity to the lateral border of the pectoralis muscle.

The lateral thoracic artery can be found along the anterior chest wall. It provides the vascular supply for the overlying skin, pectoralis major muscle, serratus anterior muscle, and breast.

The intercostal arteries are the primary vascular supply for the intercostal muscles and overlying skin.

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116

A 4-year-old boy is brought to the emergency department after sustaining a dog bite to the face. Following irrigation and primary closure of the wound, which of the following is the most appropriate prophylactic antimicrobial agent?

(A) Amoxicillin-clavulanic acid
(B) Cephalexin
(C) Clindamycin
(D) Penicillin
(E) Tetracycline

The correct response is Option A.

This 4-year-old boy who has sustained a dog bite to the face should receive prophylactic antimicrobial therapy with amoxicillin-clavulanic acid. This agent is most effective against organisms that are likely to cause infection in patients who have dog or cat bite wounds, including *Capnocytophaga canimorsus*, *Pasteurella multocida*, *Staphylococcus aureus*, and *Streptococcus*. An extended-spectrum cephalosporin or trimethoprim-sulfamethoxazole combined with clindamycin can be administered to patients who are allergic to penicillin.

Amoxicillin-clavulanic acid is also appropriate for prophylactic antimicrobial therapy for human bite wounds. Associated infectious organisms include *Eikenella corrodens*, *Staphylococcus aureus*, and *Streptococcus*. Patients who are allergic to penicillin should be treated with trimethoprim-sulfamethoxazole plus clindamycin. Tetracycline is also appropriate for adult patients.

If administered alone, cephalexin, clindamycin, and penicillin will not provide adequate antimicrobial coverage. In addition to being ineffective in the treatment of animal bites, tetracycline should not be administered to a patient younger than age 8 years because of the potential for staining of the permanent dentition.

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117

Which of the following types of skin graft undergoes the lowest primary contraction and the greatest secondary contraction?

(A) Thin split-thickness skin graft
(B) Moderate split-thickness skin graft
(C) Thick split-thickness skin graft
(D) Thin full-thickness skin graft
(E) Thick full-thickness skin graft

The correct response is Option A.

A thin split-thickness skin graft will undergo the lowest primary contraction and the greatest secondary contraction. Primary contraction of a skin graft occurs immediately after harvest and is caused by recoil of elastin fibers within the dermis. Grafts with the most amount of dermis undergo the greatest primary contraction. Primary contraction is maximized in a thick full-thickness skin graft and minimized in a thin split-thickness skin graft.
In contrast, secondary contraction occurs after wound healing and is dependent on both the graft and the recipient bed. The effect is opposite that of primary contraction because the amount of contraction is lessened when the relative proportion of dermis is greater. A lower amount of secondary contraction will be seen with full-thickness skin grafts than with split-thickness skin grafts. Greater rigidity of the recipient bed is associated with a decreased incidence of contraction.

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118

In a patient undergoing leech therapy for management of venous congestion following thumb replantation, the most appropriate adjunctive treatment is administration of which of the following antibiotics?

(A) Ampicillin
(B) Cefazolin
(C) Erythromycin
(D) Penicillin
(E) Trimethoprim-sulfamethoxazole

The correct response is Option E.

Leeches effectively relieve congestion by digesting human blood through symbiotic bacteria within the gut. However, leech therapy is associated with an increased risk for development of infection; therefore, antibiotics should be administered concomitantly. Because *Aeromonas hydrophila* is the predominant organism within the leech gut, antibiotics that are effective against this organism, such as ciprofloxacin, tetracycline, and trimethoprim-sulfamethoxazole, should be administered.

Ampicillin is less effective than trimethoprim-sulfamethoxazole in the management of *Aeromonas hydrophila* infection. Cefazolin, erythromycin, and penicillin are useful against gram-positive organisms but are not effective in patients with *Aeromonas hydrophila* infection.

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119

During harvest of a vascularized iliac crest bone graft, the deep circumflex iliac artery will be found

(A) anterior to the iliacus muscle
(B) caudad to the inguinal ligament
(C) cephalad to the upper border of the internal oblique muscle
(D) medial to the external iliac vessels
(E) superficial to the transversus abdominis muscle

The correct response is Option A.

During harvest of a vascularized iliac crest bone graft, the deep circumflex iliac artery can be found on the anterior surface of the iliacus muscle. When harvesting this flap, the surgeon should dissect the dominant pedicle cephalad to the inguinal ligament and lateral to the external iliac vessels. The deep circumflex iliac artery will be found caudad to the lower border of the internal oblique muscle and deep to the transversus abdominis muscle; from there, it courses upward and lateral to the iliac crest.

The surgeon should also be careful to avoid transecting the lateral cutaneous nerve of the thigh, which lies within the superficial plane at the lateral aspect of the dissection.

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120

Each of the following is a histologic finding in expanded human tissue EXCEPT

(A) flattening of the rete ridges
(B) presence of a multilayer capsule
(C) thinning of the epidermis
(D) thinning of the dermis
(E) thinning of the subcutaneous tissues

The correct response is Option C.

Following tissue expansion, histologic evaluation of the expanded skin will show thickening of the epidermis, thinning of the dermis with flattening of the rete ridges, thinning of the subcutaneous tissues, and the presence of a complex, multilayer capsule comprised of four zones that surrounds the tissue expander. The inner zone of the capsule, which borders the expander, is composed of macrophages and fibrillar material, while the central zone is composed of fibroblasts and myofibroblasts that are compressed between thick bundles of collagen. Loose bundles of collagen are contained in the transitional zone, along with few blood vessels. In the outer zone, there is dilation of pre-existent blood vessels and growth of new, small-caliber vessels within a stroma of collagen and thick elastic fibers. Because the presence of the capsule typically results in a significant increase in vascularity within the flap, it is not usually removed.

Other studies have shown the untoward effects of tissue expansion, including muscle atrophy and areas of depression and thinning in the underlying bone. In addition, attempts at elongating nerves and blood vessels during expansion have met with mixed results.

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INTEGUMENT — 2001

121

A 2-year-old boy is brought to the emergency department after sustaining a burn to the corner of the mouth when he bit on an electric cord. A photograph is shown above. The most appropriate management is splinting of the oral commissure for a minimum of what period of time?

(A) Six weeks
(B) Two to three months
(C) Six months
(D) One year

The correct response is Option C.

In this child who has sustained a burn to the oral commissure, the oral commissure should be splinted for a period of at least six months. Approximately 90% of all burns of the oral commissure occur in children younger than age 4 years, and boys are twice as likely to be injured; most of these injuries occur when a child places a live electric cord into the mouth. The flow of saliva produces an electrical short, resulting in thermal damage to the tissues.

Because long-term splinting has been shown to prevent microstomia and preserve function in patients who have injuries confined to the oral commissure, a custom-made device (either fixed or removable) should be applied to compress the commissure. It should be worn continuously for a minimum of six months and then at night only for several more months.

In these children, there is a 10% incidence of bleeding from the labial artery following injury. The child's parent should be instructed to place the thumb and finger on the artery to control the bleeding if this does occur.

In children who have more severe injuries or for whom splinting is not practical, early surgical intervention or delayed reconstruction following scar maturation is recommended. If the injury extends beyond the oral commissure, functional lip reconstruction should be performed.

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122

In a patient who has undergone resection of a squamous cell carcinoma of the floor of the mouth, which of the following free flaps will provide vascularized bone and a sensate skin paddle?

(A) Iliac crest flap
(B) Lateral arm flap
(C) Parascapular flap
(D) Serratus anterior flap

The correct response is Option B.

Because the lateral arm flap provides both vascularized bone and a sensate skin paddle, it is best used for reconstruction of this patient's defect involving the floor of the mouth. Vascularity and skin sensibility are provided by the radial collateral artery and posterior brachial cutaneous nerve (C5-6), respectively. As much as 7 cm × 12 cm of skin can be elevated with the flap; in addition, because of its periosteal attachments, as much as one-third of the posterior lateral humerus (or 10 cm to 15 cm in length and 1 cm to 1.5 cm in diameter) can be harvested.

The iliac crest osteocutaneous flap, which is based on the deep circumflex iliac artery, can provide a skin paddle as large as 12 cm × 6 cm and a bone segment as large as 8 cm × 18 cm. Although this flap can be used for reconstruction of large mandibular segments and extensive soft-tissue defects, the skin component is bulky and insensate. Meticulous closure of the donor site defect is required to prevent hernia formation.

The parascapular flap is based on the circumflex scapular artery. Advantages of this flap include multiple skin paddles, a large segment of bone, and a high degree of independent motion between the skin and bone segments. The serratus anterior and/or latissimus dorsi muscles can be included with the flap to reconstruct complex defects. However, the skin paddles of this flap are also bulky and lack a cutaneous sensory nerve.

The serratus anterior flap is extremely versatile. Skin, muscle, and an iliac bone graft can be included with this flap; its pedicle is long and has a large diameter. It can be harvested as a functional muscle flap with inclusion of the branches of the long thoracic nerve; however, the upper four to five muscle slips must be preserved in order to prevent winging of the scapula. This primary disadvantage of this flap is that any bone incorporated with it will be less substantial and have poor vascularization when compared with other osteocutaneous flaps. The skin component of this flap is also insensate.

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123

Which of the following best characterizes black widow spider (*Latrodectus mactans*) venom?

(A) Hemotoxin
(B) Myelotoxin
(C) Neurotoxin
(D) Tissue toxin

The correct response is Option C.

The venom of the black widow spider (*Latrodectus mactans*) is a neurotoxic agent that causes the hallmark findings of muscle pain and cramping that appear within 15 minutes after the bite. This common species of spider is found throughout the United States. Most patients with latrodectism are bitten by female spiders; in contrast, the bite of the male spider rarely penetrates the skin. Affected patients have sharp pain at the wound site with two small red spots marking the location of puncture. Late findings include pain and cramping of the striated muscles, abdominal pain, vomiting, tremor, excessive salivation, and shock.

In a patient who is bitten by a black widow spider, the most appropriate therapy is administration of 10 mL of 10% calcium gluconate solution over a period of 15 to 20 minutes; 1 ampule of methocarbamol or 5 mg to 10 mg of diazepam can be administered additionally. Improvement of the patient's symptoms following treatment is diagnostic of latrodectism. In immunocompromised patients, a diluted dose of black widow spider antivenin (Lyovac) should be administered intravenously at a slow rate.

In contrast, the brown recluse spider produces a toxin known as sphingomyelinate, a dermonecrotic factor. Envenomation with sphingomyelinate results in hemolysis, coagulation, and platelet aggregation, often affecting fatty tissue. Symptoms can range from mild irritation to severe necrosis.

Hemotoxins, such as cobra venom, are exotoxins that result in hemolysis.

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124

According to Wolff's law, which of the following factors is critical to the long-term survival of grafted bone?

(A) Presence of membranous bone
(B) Preservation of the periosteum
(C) Preservation of vascularity
(D) Stress

The correct response is Option D.

Wolff's law states that stress is necessary for preservation of the strength and volume of grafted bone. This law has been used to correctly predict the resorption of bone grafted to heterotopic recipient sites and areas lacking the required stress.

Although membranous bone grafts have shown increased long-term survival rates when compared with endochondral grafts, this difference is believed to result from differences in bony architecture as opposed to embryologic origin.

Preservation of an intact periosteum increases graft survival at all stages following transplantation. Delayed revascularization and decreased peripheral bone growth have been demonstrated in bone grafted without periosteum.

Vascularized bone is used for flaps and not for grafts.

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125

In a patient undergoing lip enhancement using sheet acellular dermal homograft (Alloderm), which of the following is the correct anatomic placement of the graft?

(A) Subdermal placement along the white roll of the lip
(B) Submucosal placement along the white roll of the lip
(C) Submucosal placement along the wet/dry vermilion border of the lip
(D) Intramuscular placement

The correct response is Option C.

Following adequate anesthesia, sheet acellular dermal homograft (Alloderm) should be placed submucosally along the wet/dry vermilion border of the lip. In order to effectively enhance the lips, the surgeon should first create bilateral incisions approximately 0.5 cm from the commissure on both the upper and lower lips; this will allow for tunneling of the Alloderm along this border. After the Alloderm is placed, the lip is stretched, allowing proper sealing of the graft. The ends should then be tapered and placed in a submucosal pocket near the commissure. Suturing is associated with the development of dynamic lip deformities and thus should not be performed.

Because subdermal placement is too superficial, the patient will be predisposed to the development of contour irregularities if the implants are placed at this level. Submucosal placement of the Alloderm along the white roll will result in unnatural lip aesthetics. Alloderm should not be placed within the muscle.

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126

Which of the following types of skin graft can be expected to grow proportionately with a young child?

(A) Split-thickness
(B) Full-thickness
(C) Epidermal
(D) Cultured epithelial autograft

The correct response is Option B.

Full-thickness skin grafts can be expected to grow proportionately with a young child. In contrast, split-thickness skin grafts will exhibit some growth, although secondary and/or revision grafting is often required. Epidermal grafts and cultured epithelial autografts will not demonstrate proportionate growth with expansion of the surrounding tissues.

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127

Bovine collagen is most effective when injected into which of the following anatomic regions?

(A) Epidermis
(B) Dermis
(C) Immediate subdermis
(D) Subcutaneous fat

The correct response is Option B.

Bovine collagen provides the most effective aesthetic result when it is injected into the dermal layer. If injected too deeply (ie, into the subdermal or subcutaneous layers), its effects are highly transitory because resorption is often immediate. However, even with appropriate injection, the desired effect of bovine collagen can only be maintained for a maximum of three to four months, and repeat injections are required for a sustained effect. Injection of bovine collagen into the epidermal layer is often associated with contour deformities.

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Which of the following is most characteristic of hydroxyapatite bone cement?

(A) Exothermic damage to the underlying dura and brain tissue
(B) Gradual loss of contour over time
(C) Osteoinductive growth of new bone
(D) Peripheral ingrowth of bone

The correct response is Option D.

Hydroxyapatite bone cement has been shown to have osteoconductive properties, resulting in growth of new bone over several months following its use in reconstruction. This bone cement is a mixture of amorphous and crystalline calcium phosphate compounds and is recommended for use in nonstress skeletal areas. Because the cement sets endothermically at body temperature, patients are not at risk for any endothermic reactions such as those seen with the use of methylmethacrylate cement. It can be molded and injected into various sites and has not been shown to interfere with craniofacial growth in children. In addition, it maintains its original contour over time. Because the x-ray defraction spectrum of hydroxyapatite cement is similar to bone, scatter effect is not seen on CT scan.

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A 21-year-old man sustains an avulsion injury involving the skin of the dorsal aspect of the right hand. On examination, there is a loss of paratenon; the extensor tendons are exposed. A reverse radial forearm flap is to be used for coverage of the defect.

The venous outflow of this flap depends primarily on which of the following vessels?

(A) Accessory cephalic vein
(B) Basilic vein
(C) Cephalic vein
(D) Radial venae comitantes
(E) Ulnar venae comitantes

The correct response is Option D.

All reverse flaps are based on a "retrograde flow" design, in which the blood flows into the artery and out of the vein, opposing normal physiology. In order for this to occur properly, either the valves of the peripheral veins must be incompetent or the flow of blood must circumvent the valves. The reverse radial forearm flap has small, intercommunicating veins that lie between the paired venae comitantes and act as shunts, bypassing the valves and allowing blood flow directly between the venae comitantes. Thus, retrograde flow is established, and a useful, viable vascularized flap is created.

As long as the paired venae comitantes and intercommunicating veins remain intact, the reverse radial forearm flap can be used to cover large defects involving the dorsal aspect of the hand. Any mechanical separation of the venae comitantes during flap harvest will result in damage to the intercommunicating veins and lead to flap failure. In addition, an Allen's test should be performed preoperatively to demonstrate an adequate retrograde flow of blood from the ulnar artery through the distal artery.

The cephalic vein originates at the radial aspect of the dorsal venous network and flows into the axillary vein. The basilic vein originates ulnarly within the dorsal venous network, joins with the median cubital vein, and ascends medial to the biceps tendon, perforating the deep fascia at the middle of the arm and then continuing as the axillary vein. The median vein of the forearm provides drainage for the superficial palmar venous plexus and ascends on the volar aspect of the forearm to drain into the basilic or median cubital vein. Because these veins and the accessory cephalic vein do not have interconnecting veins that allow for bypass of the valves, reverse flow is prohibited.

The ulnar venae comitantes act in conjunction with the ulnar artery and thus are not involved in the drainage of the reverse radial forearm flap.

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130

A 5-year-old boy is brought to the emergency department after sustaining a laceration of the left lower extremity. Physical examination shows an isolated 2-cm lesion extending through the dermis. EMLA cream is applied prior to suturing. The surgeon should wait for how many minutes before suturing the laceration?

(A) 5 minutes
(B) 10 minutes
(C) 20 minutes
(D) 30 minutes
(E) 60 minutes

The correct response is Option E.

Because EMLA cream reaches its peak efficacy approximately 45 to 60 minutes after initial application, the surgeon should wait for one hour before suturing the laceration. Studies show that EMLA cream is superior for anesthesia of simple extremity wounds and results in optimal anesthesia in open wounds after approximately 60 minutes. Cumulative sum (CUSUM) analysis has been used to confirm the minimal effective application time.

EMLA cream, a eutectic mixture of local anesthetics, contains lidocaine 5% and prilocaine 5%. Following topical application of EMLA cream, the affected site should be covered with an occlusive dressing.

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A 20-year-old man with paraplegia has a large grade IV pressure ulcer of the left ischium. He previously underwent ligation of the profunda femoris artery on the left. Which of the following flaps is most appropriate for reconstruction in this patient?

(A) Gluteal thigh flap
(B) Gracilis flap
(C) Rectus femoris flap
(D) Tensor fascia lata flap
(E) Vastus lateralis flap

The correct response is Option A.

The gluteal thigh flap is most appropriate for reconstruction of this paraplegic patient's ischial pressure ulcer because this is the only flap of those listed whose regional arterial vascularity is provided by a source other than the profunda femoris artery, namely the inferior gluteal artery and venae comitantes. As much as 10 cm × 35 cm can be harvested with this flap. It is frequently transferred as a fasciocutaneous flap with elevation of the inferior portion of the gluteus maximus muscle to the lateral edge of the sacrum.

The gracilis myocutaneous and rectus femoris flaps have a type II vascular pattern and can also be used for coverage of most ischial pressure ulcers. Circulation is provided by the profunda femoris artery via the ascending branch of the medial circumflex artery and venae comitantes for the gracilis flap and via the descending branch of the lateral circumflex artery and venae comitantes for the rectus femoris flap.

In contrast, the tensor fascia lata and vastus lateralis flaps both have a type I vascular pattern. The tensor fascia lata flap can be used for coverage of trochanteric, ischial, and sacral pressure ulcers and the vastus lateralis flap for coverage of trochanteric and ischial pressure ulcers. Like the rectus femoris flap, circulation of the vastus lateralis flap is provided by the profunda femoris artery via the descending branch of the lateral circumflex artery and venae comitantes. In contrast, vascularity of the tensor fascia lata flap is provided by the profunda femoris via the ascending branch of the lateral circumflex artery and venae comitantes.

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132

The photograph shown on the previous page is of an otherwise healthy 7-year-old boy who has had progressive enlargement of the right upper extremity with pitting edema since birth. Radiographs of the right upper extremity show bone growth that is normal and equal to the left upper extremity. An enhanced MRI shows normal soft tissues.

This patient's findings are most consistent with

(A) Klippel-Trénaunay syndrome
(B) lymphatic malformation
(C) lymphedema praecox
(D) Milroy's disease
(E) proteus syndrome

The correct response is Option D.

The findings in this 7-year-old boy are most consistent with Milroy's disease, a rare, X-linked, autosomal dominant form of primary lymphedema that is diagnosed at birth. Unilateral pitting edema is seen in this patient and is in fact associated with all forms of lymphedema. Ocular manifestations have occurred in some patients. Radiographs will show normal bone growth and no hemihypertrophy of the affected extremity. MRI of the soft tissues may also be unremarkable.

Klippel-Trénaunay syndrome is characterized by limb hemihypertrophy, most frequently affecting the leg, and lymphovenous malformations, often with a cutaneous component. A T_1-weighted MRI will show a slow-flow lesion. Lymphedema is seen in as many as 30% of these patients. In infrequent cases, limb hypoplasia has been present in place of hypertrophy. A gadolinium-enhanced MRI is needed to distinguish lymphovenous malformations from mere lymphatic or venous lesions.

Lymphatic malformations are composed of lymph-filled dysplastic vessels that can be classified as macrocystic, microcystic, or combined. Ultrasonography can be used to diagnose lymphatic malformations in utero or after birth. MRI will also aid in delineating a lymphatic malformation from lymphedema.

Lymphedema praecox is a noncongenital form of lymphedema; signs and symptoms usually first occur before puberty. Another form, lymphedema tarda, occurs in midlife.

Proteus syndrome is a sporadic condition characterized by vascular, skeletal, and soft-tissue abnormalities. Common findings include growth asymmetry and subcutaneous tumor-like structures, such as lipomas, Schwann cell structures, and lipomatosis. Associated vascular anomalies may include capillary malformations, lymphatic malformations, capillary venous malformations, and combined lymphovenous malformations, all of which will appear abnormal on MRI.

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133

Which of the following is most characteristic of an in vivo subglandular breast implant that was placed 10 years ago?

(A) Changes in the implant shell that may interfere with mammography
(B) Easier palpability resulting from increased stiffness of the implant shell
(C) Increased potential for the development of immune-related disorders
(D) Invasion of the implant shell by surrounding periprosthetic capsular tissue
(E) Loss of biomechanical shell strength when compared with preimplantation levels

The correct response is Option E.

In a patient who underwent in vivo subglandular breast implantation 10 years ago, a loss of biomechanical strength of the implant shell, when compared with preimplantation levels, is most likely to be identified. Because the implant shell is composed of a vulcanized silicone elastomer, its mechanical strength has been shown to weaken over time following implantation. This weakening, which may result from various factors such as lipid infiltration of the silicone elastomer, has been linked to aging and rupture of the implant.

Any changes that occur in the implant shell will not interfere with mammography or with the palpability of the implant. However, other complications, such as capsular contracture, will affect the findings seen on mammography. Therefore, it is important for patients who have breast implants to undergo mammographic evaluation at specialized centers experienced at obtaining mammograms using the displacement (Eklund) technique, which maximizes visualization of the breast parenchyma.

The stiffness of the implant shell does not change with time. In the same way, the incidence of immune-related disorders remains steady over the duration of implantation, at one in 40,000 patients.

Infiltration of the implant shell by the surrounding capsule has not been demonstrated or implicated in the rupture of aging implants.

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134

Which of the following lesions is associated with trigeminal nerve distribution?

(A) Blue nevus
(B) Ephelis
(C) Nevus of Ito
(D) Nevus sebaceus of Jadassohn
(E) Nevus of Ota

The correct response is Option E.

The above photograph depicts a nevus of Ota, a bluish gray facial lesion that occurs along the distribution of the ophthalmic and maxillary branches of the trigeminal nerve (V_1 and V_2) and predominantly involves the periorbital region. The cornea, nasal mucosa, and oral pharynx are rarely involved. Approximately 60% of these lesions are present at birth or develop by age 10 years, 80% are seen in female children, and 5% occur bilaterally. Because malignant transformation is rare, treatment is only indicated for cosmetic reasons.

A blue nevus is a small, well-defined intradermal nevus that rarely displays malignant transformation. Ephelis is a pigmented freckle that contains a normal quantity of melanocytes and an abnormally large quantity of melanin granules. There is no potential for malignancy. The nevus of Ito is similar to the nevus of Ota but instead follows the distribution of the lateral brachial cutaneous and supraclavicular nerves. The nevus sebaceus of Jadassohn is a yellowish orange, slightly elevated plaque seen at or soon after birth. It is a benign epidermal tumor that occurs most frequently on the scalp and face. Approximately 15% of these lesions develop into basal cell carcinoma.

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A 5-month-old infant has a nodular, nonulcerated 2-cm capillary hemangioma of the upper eyelid that is obstructing the visual axis; a photograph is shown above. His parents report that the lesion grew rapidly and then decreased in size. Which of the following is the most appropriate next step in management?

(A) Systemic administration of corticosteroids
(B) Intralesional injection of corticosteroids
(C) Interferon alfa–2a therapy
(D) Radiation therapy
(E) Surgical resection of the lesion

The correct response is Option E.

In this infant who has a hemangioma that is obstructing the visual axis, the most appropriate management is immediate surgical resection to preserve vision. Studies have shown that children younger than age 1 year are susceptible to the development of amblyopia if visual obstruction is present for a period of time as short as one week. Once the hemangioma has been carefully excised, primary closure can be attempted; larger wounds should be covered with a skin graft or flap because of the risk for lagophthalmos and corneal exposure.

Because systemic administration of corticosteroids has been shown to result in significant regression of lesions, it is the recommended course of therapy in patients with hemangiomas that do not obstruct the visual axis or airway. In these patients, doses of prednisone 2 mg/kg/daily to 4 mg/kg/daily are prescribed for two to three weeks and then tapered to 1 mg/kg/daily before the prednisone is discontinued. Although success rates of as high as 60% have been reported, associated complications in infants can include adrenal suppression, immunosuppression, growth arrest, and the development of cushingoid facies.

Intralesional corticosteroids such as betamethasone, dexamethasone, and triamcinolone can be extremely effective when injected at multiple sites under sedation or general anesthesia. As many as three separate injections can be administered every four to eight weeks, and marked involution has been reported in a majority of patients. Nevertheless, this course of treatment is rarely recommended because patients are at risk for significant

complications, including perforation of the globe, infection, renal artery embolism, blindness, eyelid necrosis, and atrophy of soft tissues.

Interferon alfa–2a is a newly recognized treatment of hemangiomas. This agent is thought to inhibit the migration and proliferation of endothelial cells through a blockade of basic fibroblast growth factor. Complications, which are infrequent, can include low-grade fever, a transient increase in liver enzymes, and rebound tumor growth, which can be prevented by prolonging the course of therapy. However, investigational studies of the use of interferon alfa-2a for the treatment of hemangiomas have been limited to those patients in whom corticosteroid therapy has been unsuccessful.

Radiation therapy is effective for treatment of proliferative hemangiomas but is often associated with significant adverse effects, especially in infants. These include the potential for injury to the globe and optic nerve, as well as the risk for subsequent induction of malignancy, such as thyroid carcinoma. Therefore, this treatment is limited to patients who have high risk lesions that have not responded to corticosteroid therapy.

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A 57-year-old man undergoes composite resection of an advanced squamous cell carcinoma of the retromolar trigone. An osteocutaneous free flap that provides a 6-cm bone segment, intraoral lining, and external skin will be used for reconstruction of the defect.

Which of the following osteocutaneous free flaps will allow for maximum independence in repositioning the skin paddle in relation to the bone segment?

(A) Fibular
(B) Iliac crest
(C) Lateral arm
(D) Radial forearm
(E) Scapular

The correct response is Option E.

Reconstruction in this patient should be performed using the scapular flap, which will provide the greatest degree of leeway in positioning the skin paddle in relation to the bone segment. This is typically advantageous when using the flap to reconstruct complex defects of the head and neck. The scapular flap derives its primary blood supply from the circumflex scapular artery, which originates from the subscapular artery and passes through the triangular space. Branches of the circumflex scapular artery consistently supply the lateral border of the scapula at a point prior to the division of the artery into transverse and descending branches. A 3-cm vascular pedicle extends from the border of the scapula to the overlying skin and allows for an additional three degrees of spatial freedom when insetting the skin paddle. In addition, the angular branch of the thoracodorsal artery has been shown to consistently provide an independent source of perfusion to the inferior pole of the scapula. This allows for a greater arc of rotation between the bone and skin paddle because each portion derives its vascularity from separate sources.

The fibular flap is based on the peroneal artery as well as its multiple periosteal vessels and cutaneous perforators; it can provide as much as 25 cm of bone for mandibular reconstruction. Because of the limited amount of skin that can be harvested with this flap, it is not often used in reconstruction without additional skin grafting; in addition, there is very little freedom in repositioning the skin relative to the bone. Harvest of this flap is contraindicated in patients with several peripheral vascular disease.

The iliac crest osteocutaneous flap, which is based on the deep circumflex iliac artery, can provide a skin paddle as large as 12 cm × 6 cm and a bone segment as large as 8 cm × 18 cm. Although this flap can be used for reconstruction of large mandibular segments and extensive soft-tissue defects, the skin component is bulky and insensate. Meticulous closure of the donor site defect is required to prevent hernia formation.

Advantages of the lateral arm flap include a thin, pliable, sensate skin paddle and the potential harvest of as much as 12 cm of skin and one third of the diameter of the humerus. Because of these factors, the flap is often used for reconstruction of defects of the head and neck or upper extremities. A skin paddle as large as 6 cm can be harvested without skin grafting. However, the use of this flap is once again limited by its lack of freedom between the skin and underlying bone segment.

The radial forearm flap can provide thin, pliable skin and a maximum of 10 cm of bone, which can include a cross-sectional area comprising approximately 40% of the radius. Once again, there is minimal freedom when positioning the skin paddle relative to the underlying bone. The quality of bone harvested with this flap is often poor, and it is rarely used in elderly patients because of the increased risk for radial fracture seen with the removal of such a large portion of bone.

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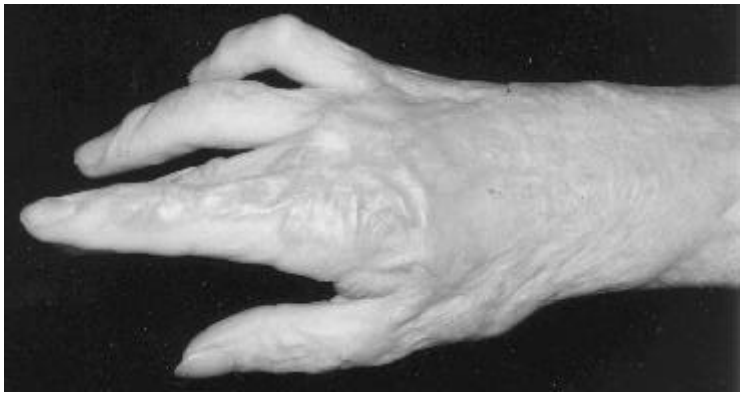

Eight months after sustaining a deep second-degree burn of the dorsal aspect of the right hand, a 45-year-old woman has hyperextension of the metacarpophalangeal joint of the little finger resulting from a progressively worsening scar contracture. A photograph is shown above. Intensive occupational therapy has not improved this patient's condition.

Following release of the scar contracture, which of the following is the most appropriate operative management?

(A) Thin split-thickness skin grafting
(B) Full-thickness skin grafting
(C) Cultured epithelial autografting
(D) Coverage with a free lateral arm flap
(E) Coverage with a radial forearm flap

The correct response is Option B.

This patient has a significant scar contracture after sustaining a deep second-degree burn, which by nature is defined as a partial-thickness burn. This type of burn is often associated with hyperextension scarring and preservation of the underlying extensor tendon mechanism. Following release of the scar contracture, this patient should undergo full-thickness skin grafting of the hand. The paratenon of the extensor mechanism will readily accept a full-thickness skin graft, which will maximize long-term mobility of the metacarpophalangeal joint. In addition, full-thickness skin grafts have the lowest associated scar contraction.

Both thin and thick split-thickness skin grafts have higher secondary contraction rates than full-thickness skin grafts, with thin split-thickness skin grafts having the greatest rate of secondary contraction.

Because full-thickness skin grafting will provide the best thin coverage of the burn wound, more difficult and sophisticated procedures, such as autografting or coverage with free or pedicled flaps, are unnecessary.

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138

A 68-year-old woman has had a slowly enlarging nodule on the right upper eyelid for the past eight months. Physical examination shows a dark purple 8-mm nodule on the eyelid; ipsilateral parotid and cervical nodes can be palpated. Histologic examination of a biopsy specimen of the lesion shows uniform sheets of small oval cells within the deep epidermis and subcutaneous fat that have indistinct margins.

These findings are most consistent with

(A) basal cell carcinoma
(B) malignant melanoma
(C) Merkel cell carcinoma
(D) microcystic adnexal carcinoma
(E) squamous cell carcinoma

The correct response is Option C.

This patient has findings consistent with Merkel cell carcinoma, an extremely aggressive tumor most commonly encountered in the head and neck region of elderly women. These nodules are pink to deep purple in color and rarely ulcerate. Light microscopy will show dense sheets of oval cells with indistinct borders that invade the deep dermis, subcutaneous fat, and muscle while sparing the papillary dermis and epidermis. Some surgeons advocate the use of electron microscopy and immunohistochemistry because these lesions can be mistaken for metastatic oat cell carcinoma or poorly differentiated lymphoma. A biopsy specimen of the lesion will most likely stain positive for neuron-specific enolase.

Because 33% of affected patients will experience a local recurrence within one year of initial treatment and approximately 50% will ultimately develop nodal metastases, wide local excision with a margin of 2.5 cm to 3 cm is indicated. En bloc resection of involved nodes and postoperative radiation therapy are also recommended; chemotherapy and prophylactic nodal dissection are controversial treatment options. Long-term survival rates are poor; only 55% of patients diagnosed with Merkel cell carcinoma will survive for three years. Factors that are associated with a poor prognosis include male gender, early age at initial onset, and location of the tumor on the head, neck, or trunk.

Basal cell carcinomas are common slow growing tumors of the head and neck that can be pigmented or ulcerated. Because these tumors rarely metastasize, local excision with 5 mm margins is recommended.

Malignant melanoma is a highly aggressive tumor of brown pigmentation that often develops within an existing nevus. Exposure to ultraviolet radiation has been associated. Melanomas of the hands and feet are associated with a significantly worse prognosis than those of the arm and leg. Excision with wide margins is advocated for treatment of malignant melanoma.

Microcystic adnexal carcinomas are rare, flesh colored nodules involving the upper lip, nose, and periorbital regions in middle aged patients. Perineural invasion is almost always seen with this locally aggressive and often recurrent tumor. Ulceration and nodal metastases are rare. Appropriate management of microcystic adnexal carcinoma is Mohs' micrographic resection, including complete histologic examination of the tumor margins. Radiation therapy is ineffective.

Squamous cell carcinomas arise from the malpighian layer and have a strong association with actinic radiation. Cutaneous squamous cell carcinomas have a rough, ulcerated appearance and most frequently affect the head and neck region. The overall rate of metastasis is extremely low. Direct excision or radiation therapy are equally advocated as initial treatment. Recurrent lesions are treated with Mohs' micrographic resection.

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Sebaceous carcinoma most frequently affects which of the following anatomic sites?

(A) Eyelid
(B) Finger
(C) Nose
(D) Tongue
(E) Trunk

The correct response is Option A.

Sebaceous carcinoma arises from the adnexal epithelium of the sebaceous glands. It can be divided into two subtypes; the ocular subtype, which is most common, typically arises from the meibomian gland of the eyelid. This is a more aggressive carcinoma, frequently resulting in metastasis. In contrast, extraocular lesions are common to hair-bearing areas, and metastases are infrequent.

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A 25-year-old woman sustains a contact injury to the posterior aspect of the scalp. Following debridement, she has a 6 × 4-cm defect of the posterior scalp with exposed bone. Which of the following is the most appropriate next step in management?

(A) Excision and primary closure
(B) Full-thickness skin grafting
(C) Coverage with a rotation flap
(D) Hair transplantation
(E) Tissue expansion

The correct response is Option C.

In this 25-year-old woman who has a 6 × 4-cm defect of the posterior aspect of the scalp, the most appropriate management is coverage of the defect using a rotation flap. This flap provides local hair-bearing tissue and can be used to cover defects as large as 6 cm. In order to advance an adequate length of flap, multiple relaxing incisions must be performed within the galea. If the galea is not carefully divided, injury to the subcutaneous vessels or hair follicles may result, leading to the onset of alopecia or delayed wound healing.

Tissue expansion is most appropriate for patients who have large defects of the scalp (typically greater than 15%) because the scalp defect will be covered with similar tissue. Donor site scarring is not a factor in most cases, and the expanders can be left in place if further tissue expansion is required. In addition, the hair follicles will be oriented correctly; as much as 50% of the scalp can be covered with expanded tissue without altering hair growth. However, the process of tissue expansion involves multiple procedures and frequent office visits over a lengthy period of time. During the expansion process, the patient often expresses displeasure with his/her physical appearance.

Excision and primary closure combined with extensive undermining are only appropriate for patients who have defects measuring less than 5 cm. Patients with small areas of scalp alopecia may undergo multiple staged excisions of the alopecic scalp followed by advancement of hair-bearing tissue. Because this process involves fewer procedures and less follow-up, it can be used as an alternative to tissue expansion.

Although a full-thickness skin graft can be used for temporary wound coverage in a patient who will undergo further scalp reconstruction, it is not an appropriate long-term treatment because many donor sites do not provide adequate hair-bearing skin.

Hair transplantation is currently being used with increasing regularity for treatment of traumatic or age-related alopecia.

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141

A patient who wishes to undergo cosmetic surgery for correction of skin hyperextensibility has an inherited disorder of collagen polymerization that results in laxity of the joints and poor wound healing. These findings are most consistent with

(A) cutis laxa
(B) Ehlers-Danlos syndrome
(C) progeria
(D) pseudoxanthoma elasticum
(E) Werner's syndrome

The correct response is Option B.

This patient has Ehlers-Danlos syndrome, or cutis hyperelastica, an inherited disorder of abnormal molecular collagen cross-linking characterized by hyperextensibility of the skin and laxity of the joints. Cosmetic surgery is contraindicated in patients with Ehlers-Danlos syndrome because wound healing is poor.

Patients with cutis laxa have coarsely textured, drooping skin resulting from a nonfunctioning elastase inhibitor or premature degeneration of elastin fibers. Because this condition is not associated with wound healing problems, rhytidectomy may be performed.

Progeria is an autosomal recessive disorder characterized by skin laxity, loss of subcutaneous fat, and findings of generalized atherosclerosis similar to premature aging. Aesthetic surgery is contraindicated because wound healing is poor; in addition, the lifespan of patients with progeria is shortened.

The mechanisms of action of pseudoxanthoma elasticum, an inherited disorder of premature skin laxity, include increased degradation of collagen and deposition of calcium within the elastic fibers. Rhytidectomy should be considered because healing is normal.

Werner's syndrome is a rare autosomal recessive disorder of unknown etiology. Associated features include sclerodermic skin changes and accelerated atherosclerosis, which can limit or prolong the wound-healing process.

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142

In paraplegic patients with chronic pressure ulcers, which of the following is the most common cause of death?

(A) Pulmonary sepsis
(B) Pulmonary thromboembolism
(C) Renal failure
(D) Sepsis secondary to pressure ulcers
(E) Urosepsis

The correct response is Option C.

In paraplegic patients with chronic pressure ulcers, renal failure secondary to chronic amyloidosis is the most common cause of death. Pulmonary sepsis, thromboembolism, and respiratory failure are frequent causes of death immediately following the traumatic onset of paraplegia but not in patients with long-standing paraplegia who subsequently develop pressure ulcers. Sepsis secondary to pressure ulcers is uncommon. Although urosepsis is a common problem for patients with long-standing paraplegia, antibiotics decrease the likelihood of death.

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143

Which of the following immunologic responses is most likely to be seen in a 50-year-old woman who has sustained a 50% total body surface area (TBSA) burn in a house fire?

(A) Augmented B lymphocyte function
(B) Decreased fibronectin levels
(C) Decreased quantity of suppressor T lymphocytes
(D) Increased complement activation
(E) Increased production of IgG and IgM antibodies

The correct response is Option B.

Immunologic responses anticipated in this 50-year-old woman who has sustained a 50% TBSA burn include decreased levels of fibronectin, diminished complement activation, and decreased production of immunoglobulin antibodies. Patients who sustain burn injuries enter into an immunocompromised state, in which the ability to perform the functions of phagocytosis and pathogen elimination are severely limited, resulting in an inability to produce fibronectin. In addition, there is a generalized depression of the cellular immune response, including a decrease in the quantity and function of both B and T lymphocytes; however, the number of suppressor T lymphocytes is actually increased following acute thermal injury.

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144

Which of the following impairs the process of epithelialization during wound healing?

(A) Basic fibroblast growth factor
(B) Epidermal growth factor
(C) Isotretinoin
(D) Keratinocyte growth factor
(E) Tretinoin

The correct response is Option C.

Isotretinoin is the only agent of those listed that impairs epithelialization instead of promoting it. Isotretinoin (13-cis retinoic acid, or Accutane) is a retinoid, one of a family of vitamin A-related agents. Because of its antikeratinization effect, which results in thinning of the stratum corneum and decreased activity of skin appendages such as sebaceous glands, as well as its effect on wound epithelialization, it is used in the treatment of cystic acne. In addition, patients who have been taking isotretinoin experience delayed or poor wound healing following chemical peeling or laser skin resurfacing because of the effect on wound epithelialization. Therefore, it is recommended that isotretinoin be discontinued a minimum of one year before chemical peeling or laser peeling is performed.

Basic fibroblast growth factor is a polypeptide and a member of the family of fibroblast growth factors (FGF). This agent stimulates important aspects of wound healing, including angiogenesis, collagen and collagen matrix syntheses, wound contraction, and epithelialization.

Epidermal growth factor is a polypeptide FGF that affects endothelial cells, fibroblasts, and smooth muscle cells. Because epithelial cells have been shown to have the greatest number of receptors for epidermal growth factor, the primary effect of epidermal growth factor is believed to be promotion of epithelialization.

Keratinocyte growth factor is produced by fibroblasts and also primarily affects epithelialization; only epithelial cells have keratinocyte growth factor receptors. Delayed wound healing has been reported in transgenic animals that lack this signaling receptor.

Although tretinoin is also classified as a retinoid, its effects are far different than isotretinoin. Tretinoin (all-trans-retinoic acid, Retin-A) promotes epithelialization by stimulating mitotic activity and decreasing the turnover of follicular epithelial cells. As a result, tretinoin is often used as a pretreatment in patients undergoing chemical peeling and laser skin resurfacing to accelerate wound healing. Other conditions for which tretinoin has proved beneficial include skin aging, acne vulgaris, and dysplastic nevus syndrome, as well premalignant and malignant tumors such as actinic keratosis, carcinoma in situ, and superficial basal cell carcinoma.

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145

Which of the following structures provides motor innervation to the gracilis free muscle flap?

(A) Anterior branch of the obturator nerve
(B) Femoral nerve
(C) Inferior branch of the superior gluteal nerve
(D) Medial femoral cutaneous nerve
(E) Median sural nerve

The correct response is Option A.

The anterior branch of the obturator nerve provides motor innervation to the gracilis free muscle flap. This nerve branch courses between the adductor longus and adductor brevis tendons to innervate the gracilis muscle.

The femoral nerve innervates the rectus femoris muscle at the level of the thigh, while the inferior branch of the superior gluteal nerve supplies motor innervation to the tensor fascia lata. The medial femoral cutaneous nerve, which is a branch of the femoral nerve, supplies sensory innervation to the medial thigh flap. The median sural nerve is found below the knee and courses parallel to the lesser saphenous vein.

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146

Patients with erythroplasia of Queyrat have squamous cell carcinoma affecting which of the following sites?

(A) Arm
(B) Ear
(C) Nose
(D) Penis
(E) Scalp

The correct response is Option D.

Erythroplasia of Queyrat is an irregular, erythematous patch of full-blown squamous cell carcinoma or carcinoma in situ that affects the penis. It is a feature of the condition known as Bowen's disease, which is characterized by widespread erythematous, brown, scaly patches. These lesions are composed of squamous cells that can completely replace normal dermis at the affected sites. Because approximately 15% of Bowen's disease lesions progress to become invasive squamous cell carcinoma, surgical excision of an erythroplasia of Queyrat is recommended.

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147

Which of the following is the predominant type of collagen found in basement membrane?

(A) Type I
(B) Type II
(C) Type III
(D) Type IV
(E) Type V

The correct response is Option D.

Type IV collagen is the predominant collagen in basement membrane. In contrast, type I collagen is most often found in normal, mature skin, as well as in tendon and bone. Type II collagen is present in hyaline cartilage and the tissues of the eye. Type III collagen is located in the papillary dermis, arteries, intestinal walls, and uterus. In addition, hypertrophic and immature scars can contain as much as 30% type III collagen. Type V collagen is also found within the basement membrane in lesser amounts than type IV collagen.

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148

Which of the following graft types exhibits the lowest relative volume loss and resorption?

(A) Bone graft
(B) Cartilage graft
(C) Macro-fat graft
(D) Micro-fat graft
(E) Muscle graft

The correct response is Option B.

Because of its unique composition, cartilage is a tissue well formulated for grafting due to its minimal volume loss and resorption. The metabolic rate of cartilage resorption is far less than other human tissues, and its glycolic activity and relatively low consumption rate result from a decreased quantity of cells and a relatively isolated cartilage matrix. Sites that are easily accessible for harvest include the auricular cartilage, rib cartilage, and septum.

Rates of resorption following bone grafting typically depend on graft size and clinical variables. Macro-fat grafts are often unreliable and associated with high rates of resorption. Dermal fat grafts are more commonly used because of their lower rates of resorption and fibrosis. Although micro-fat grafts obtained by injection may be more reliable, resorption rates have been reported as 25% to 50% of the volume of the originally injected fat. Muscle alone is not routinely transferred as a graft; vascularized muscle is more often used in flaps.

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149

Which of the following sites is most susceptible to the development of a keloid following injury?

(A) Eyelid
(B) Genitalia
(C) Upper arm
(D) Palm
(E) Sole

The correct response is Option C.

Although keloids can occur in persons of any race, they are most frequently seen in dark-skinned persons. Keloids are most likely to develop on the face, cheek, earlobe, shoulder, upper arm, and anterior chest; in contrast, they are rarely seen on the eyelid, cornea, umbilical cord region, palm, genitalia, or sole. The origin of this regional susceptibility is unknown.

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150

A 70-year-old woman has a skin defect with a diameter of 1 cm after undergoing resection of a basal cell carcinoma of the right upper eyelid. Primary closure of the defect is not possible. Which of the following is most appropriate for cutaneous full-thickness coverage of the defect?

(A) Cross-lid flap
(B) Retroauricular skin graft
(C) Skin graft from the contralateral upper eyelid
(D) Supraclavicular skin graft
(E) Wedge resection and primary closure of the remaining eyelid

The correct response is Option C.

A skin graft from the contralateral upper eyelid should be used for full-thickness coverage of this patient's defect. Because older patients typically have dermatochalasia, there is often sufficient skin in the unaffected upper eyelid that can be harvested and used to cover small skin deficits.

A cross-lid flap is more appropriate for coverage of a full-thickness defect. Grafts harvested from the retroauricular and supraclavicular regions are better used for skin grafting of the face due to their optimal color match; however, this skin is often too thick for use in the upper eyelid. Wedge resection is an excessive, unnecessary procedure.

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151

A patient develops an infection at the wound site five days after beginning leech therapy. Which of the following is the most appropriate antibiotic therapy?

(A) Cephalexin
(B) Clindamycin
(C) Metronidazole
(D) Penicillin
(E) Trimethoprim-sulfamethoxazole

The correct response is Option E.

This patient has developed infection with *Aeromonas hydrophila* after undergoing leech therapy for five days. Medicinal leeches such as the *Hirudo medicinalis* species (which is the most commonly used leech and is endemic to Southeast Asia and Europe) can be applied to flaps or replanted limbs in order to relieve venous congestion. However, a common complication of leech therapy is the development of infectious organisms such as *Aeromonas hydrophila*, a gram-negative rod that can be detected in as many as 20% of persons within the first 10 days of therapy. Infiltration of *Aeromonas hydrophila* organisms can result in a rapidly progressive infection with gas in the soft tissues that can resemble clostridial myonecrosis. If infection does develop, trimethoprim-sulfamethoxazole is recommended for first-line therapy. Fluoroquinolones such as ciprofloxacin are also effective. Antibiotics that are still effective but less frequently recommended include antipseudomonal aminoglycoside, imipenem, meropenem, tetracycline, and second-, third-, or fourth-generation cephalosporins.

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152

Which of the following physiologic mechanisms is increased during the first 24 hours following thermal burn injury?

(A) Cardiac output
(B) Central venous pressure
(C) Circulating erythrocyte volume
(D) Circulating glucose concentration
(E) Plasma volume

The correct response is Option D.

The circulating glucose concentration is increased during the first 24 hours following thermal burn injury. The affected patient develops glucose intolerance due to the release of catecholamines from the burn site. Because of this, glucose should not added to the fluids given intravenously for acute resuscitation.

Following burn injury, the release of myocardial depressants diminishes cardiac output. Cardiac output is decreased to 40% to 60% of normal as a result of decreased plasma volume and increased systemic vascular resistance. Cardiac output then returns to normal but is not increased. The aforementioned decrease in plasma volume, which occurs in part from a capillary leak, subsequently leads to a decrease in central venous pressure. In addition, there is a decrease in circulating erythrocyte volume, due in part to a direct destruction of erythrocytes by the injured tissue.

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153

A 40-year-old man has a dark purple "cobblestone" lesion covering the entire right cheek. This finding is most consistent with

(A) an arteriovenous malformation
(B) a capillary malformation
(C) a hemangioma
(D) a lymphatic malformation
(E) a venous malformation

The correct response is Option B.

This 40-year-old man has a capillary malformation, or port-wine stain. These lesions are often seen in the distribution of the abducens (VI) and facial (VII) nerves. If left untreated, cobblestoning and progressive darkening may occur due to ectasia of the vessels within the capillary malformation.

An arteriovenous malformation is a high-flow lesion often characterized by a palpable thrill or bruit. Compression of the lesion results in occlusion of the associated arteriovenous fistula, causing a baroreceptor response and an increase in blood pressure. This leads to a decrease in heart rate and is known as the Branham sign.

Hemangiomas are vascular tumors that appear just after birth and rapidly enlarge during the first year of life. Because spontaneous regression is common, conservative management is suggested for non-life-threatening lesions that do not obstruct the airway or visual axis.

Lymphatic malformations, also known as cystic hygromas, occur most frequently in the head and neck region and often enlarge in response to an adjacent infection. Recurrent swelling can lead to scarring, which will significantly decrease the size of the lesion.

Venous malformations are low-flow lesions composed of dilated venous channels. These lesions are compressible and have a propensity to fill with blood when the patient changes body positions. When the malformation is associated with thrombosis, pain may result.

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154

In a 47-year-old woman who has used topical tretinoin for the last four years, which of the following histologic features is most likely?

(A) A compact stratum corneum
(B) A decrease in dermal mucin
(C) A decrease in epidermal thickness
(D) A decrease in hyaluronic acid
(E) An increase in melanin production

The correct response is Option A.

Topical tretinoin (Retin-A) can be used to decrease the effects of photoaging, including those resulting from solar exposure. Long-term studies have uncovered several histologic features resulting from the topical application of tretinoin, including compactness of the stratum corneum, which produces smoothing of the skin; an increase in hyaluronic acid, which is thought to reduce the appearance of fine lines; an increase in epidermal thickness with return of the granular layer thickness to a baseline value; an increase in dermal mucin; and a decrease in melanin production.

Adverse effects associated with tretinoin use include erythema and crusting of the skin. Alternate-day therapy or daily therapy using a dilute dose has been shown to decrease these effects. Because tretinoin is also associated with sun sensitivity, skin protection during sun exposure is advocated.

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155

In patients who exhibit allergic sensitivity to bovine collagen, which of the following types of immunologic response is most common?

(A) IgA antibodies
(B) IgD antibodies
(C) IgE antibodies
(D) IgG antibodies
(E) IgM antibodies

The correct response is Option D.

Anti-bovine collagen (Zyderm) antibodies are classified as IgG antibodies. Zyderm is a purified form of bovine collagen that consists of 95% type I collagen with 5% type II collagen. It is available in two concentrations, 35 mg/mL and 65 mg/mL, as well as in a glutaraldehyde cross-linked form known as Zyplast, which in theory degrades more slowly. Enzymatic processing is used to remove the nonhelical portion of the collagen molecule, thus reducing most of its associated antigenicity.

These various forms of injectable collagen are used for correction of depressed scars, shallow or soft acne scars, and fine facial rhytids associated with aging. Ice pick acne scars cannot be treated with collagen injections. In patients undergoing treatment, the collagen is injected intradermally in excess amounts, which are necessary to compensate for absorption of the saline component of the solution. Some of the injected collagen is lost over the next six to nine months as collagen breakdown occurs.

Because approximately 3% of all treated patients will have an allergic reaction to injectable bovine collagen, skin testing should be performed prior to any treatment. Following intradermal injection of a test dose into the volar forearm, the patient should be assessed 72 hours after injection and again at four weeks after injection, as any adverse changes noted at the test site may indicate an allergic reaction. This is defined as the onset of erythema, induration, tenderness, or swelling to any degree, with or without pruritus, that appears more than 24 hours after injection and/or persists longer than six hours.

Approximately 66% of those patients who are allergic to injectable collagen will have a positive reaction within 72 hours, while 33% will develop positive findings within four weeks. An additional 1% will have negative findings on skin testing but will subsequently develop an allergic reaction following injection. One study of those patients who had negative skin tests and subsequent allergic reactions showed that 56% developed a reaction following the first treatment, while 28% experienced the reaction after two treatments. All of the patients who exhibited allergic sensitivity developed IgG antibodies against bovine collagen. In contrast, 50% developed IgA antibodies; IgD, IgE, and IgM antibodies were not identified.

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156

Which of the following characteristics of a full-thickness skin graft has the greatest effect on inhibition of wound contraction?

(A) Epidermal-to-dermal ratio
(B) Percentage of grafted dermis
(C) Presence of muscle at the base of the recipient bed
(D) Skin thickness of the recipient bed
(E) Thickness of the entire graft

The correct response is Option B.

Full-thickness skin grafts inhibit wound contraction by accelerating the rate of dissolution of myofibroblasts from the wound. Because of this, it is the percentage of grafted dermis, rather than the absolute thickness of the total graft, that has the greatest effect on inhibition of wound contraction.

The epidermal-to-dermal ratio, skin thickness of the recipient bed, and presence of muscle within the recipient bed play only minor roles in inhibiting wound contraction.

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157

An 8-year-old boy has a bulky soft-tissue anomaly of the right upper extremity. Radiographs show bony destruction of the underlying humerus. These findings are most consistent with

(A) arteriovenous malformation
(B) hemangioma
(C) hereditary hemorrhagic telangiectasia
(D) lymphatic malformation
(E) venous malformation

The correct response is Option A.

This 8-year-old boy has findings consistent with an arteriovenous malformation, a congenital vascular soft-tissue anomaly that has extended to cause destruction of the underlying humerus. Arteriovenous malformations are a subtype of vascular malformation involving arterial channels; they are present at birth and thus grow commensurately with the child's growth. Associated physical findings can include increased warmth in the area of the malformation, mass effect, the presence of a thrill or bruit on auscultation, ulceration, and distal ischemia, which is related to the "steal" phenomenon (ie, diversion of normal blood flow). Skeletal changes, especially intraosseous extension and lytic changes, occur in 34% of affected patients.

Hemangiomas are also classified as vascular anomalies but instead appear shortly after birth and are characterized by a period of rapid growth (typically six to nine months) followed by slow involution. Rapid endothelial proliferation is characteristic, but skeletal changes are not, occurring in only 1% of patients. Lytic lesions are also not seen. Although hemangiomas are often unpleasant looking, they are typically only removed surgically if they begin to obstruct the airway or visual fields.

Hereditary hemorrhagic telangiectasia, or Osler-Weber-Rendu syndrome, is an autosomal dominant disorder that first manifests following puberty and is characterized by lesions with ectatic vessels involving the skin, mucous membranes, and viscera that worsen over time. Epistaxis, hematuria, and hematemesis are frequently associated. Neurologic symptoms may occur in patients who have involvement of the central nervous system. Skeletal malformations are not associated.

In patients with lymphatic malformations, skeletal hypertrophy and distortion are frequent. Venous malformations, especially those affecting the extremities, can cause hypoplasia and bone demineralization.

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158

In normal wound healing, collagen synthesis and collagen breakdown typically reach a state of equilibrium approximately how many days after injury?

(A) 7
(B) 14
(C) 21
(D) 60
(E) 90

The correct response is Option C.

In normal wound healing, collagen synthesis and collagen breakdown typically reach a state of equilibrium approximately 21 days after initial injury. Collagen synthesis depends primarily on production of procollagen by fibroblasts. This procollagen is inserted into secretory vessels that move toward the cell surface. It then is cleaved into collagen at the level of the cell membrane, and the collagen is then released into the wound. Macrophages help to regulate collagen synthesis by producing growth factors that stimulate fibroblast proliferation and subsequent collagen production.

In collagen degradation, fibroblasts, granulocytes, macrophages, and other cells produce specific matrix metalloproteinases (MMP) at the wound site. The MMP family of zinc-dependent endopeptidases includes collagenase, gelatinase, and stromelysin. Several members of the MMP family have been linked to chronic wounds; these substances, such as MMP-2 and MMP-9, have been shown to be absent in acute wounds. A higher turnover of extracellular matrix is thought to contribute to the delayed healing or nonhealing seen in association with chronic wounds. Transforming growth factor-beta can be used to combat this; it has been shown to decrease MMP activity and increase the activity of MMP inhibitors.

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159

A 25-year-old man has burn alopecia after sustaining a burn wound involving 35% of the hair-bearing scalp. Which of the following is the most appropriate method of reconstruction in this patient?

(A) Free flap reconstruction
(B) Micrografting
(C) Minigrafting
(D) Strip grafting
(E) Tissue expansion

The correct response is Option E.

In patients with burn alopecia, the hair-bearing area of the scalp is amenable to tissue expansion; therefore, it is most appropriate for reconstruction in this patient. With this technique, large areas of the scalp can be resurfaced with similar tissue, resulting in reliable, consistent hair growth.

Grafting techniques, such as the use of micrografts, minigrafts, or strip grafts, are appropriate for management of male pattern alopecia but are unreliable in a patient with a compromised recipient site, such as a burn wound. Free flap reconstruction will allow rapid wound healing in a patient who has acute extensive and/or deep injuries involving exposed, devitalized skull.

Although hair transplantation is an option in patients with burn-related alopecia, it would not be the treatment of choice in this patient because of the diminished vascularity and severe scarring seen in the recipient bed.

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160

Which of the following flaps is most appropriate for coverage of a 2-cm full-thickness skin defect of the columella?

(A) Bi-lobe flap
(B) Glabellar flap
(C) Median forehead flap
(D) Nasolabial flap
(E) Scalping flap

The correct response is Option D.

The nasolabial flap should be used for coverage of a 2-cm full-thickness skin defect of the columella. This flap, which is based on the angular artery (terminal branch of the facial artery), can be tunneled deeply to provide tissue for intraoral or columellar reconstruction. It can also be used to cover defects of the lower nose, nasal alae, and upper lip.

Bi-lobe flaps are best used for coverage of defects involving the upper and middle thirds of the nose, not the columella and nasal tip. Glabellar flaps are used for coverage of defects involving the medial canthal and upper nasal regions. The median forehead flap, which is based on the supratrochlear artery, is more useful for coverage of large defects of the nose. A scalping flap is appropriate for near-total and total nasal reconstruction.

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161

A vastus lateralis muscle flap elevated on its dominant pedicle provides reliable coverage for each of the following anatomic sites EXCEPT the

(A) acetabulum
(B) groin
(C) knee
(D) perineum
(E) trochanter

The correct response is Option C.

When the vastus lateralis flap is based on its dominant pedicle, the descending branch of the lateral femoral circumflex artery, it has an area of rotation that will provide vascularized coverage of the lower abdomen, groin, perineum, ischium, trochanter, and acetabular fossa. However, the flap must be reversed in order to rotate and provide coverage of knee defects. When used in this manner, the flap is then based on a branch of the lateral genicular artery, which is a minor distal pedicle. Because the risk for partial flap loss is greater, this flap is not often advocated for coverage of knee defects.

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162

Each of the following is an effective technique for continuous postoperative free flap monitoring EXCEPT

(A) differential surface temperature monitoring
(B) external Doppler ultrasonography
(C) intravenous injection of fluorescein
(D) laser Doppler ultrasonography
(E) photoplethysmography

The correct response is Option C.

Although fluorescein 15 mg/kg is often administered intravenously to determine the viability of a flap's skin paddles, this cannot be used for continuous free flap monitoring because fluorescein often takes several hours to clear from the skin. Lower doses of fluorescein can be used for sequential monitoring, but not for continuous monitoring.

Each of the other options listed can be used for continuous flap monitoring. Although external Doppler ultrasonography is the most frequent choice for flap monitoring, difficulties can be experienced when the flap pedicle is located close to a large artery. External Doppler ultrasonography also cannot be used with buried flaps. Differential surface temperature monitoring compares the temperature of the transferred tissue with the normal surrounding tissue. A temperature difference of greater than 1.8EC (35.3EF) is believed to be significant. Laser Doppler ultrasonography and photoplethysmography both involve the measurement of reflected light from a source that penetrates the flap.

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163

A 72-year-old woman has had a long history of a compressible, nonpulsatile lesion on the lip and chin; photographs are shown above. The lesion swells with activity, sometimes produces pain, and is associated with episodes of bleeding and ulceration.

These findings are most consistent with which of the following types of malformation?

(A) Arteriovenous
(B) Capillary
(C) Lymphatic
(D) Venous

The correct response is Option D.

This 72-year-old woman has a classic venous malformation, a dark lesion that often becomes swollen with dependency and is exsanguinated easily. Venous malformations occur in 1% to 4% of patients and may vary from well-localized lesions to diffuse generalized ectasia. Intermittent pain can develop secondary to generalized thrombosis; analgesics are frequently prescribed for relief. Wedge resection is most appropriate for removal of this patient's small lesion on the chin. Other recommended procedures include sclerotherapy and surgical resection. Laser therapy can be used to remove small superficial lesions, and compression garments can be applied for lesions on the extremities. More invasive techniques are reserved for symptomatic malformations characterized by chronic pain, ulceration, and bleeding.

Arteriovenous malformations are generally pulsatile and not associated with pain. Surgery is often recommended because of the risk for hemorrhage. Capillary malformations (ie, port-wine stains), which involve the intradermal capillaries, are most frequently seen on the face and can be linked to other anomalies. Although lymphatic malformations appear as superficial lesions characterized by cutaneous vesicles, they are much deeper than their appearance, involving both the dermis and subcutaneous tissue.

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164

Which of the following muscles comprise the borders of the triangular space?

(A) Anterior border of the scapula, serratus anterior, and long head of the triceps muscles
(B) Latissimus dorsi, teres major, and teres minor muscles
(C) Medial border of the scapula, rhomboideus major, and rhomboideus minor muscles
(D) Triceps, teres major, and teres minor muscles

The correct response is Option D.

The triceps, teres major, and teres minor muscles comprise the borders of the triangular space. A knowledge of this region is essential to harvest the scapular and parascapular flaps, which receive their blood supply from the circumflex scapular artery. The pedicle of the parascapular flap arises from the triangular space and enters the deep surface of the flap.

The other muscles listed above can be identified in the region of the shoulder and trunk but do not define the triangular space.

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165

Which of the following proteins has been implicated in the pathogenesis of breast implant capsule formation?

(A) Albumin
(B) Fibrinogen
(C) Complement
(D) IgG

The correct response is Option B.

The surface-bound protein fibrinogen has been implicated in the generation of inflammatory responses to biomaterials (ie, implants); early protein absorption of these biomaterials mediates the foreign body response. Understanding the intricate pathways that result in fibrinogen absorption and its subsequent inflammatory response, leading to capsule formation, may aid in the prevention and management of breast implant capsular contracture.

Other dominant proteins in the body, such as albumin, complement, and immunoglobulin G (IgG), have not been shown to play a critical role in capsule formation resulting from foreign body reaction.

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166

A neonate has a 4 × 4-cm congenital defect of the scalp and underlying skull. The brain is visible beneath a gray membrane. Which of the following is the most appropriate initial management?

(A) Frequent application of silver sulfadiazine ointment
(B) Wet-to-dry dressing changes twice daily
(C) Biopsy of the wound margins
(D) Tissue expansion and coverage with scalp flaps

The correct response is Option A.

This neonate has cutis aplasia, or congenital absence of the layers of the skin and scalp that can also expand to include the skull. Conservative management is most appropriate; frequent application of silver sulfadiazine ointment and coverage with occlusive dressings will allow for wound healing. Some surgeons also advocate skin grafting over the exposed areas to prevent wound desiccation.

Use of dry dressings can actually result in desiccation of the dura and rupture of the sagittal sinus, a fatal complication. In patients with cutis aplasia, the wound must be kept moist at all times. Biopsy of the wound margins is not indicated because this patient does not have a malignant or premalignant condition. Tissue expansion is not required for this small wound, which will heal by secondary intention without reconstruction.

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167

In a patient who is undergoing dissection of a gracilis musculocutaneous flap, the gracilis muscle can be identified immediately posterior to which of the following muscles in the thigh?

(A) Adductor longus muscle
(B) Adductor magnus muscle
(C) Pectineus muscle
(D) Sartorius muscle

The correct response is Option A.

In order to effectively identify the gracilis muscle prior to flap harvest, the patient should be placed in the supine position with the knee in abduction. With the patient in this position, the adductor longus muscle can be palpated before surgery. Following incision, the gracilis muscle is easily identified posterior to the adductor longus.

The adductor magnus muscle lies posterior to the gracilis, and the pectineus muscle is found anterior to the adductor longus at the floor of the femoral triangle. The sartorius muscle overlies the gracilis muscle distally.

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168

Inadequate fluid resuscitation in a burn patient is most likely to result in which of the following conversion mechanisms?

(A) Zone of coagulation to zone of hyperemia
(B) Zone of coagulation to zone of stasis
(C) Zone of stasis to zone of coagulation
(D) Zone of stasis to zone of hyperemia

The correct response is Option C.

There are three zones of injury in burn patients. The zone of coagulation lies in the center of the wound and is characterized by irreversible tissue destruction. It is immediately surrounded by the zone of stasis, an area of decreased perfusion with demonstrated damage to the microvasculature. The surrounding zone of hyperemia sustains the least amount of damage.

During the first 48 hours following burn injury, patients who are not properly resuscitated are at increased risk for conversion of the zone of stasis to a zone of coagulation. In contrast, if appropriate resuscitation is begun immediately, the zone of stasis can be reversed, potentially preventing the development of necrosis.

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169

A 25-year-old woman who sustained the forearm avulsion shown in the photograph above subsequently underwent reconstruction using a free groin flap based on the superficial circumflex iliac artery. Which of the following best describes the vascular anatomy of this flap?

(A) The superficial circumflex iliac artery arises directly from the external iliac artery in approximately 85% of patients
(B) The superficial circumflex iliac artery arises from a common trunk, terminally splitting with the superficial inferior epigastric artery in approximately 70% of patients
(C) The superficial circumflex iliac and superficial inferior epigastric arteries have separate origins in approximately 40% of patients
(D) The superficial circumflex iliac artery is generally found approximately 1 cm below the inguinal ligament in approximately 70% of patients

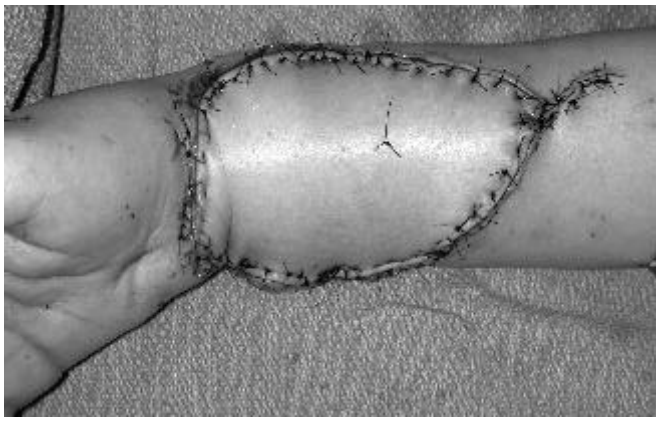
The correct response is Option C.

The free groin flap is typically an axially patterned flap that receives its vascularity by the superficial circumflex iliac artery, which arises from the common or superficial femoral artery and then traverses laterally, parallel to the inguinal ligament, typically 2 to 3 cm inferior to the ligament. Although it provides excellent thin soft-tissue coverage of

cutaneous defects and is associated with minimal donor site morbidity, especially in women, its use is limited by potential variations in vascular anatomy.

In 45% to 50% of persons the superficial circumflex iliac artery and superficial inferior epigastric artery arise from a common trunk, as shown in the figure on the left. In contrast, 40% to 45% of persons have a superficial circumflex iliac artery and superficial inferior epigastric artery that arise from separate origins, as shown in the figure on the right. The middle figure demonstrates a large superficial circumflex iliac artery without a superficial inferior epigastric artery, which is present in 10% to 15% of persons. In patients being considered for reconstructive procedures using the free groin flap, vascular anatomy can be determined preoperatively using Doppler ultrasonography.

In addition to its usefulness in coverage of cutaneous defects, as shown in the postoperative photograph below, the free groin flap can also be deepithelialized and transferred as soft-tissue fill in patients with Romberg's disease or hemifacial microsomia.



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170

A 33-year-old man who weighs 80 kg is brought to the emergency department eight hours after sustaining deep partial-thickness burns involving 25% total body surface area (TBSA) and full-thickness burns involving 15% TBSA. According to the Parkland formula, how many milliliters (mL) of crystalloid should be administered for initial fluid resuscitation over the next eight hours?

(A) 3200
(B) 6400
(C) 9600
(D) 12,800
(E) 16,000

The correct response is Option C.

In a patient who has a burn injury that covers more than 20% of the total body surface area (TBSA), acute fluid resuscitation should be performed with administration of crystalloid during the initial 24 hours after injury. The Parkland formula is used to estimate the amount of fluid required. According to this formula, lactated Ringer's solution 4 mL/kg/% TBSA burned should be administered during the first 24 hours. A total of 50% of the solution should be administered during the first eight-hour period and the remaining 50% over the next 16 hours.

An 80-kg patient who has burns involving 40% TBSA will require 12,800 mL of fluid during the first 24 hours: 6400 mL during the first eight hours and the remaining 3200 mL in both the second and third eight-hour periods. Because he received no fluid during the first eight hours immediately following injury, 9600 mL of crystalloid should be administered over the next eight hours in order to adequately resuscitate the patient.

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171

A 70-year-old woman has a firm, pink 1.2-cm nodule located anterior to the tragus. Histologic examination of an incisional biopsy specimen of the lesion shows Merkel cell carcinoma. Which of the following is the most appropriate management?

(A) Excision with 1-cm margins and ipsilateral neck dissection
(B) Excision with 1-cm margins, superficial parotidectomy, and ipsilateral neck dissection
(C) Excision with 3-cm margins
(D) Excision with 3-cm margins and ipsilateral neck dissection
(E) Excision with 3-cm margins, superficial parotidectomy, and ipsilateral neck dissection

The correct response is Option E.

The most appropriate management of this patient's Merkel cell carcinoma is excision with 3-cm margins followed by superficial parotidectomy and ipsilateral neck dissection. Merkel cell carcinoma is a rare cutaneous malignancy believed to arise from neuroendocrine cells within the skin. It typically occurs on the head, neck, and other sun-exposed areas in patients 50 to 70 years of age. Lymphatic and distant metastasis are common, and prognosis is poor; mortality rates as high as 67% have been reported. Excision of the tumor with margins of 2 to 5 cm is generally recommended; prophylactic neck dissection is advocated because approximately 50% of affected patients have positive regional nodes at the time of initial diagnosis. Because the parotid gland is a primary drainage basin for preauricular lesions, superficial parotidectomy should also be performed. Although radiation therapy can be performed adjuvantly, it is inadequate when used with excision alone.

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172

A Z-plasty revision procedure is to be performed for lengthening of a scar contracture. In order to achieve a theoretical 100% gain in the length, the angle of the Z-plasty should be how many degrees?

(A) 30
(B) 45
(C) 60
(D) 75
(E) 90

The correct response is Option D.

The Z-plasty is a technique in which pairs of triangular transposition flaps are created adjacent to a scar and then transposed across the scar, resulting in an increase in the length of the central limb and a change in the orientation of the scar. This technique can be used in patients undergoing burn reconstruction to lengthen linear scar contractures, disperse linear scars, and realign the scars within the lines of minimal tension. The actual amount of scar lengthening correlates directly with the angle and length of the flap limbs.

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173

A 45-year-old man has a painful lesion in the left conchal bowl. A biopsy specimen of the lesion shows chondrodermatitis nodularis helicis. Which of the following is the most appropriate management?

(A) Topical administration of retinoic acid
(B) Administration of acyclovir
(C) Administration of fluorouracil
(D) Administration of interferon
(E) Surgical excision of the lesion

The correct response is Option E.

Surgical excision is the most appropriate management of chondrodermatitis nodularis helicis, a painful erythematous nodule found on the helix, antihelix, or antitragus in persons older than 40 years. Although the cause of chondrodermatitis nodularis helicis is unknown, trauma, sun damage, and cold exposure may be mitigating factors. Men are more frequently affected. Because these lesions can become ulcerated, resulting in exposure of underlying cartilage, early surgical excision is recommended. Adjunctive removal of the underlying cartilage lessens the risk for recurrence, which is common at the borders of the resection. Other forms of therapy such as topical retinoic acid, acyclovir, fluorouracil, and interferon have not been proven effective. Intralesional injection of a corticosteroid has been helpful in some patients.

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174

After undergoing radical mastectomy of the left breast for management of breast carcinoma, a 40-year-old woman with obesity is scheduled for delayed reconstruction using a transverse rectus abdominis myocutaneous (TRAM) flap. Which of the following is the most likely sequela of a delayed TRAM flap procedure?

(A) Increased blood flow to the deep inferior epigastric artery
(B) Increased diameter of the superior epigastric artery
(C) Increased pressure within the superior epigastric vein
(D) Increased quantity of choke vessels
(E) Increased quantity of myocutaneous perforators

The correct response is Option B.

A delay procedure is appropriate for any patient considering TRAM flap reconstruction who has risk factors for flap loss, including obesity, a smoking history, a previous history of radiation therapy, or large volume requirements. A delayed procedure is typically performed in the outpatient setting and involves ligation of the deep and superficial inferior epigastric vessels, eliminating blood flow through the deep inferior epigastric artery. Studies of patients who have undergone this procedure demonstrated increased diameter and flow volume of the superior epigastric artery. The vascular structures within the flap are also dilated during the delay procedure. The choke vessels connect adjacent vascular regions and have been shown in animal studies to achieve maximum dilation 48 to 72 hours after surgery. Cell hypertrophy has been demonstrated within the walls of the choke vessels.

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175

A 53-year-old man has a chronic draining sinus of the perineal region one year after undergoing abdominoperineal resection of a low-lying rectal carcinoma followed by localized radiation therapy. Following debridement of the affected area, which of the following is the most appropriate management?

(A) Healing by secondary intention
(B) Primary closure
(C) Skin grafting
(D) Coverage with a fasciocutaneous flap
(E) Coverage with a muscle flap

The correct response is Option E.

In a patient who has a chronic, irradiated wound, the most appropriate management is coverage with a muscle or musculocutaneous flap with a vascular pedicle that lies outside the field of radiation, such as the gracilis flap. Secondary intention healing is unlikely to be successful in a radiated wound bed, and primary closure of a previously radiated, nonhealing wound will also not result in appropriate healing. Skin grafting will be ineffective due to the poor vascularity of the wound bed. A fasciocutaneous flap is less appropriate than a muscle flap to fill the dead space within the wound.

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176

In a patient who has just undergone skin grafting of a recipient wound bed, which of the following is the immediate mechanism of graft survival?

(A) Coaptation of the cut vessels in the graft to the vessels in the recipient bed
(B) Development of a fine network of capillaries from the vascularized bed of exposed bone or tendon
(C) Maintenance of a barrier of blood between the graft and recipient bed
(D) Peripheral ingrowth of the capillary buds into the skin graft
(E) Plasmatic imbibition

The correct response is Option E.

Following the application of a skin graft to a recipient wound bed, initial graft survival is dependent on nourishment provided by transudate from the wound bed through a process known as plasmatic imbibition. The vascularization process is believed to involve ingrowth of capillary buds from the wound edges and bed into the grafted skin. Skin

grafts will not take over exposed tendon or bone and are not adequate for coverage of vital structures. Because blood barriers have been demonstrated to be extremely potent, the development of a hematoma will result in graft loss even if infection is not present.

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177

A 32-year-old man has severe pain and swelling of both hands after being exposed to hydrofluoric acid while working with a rust remover. On examination, there is significant edema, mottling, and exquisite tenderness of the index, long, and ring fingers of both hands. Digital pulses are present on Doppler ultrasonography.

Following copious irrigation of the hands with water, which of the following is the most appropriate next step in management?

(A) Irrigation with 1% copper sulfate
(B) Topical application of phenol
(C) Application of a calcium sulfate splint
(D) Local injection of 10% calcium gluconate
(E) Debridement of the wounds and coverage with split-thickness skin grafts

The correct response is Option D.

This patient has sustained chemical burns to both hands after coming in contact with hydrofluoric acid, a corrosive material derived from elemental fluoride and used in rust removal and plastic and pottery manufacturing. Hydrofluoric acid burns can result in necrosis of soft tissues and decalcification of bone; affected patients can have pain that persists for days. The mechanism of action of this type of burn is due to the high concentration of hydrogen ions within the tissues, as well as liquefaction necrosis caused by the soluble free fluoride ion. Following copious irrigation of the burn site with water to remove as much of the hydrogen ion as possible, 10% calcium gluconate should be injected locally in multiple small doses to prevent vascular compromise. The calcium will bind to the fluoride ion, resulting in immediate relief of pain. A topical calcium gluconate paste can be applied in patients who have less severe burns, and intra-arterial injection is advocated for patients with more severe burns.

Copper sulfate is used for irrigation in patients with phosphorus burns to identify buried particles of phosphorus. Phenol should not be applied because it can be absorbed through intact skin and further worsen injury. In patients who have sustained phenol burn injuries, topical application of polyethylene glycol or vegetable oil is recommended. Similarly, calcium sulfate (eg, plaster of Paris) can result in exothermic burns when used in a splint or cast. Debridement with split-thickness skin grafting should be considered only after the extent of demarcation of the injury

is fully known; it may be necessary in patients who have persistent liquefaction necrosis, which manifests as unrelenting pain, even after treatment with calcium gluconate.

Reference

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178

Which of the following is the most common unfavorable result of lip augmentation with acellular dermal homograft?

(A) Exposure
(B) Hematoma
(C) Infection
(D) Rejection
(E) Resorption

The correct response is Option E.

Graft resorption has been reported as the most common complication of lip augmentation with acellular dermal homograft (Alloderm), a product derived from human cadaveric skin for use in soft-tissue augmentation. During harvest of the graft, the dermal and extracellular matrices are left intact, while the immunogenic components are removed. Alloderm can be used for skin grafting of burn wounds, nasal reconstruction, replacement of gingiva, and facial augmentation. Good results have been reported with the use of Alloderm for lip augmentation. Complications other than resorption, such as graft exposure or rejection, hematoma, and infection, have been reported to be minimal.

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179

In a patient who has a halo nevus, which of the following is the primary indication for surgical excision?

(A) Elimination of circulating antibodies
(B) Premalignant potential
(C) Prevention of leukoderma
(D) Relief of pain
(E) Resemblance to melanoma

The correct response is Option E.

Halo nevi, so called because of the distinct "halo" area of depigmentation surrounding the benign nevus, are typically seen on the trunk in teenagers and young adults. Histologic examination will show nevus cells surrounded by a band-like infiltrate of lymphocytes that may completely obliterate the lesion. Halo nevi have no known premalignant potential; however, because melanomas can also develop an irregular, incomplete halo, excisional biopsy should be performed for any halo nevus that becomes enlarged, asymmetric, or ulcerated or displays other characteristics similar to melanoma. The depigmentation around the nevus, known as leukoderma, is typically not painful. Although circulating antibodies to melanoma have been found in patients with halo nevi, this discovery alone is not an indication for nevus excision.

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180

A 33-year-old man has the onset of necrosis after sustaining a brown recluse spider bite. Dapsone 50 mg twice daily is prescribed for the next 14 days. Which of the following adverse effects is most likely to be seen in this patient?

(A) Diarrhea
(B) Diplopia
(C) Headache
(D) Hemolysis
(E) Peripheral neuropathy

The correct response is Option D.

The brown recluse spider (*Loxosceles reclusa*) is one of two species of North American spider capable of envenomation. It is generally found throughout the southern United States. This spider is believed to be nocturnal but may also be active during the day; it does not weave a web. Features include long slender legs and a distinctive fiddle-shaped marking on its dorsal cephalothorax. Both male and female brown recluse spiders are venomous.

Most patients are unaware that they have been bitten by this spider until pain develops or the wound becomes noticeable. Blistering, ischemia, and ulceration may be seen and can ultimately lead to necrosis.

Conservative treatment with administration of dapsone 100 mg daily for 14 days is advocated as the injury is often more extensive than initially thought. There is no antivenin to brown recluse spider venom. Dapsone is a leukocyte inhibitor that has both bacteriostatic and bacteriocidal properties and is frequently used in the treatment of leprosy. Hemolysis is the most common adverse effect of dapsone therapy. Because of the risk for hemolysis and other hematologic side effects, including methemoglobinemia, blood counts should be measured weekly. In addition, dapsone should not be administered to patients who have glucose-6 phosphate dehydrogenase deficiency.

Diarrhea, diplopia, headache, and peripheral neuropathy are not complications of dapsone therapy.

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181

A 36-year-old woman is being evaluated 17 years after undergoing augmentation mammaplasty with silicone gel implants. On examination, the implants are soft and minimally palpable; she reports no complications. This patient is at risk for which of the following?

(A) Implant rupture
(B) Increased silicon levels in breast milk
(C) Rheumatoid arthritis
(D) Scleroderma
(E) Silicone synovitis

The correct response is Option A.

This 36-year-old woman is at risk for implant rupture, which has been shown in recent studies to increase proportionately with the age of the implant. One retrospective study determined the mean age of implant rupture to be 13.4 years. MRI is most effective for assessing potential implant rupture, which in one study was reported in as many as 71% of implant patients. Another study showed that 50% of patients who had had implants for seven to 10 years showed evidence of rupture or hemorrhage on MRI.

Although attempts have been made to associate silicone gel implants to the onset of rheumatoid symptoms in children who were breast-fed, one study showed no difference in silicone levels measured in breast milk in women with implants versus controls. In addition, several large epidemiologic studies have shown no link between silicone gel implants and the subsequent development of either rheumatologic (ie, rheumatoid arthritis) or connective tissue (ie, scleroderma) diseases. Silicone synovitis occurs in patients who have silicone joint prostheses, but not in patients with silicone gel breast implants.

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182

A 50-year-old man has a keratoacanthoma on the left arm. He underwent removal of skin tumors on three previous occasions. His brother and father have had similar findings; the father subsequently died of a malignant tumor. Which of the following is the most appropriate diagnostic test?

(A) Bone scan
(B) Colonoscopy
(C) CT scan of the chest
(D) Panoramic radiograph
(E) Plain radiographs of the long bones

The correct response is Option B.

This patient has findings consistent with Muir-Torre syndrome, an autosomal dominant disorder that typically has its onset between the ages of 50 and 70 years. Multiple skin malignancies (eg, keratoacanthomas, basal and squamous cell carcinomas, adenocarcinomas) are characteristic. Because malignancies of the colon, kidneys, bladder, ovary, pancreas, and breast are also associated and may even be present prior to the appearance of skin lesions, diagnostic testing (such as colonoscopy) should be performed in any patient with multiple keratoacanthomas, especially in this patient who has a family history of similar findings. The other diagnostic tests listed above would not be effective in detecting malignancies associated with Muir-Torre syndrome.

References

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183

A 7-year-old boy has significant scar contractures of the anterior neck six months after sustaining a 20% total body surface area (TBSA) burn involving the neck, abdomen, chest, and axillae. He has previously undergone extensive skin grafting at a burn unit followed by splinting. Skin contractures are worsening despite physical therapy. Photographs are shown on the previous page.

Which of the following is the most appropriate management at this time?

(A) Coverage with a free parascapular flap
(B) Full-thickness skin grafting with postoperative splinting
(C) Multiple Z-plasties
(D) Split-thickness skin grafting with postoperative splinting
(E) Tissue expansion of the surrounding skin graft

The correct response is Option A.

Burn scars of the neck are particularly susceptible to the development of flexion contractures because a wide range of motion is required in this region and the skin overlying the neck is especially thin. Scarring results in functional impairment and often facial disfigurement by increasing the tension on the facial skin. Management of flexion contractures is often unsuccessful, and the contractures typically recur, as in this child who has already undergone skin grafting. Transfer of free tissue, such as a parascapular flap, will provide soft, pliable, elastic coverage and prevent the development of hypertrophic scarring.

Although full-thickness skin grafts are less likely to contract than split-thickness skin grafts, the risk for recurrent contracture is still present. In addition, coverage of the anterior neck would necessitate the harvest of an excess amount of skin for grafting. Multiple Z-plasties are used for smaller contractures but would not be appropriate for contractures of the entire anterior neck. Local flap transfer is often combined with the Z-plasties to produce optimal results. Postoperative splinting has been performed in the past but is associated with patient discomfort and the potential for breakdown of the burn scars on the chest. Tissue expansion of grafted skin is unlikely to provide significant laxity.

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184

An otherwise healthy 3-year-old boy has enlargement and elongation of the right upper extremity. On examination, there is a port-wine stain on the forearm and tortuous vessels on the arm. A thrill can be palpated in the area of the vessels. These findings are most consistent with which of the following syndromes?

(A) Maffucci's syndrome
(B) Parkes-Weber syndrome
(C) Proteus syndrome
(D) Rendu-Osler-Weber syndrome
(E) Sturge-Weber syndrome

The correct response is Option B.

This 3-year-old boy has findings most consistent with Parkes-Weber syndrome, an anomaly characterized by skeletal hypertrophy of one upper extremity with associated port-wine stains. Deep soft-tissue involvement, including capillary, lymphatic, and venous malformations, is also seen. Klippel-Trenaunay syndrome is similar to Parkes-Weber syndrome but instead involves the lower extremities.

Patients with Maffucci's syndrome have multiple enchondromas, most frequently affecting the hand, and venous malformations. The limbs are foreshortened. Approximately 20% of patients with Maffucci's syndrome will develop chondrosarcoma.

Proteus syndrome manifests as partial gigantism of the extremities. Hemifacial hemihypertrophy, macrocephaly, macrodactyly, localized exostoses, subcutaneous lipomas, and vascular malformations are also associated.
Patients with Rendu-Osler-Weber syndrome have multiple bright red telangiectasias affecting the face, fingertips, and mucosal surfaces of the gastrointestinal tract, bladder, and bronchial lining. Brain involvement can lead to the onset of seizures.

Sturge-Weber syndrome is associated with a large vascular malformation, usually a port-wine stain, in the distribution of the first and second branches of the trigeminal nerve (V_1 and V_2). Other findings include vascular anomalies of the choroid plexus and leptomeninges, focal motor seizures, and visual field defects, especially glaucoma. Mental retardation may also be seen.

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185

An otherwise healthy 5-year-old child who weighs 22 kg sustains a 3-cm laceration of the right arm in a fall. A 1% lidocaine solution is to be injected prior to suturing. What is the maximum safe dose of lidocaine that should be used in this patient?

(A) 5 mL
(B) 10 mL
(C) 15 mL
(D) 20 mL
(E) 25 mL

The correct response is Option B.

In otherwise healthy children older than 3 years of age who have normal lean body mass, the maximum safe dose of lidocaine (Xylocaine) that can be administered is determined by the child's age and weight. The maximum safe dosage in a 22-kg 5-year-old child is 22 multiplied by 4.5, or 100 mg of lidocaine. At a 1% concentration, which contains 10 mg lidocaine per milliliter (mL), the maximum dose is 10 mL, according to the manufacturer's recommendation.

Reference

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186

Which of the following modalities best delineates the extent of involvement of an arteriovenous malformation with its surrounding tissues?

(A) Angiography
(B) CT scan
(C) MRI
(D) PET scan
(E) Ultrasonography

The correct response is Option C.

Arteriovenous malformations are structural anomalies that develop during the fourth through sixth weeks of gestation secondary to inhibited development of the capillary network. These malformations are typically present at birth but may be seen initially in persons of all ages. Hormonal changes, such as those seen in puberty and adolescence, can result in progression of the lesion; its growth is thought to be caused by increased blood flow and expansion and not by cellular proliferation.

Although angiography has long been the standard for diagnosis of vascular lesions, defining their vascular anatomy and flow characteristics, this technique does not adequately delineate the involvement of the surrounding soft tissues.

Thus, MRI and magnetic resonance angiography (MRA) are currently recommended as noninvasive means of determining both the extent of the lesion and its flow characteristics. Because contrast enhancement and ionizing radiation are unnecessary, both MRI and MRA can be obtained in the same setting. Angiography is still reserved for delineation of large, highly vascular lesions that require preoperative embolization.

CT scan is used for bony evaluation but is now secondary to MRI as the diagnostic procedure of choice. PET scan is not effective in evaluating vascular malformations. Doppler ultrasonography may be performed in conjunction with MRI to determine the lesion's flow characteristics but is not used alone.

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187

A 54-year-old woman undergoes excisional biopsy of a 6-mm papule from the right alar crease followed by direct closure of the wound. Histologic examination of a biopsy specimen of the lesion shows sclerosing basal cell carcinoma with positive deep margins.

Which of the following is the most appropriate next step in management?

(A) Observation and follow-up examination every two months
(B) Postoperative radiation therapy
(C) Reexcision with 5-mm margins and immediate reconstruction
(D) Reexcision with 1-cm margins and immediate reconstruction
(E) Mohs' micrographic surgery and immediate reconstruction

The correct response is Option E.

This patient has many risk factors for recurrence of her basal cell carcinoma, indicating the need for surgical removal. The lesion is located within the "H" zone of the face (defined as the upper lip, nose, periocular regions, and temporal and preauricular areas) which is associated with an increased risk for local recurrence. In addition, because the sclerosing and morpheaform types of basal cell carcinoma are more prone to recur, pathologic evaluation of the margins is indicated prior to reconstruction, especially in this patient who has positive deep margins. Therefore, Mohs' micrographic surgery is recommended to excise this high-risk carcinoma and provide tissue for immediate horizontal frozen section analysis. This technique is associated with a high cure rate in patients with recurrent or large tumors, poorly differentiated or aggressive histologic-type lesions, and tumors with positive margins and/or perineural invasion. Standard frozen section analysis may also be considered in this patient.

Although observation has been advocated in the past for the less aggressive variants of basal cell carcinoma (ie, not sclerosing and morpheaform variants), excision is now advocated because the recurrence rate has been shown to be

high. Radiation therapy is appropriate only adjuvantly or as a first-line treatment in patients who are not surgical candidates.

References

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188

Injection of autologous fat at which of the following sites is associated with increased risk for fat embolism and subsequent blindness and/or central nervous system damage?

(A) Forehead
(B) Glabella
(C) Lateral orbit
(D) Nasolabial fold
(E) Tear trough

The correct response is Option B.

Although injection of autologous fat during aesthetic and reconstructive procedures is typically a safe procedure, adverse effects, such as fat embolism and central nervous system damage, have been reported. The surgeon should be particularly cautious when injecting fat into the glabellar region, as the ophthalmic artery, which connects directly to the glabellar vasculature, can be inadvertently divided. Methods to help minimize complications of fat injection include the use of blunt tip large bore cannulas, as well as retrograde injection techniques.

Although the risk for injury exists with injection into the periorbital and nasal regions, it is less than that seen with injection into the glabellar region. Injection into the region of the frontalis muscle (ie, forehead), or into crow's feet in the region of the lateral orbit, a tear trough, or the nasolabial fold is associated with a lower risk for fat embolism than injection into the glabellar region.

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189

What percentage of hemangiomas are noted in the first month of life?

(A) 20%
(B) 40%
(C) 60%
(D) 80%
(E) 100%

The correct response is Option D.

Approximately 80% of hemangiomas are noted in the first month of life. Hemangiomas are the most common tumors of infancy; their incidence at birth ranges from 1% to 3%, and nearly one-third are noted before the neonate is discharged from the nursery. Boys are reportedly three times more likely than girls to be affected. Approximately 60% of hemangiomas occur in the head and neck region.

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190

Which of the following lesions is most likely to contain malignant cells?

(A) Acrochordons
(B) Cutaneous horn
(C) Dermatofibroma
(D) Molluscum contagiosum
(E) Seborrheic keratosis

The correct response is Option B.

Cutaneous horns are most likely to contain malignant cells. These hard, cone-shaped cutaneous projections are typically caused by excessive epidermal growth and retention of keratin. Although cutaneous horns are most frequently associated with benign irregularities, approximately 20% are associated with premalignant lesions, and nearly 15% are associated with squamous cell carcinoma. Therefore, in patients with cutaneous horns, shave biopsy should be performed initially to exclude any underlying malignancy.

Acrochordons are simple skin tags not linked to malignancy. Dermatofibromas are benign, localized, fibrous tumors contained within the dermis that can develop following trauma. Molluscum contagiosum are virally induced papules

commonly seen in children and young adults and may be associated with sexual transmission. Seborrheic keratoses are benign keratinocytic tumors seen in patients older than 30 years of age. Although these lesions often affect sun-damaged areas, they do not contain malignant cells.

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191

In a patient undergoing lip enhancement using sheet acellular dermal homograft, which of the following is the correct anatomic placement of the graft?

(A) Subdermal placement along the white roll of the lip
(B) Subdermal placement along the wet/dry vermilion border of the lip
(C) Submucosal placement along the white roll of the lip
(D) Submucosal placement along the wet/dry vermilion border of the lip
(E) Intramuscular placement

The correct response is Option D.

Following adequate anesthesia, sheet acellular dermal homograft (Alloderm) should be placed submucosally along the wet/dry vermilion border of the lip. In order to effectively enhance the lips, the surgeon should first place bilateral incisions approximately 0.5 cm from the commissure on both the upper and lower lips; this will allow for tunneling of the Alloderm along this border. After the Alloderm is placed, the lip is stretched, allowing proper sealing of the graft. The ends should then be tapered and placed in a submucosal pocket near the commissure. Suturing is associated with the development of dynamic lip deformities and thus should not be performed.

Because subdermal placement is too superficial, the patient will be predisposed to the development of contour irregularities if the implants are placed at this level. Submucosal placement of the Alloderm along the white roll will result in unnatural lip aesthetics. Alloderm should not be placed within the muscle.

References

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2. Tobin HA, Karas ND. Lip augmentation using an alloderm graft. *J Oral Maxillofac Surg*. 1998;56:722-727.

192

In children, Spitz nevi are most frequently found at which of the following sites?

(A) Head and neck
(B) Upper extremities
(C) Trunk
(D) Genitalia
(E) Lower extremities

The correct response is Option A.

The Spitz nevus was first described in 1948 when one researcher found that several children who had been previously diagnosed with melanoma were still alive at follow-up examinations as long as 13 years later. As a result, these lesions became known as benign melanomas. Although the diagnosis of Spitz nevus may be difficult to determine both clinically and pathologically, these are most commonly considered benign lesions. They are usually small, often less than 6 cm in diameter, and nodular, and may be multiple. In children, Spitz nevi are most commonly located in the head and neck region and first appear between ages 5 and 10 years. In adults, these lesions are most frequently found on the extremities.

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193

Hutchinson's freckle is another name for which of the following types of melanoma?

(A) Acral-lentiginous
(B) Lentigo maligna
(C) Mucosal
(D) Nodular
(E) Superficial spreading

The correct response is Option B.

Hutchinson's freckle is a misleading term for lentigo maligna melanoma, a melanoma in situ that is found within the layers of the epidermis only. This lesion typically occurs in fair-skinned, elderly persons and manifests as a macule or patch of darkened skin on the face or other sun-exposed areas. Although 5% to 10% of all melanomas can be classified as lentigo maligna, the risk for development of invasive melanoma in affected patients has been shown to range from 5% to 30% in various studies. Slow growth, often for a period of 10 to 20 years, is common initially and is then followed by an aggressive, invasive phase.

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194

Administration of which of the following reverses the potential for development of premalignant lesions?

(A) Oxybenzone
(B) Padimate
(C) Para-aminobenzoic acid
(D) Retinoids
(E) Zinc oxide

The correct response is Option D.

Retinoids, which are natural derivatives of vitamin A, have been shown to reverse the formation and growth of actinic keratoses. Because approximately 5% of these lesions will undergo transformation into nonmelanotic malignancies, topical application of retinoids is recommended to reverse cutaneous actinic damage, resulting in a return to normal skin in the affected areas.

Para-aminobenzoic acid, padimate, oxybenzone, and zinc oxide are sunscreen ingredients that limit the effects of ultraviolet-A and/or ultraviolet-B light but do not treat potentially premalignant lesions.

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195

Which of the following arteries provide(s) the primary vascular supply to the gastrocnemius muscle?

(A) Inferior genicular arteries
(B) Peroneal artery
(C) Posterior tibial artery
(D) Superior genicular arteries
(E) Sural arteries

The correct response is Option E.

The sural arteries, which arise from the popliteal artery above the knee, provide the primary vascular supply to the gastrocnemius muscle. Knowledge of the vascular anatomy is especially critical for management of patients with peripheral vascular disease, in which the vessels below the level of the popliteal artery are affected. Because the vascularity of the gastrocnemius muscle is derived from a level above the popliteal artery, use of the gastrocnemius muscle is not necessarily contraindicated.

The inferior genicular, middle genicular, and superior genicular arteries also arise from the popliteal artery. The medial and lateral inferior genicular arteries are found on the popliteus muscle and beneath the head of the corresponding gastrocnemius muscle. These arteries form a portion of the anastomotic network surrounding the knee. The middle genicular artery courses directly anterior to the popliteal artery and pierces the oblique popliteal ligament; it supplies blood to the knee. The medial and lateral superior genicular arteries, which are also part of the anastomotic network of the knee, pass medially and laterally above the corresponding condyles of the femur and head of the gastrocnemius and deep to the hamstrings.

The peroneal artery arises from the posterior tibial artery, which is a terminal branch of the popliteal artery located at the lower border of the popliteal muscle. Although the posterior tibial artery is considered to be the supplier of vascularity to the posterior compartment, it does not supply the gastrocnemius muscle.

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196

Which of the following best describes a hemangioma?

(A) Aplasia
(B) Dysplasia
(C) Fibroplasia
(D) Hyperplasia
(E) Metaplasia

The correct response is Option D.

Hemangiomas are vascular lesions that enlarge through a process of rapid cellular proliferation known as hyperplasia. These lesions have an increased rate of cellular turnover uncommon to all other vascular malformations. Instead, vascular malformations, which can be classified as arterial, capillary, lymphatic, or venous, have structural anomalies not present in hemangiomas.

Aplasia describes the lack of development of an organ or tissue; dysplasia refers to an abnormality in the developmental process. Fibroplasia is the formation of fibrous tissue. Metaplasia describes a change in the type of adult cells within a tissue to another form of cells not normal for that tissue.

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197

Which of the following is most characteristic of an amateur tattoo?

(A) Irregular penetration of the dye in the superficial dermis
(B) Large pigment particles (50 μm)
(C) Organometallic pigments
(D) Penetration of the dye confined to the epidermis
(E) Uniform penetration of the dye in the deep dermis

The correct response is Option A.

Amateur tattoos are most frequently characterized by irregular penetration of the ink within the superficial dermis. This type of tattoo is popular because it is inexpensive and easily created using ink and a needle. Blue and black dyes are generally used. Pigment particles within the tattoo are small, typically 5 µm or less.

Professional tattoos are more likely to have brightly colored dyes and large pigment granules (greater than 50 µm). There is a consistently uniform depth of penetration within the deep dermis.

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198

Which of the following is NOT an indication for Z-plasty?

(A) Adjusting soft-tissue contour
(B) Dispersing linear scars
(C) Lengthening linear scar contractures
(D) Preventing burn scar contractures

The correct response is Option D.

The Z-plasty is a fundamental plastic surgery technique that involves the elevation and interposition of two equal, interposed triangular skin flaps. This procedure can be used to improve soft-tissue contour via reorientation of skin, realign scars within the lines of minimal tension, and lengthen linear scar contractures. However, it is not performed for prevention of burn scar contractures.

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199

Which of the following syndromes is NOT associated with capillary malformations?

(A) Kasabach-Merritt syndrome
(B) Klippel-Trenaunay syndrome
(C) Parkes-Weber syndrome
(D) Sturge-Weber syndrome

The correct response is Option A.

Kasabach-Merritt syndrome is a disorder characterized by profound thrombocytopenia associated with a solitary hemangioma or diffuse hemangiomatosis. Capillary malformations, or port-wine stains, are not seen. Systemic heparin should not be administered to patients with Kasabach-Merritt syndrome because of the associated risk for exacerbation of bleeding diatheses. Instead, appropriate management includes embolization or compression of lesions, interferon therapy, radiation therapy, and systemic administration of corticosteroids.

All of the other syndromes are associated with port-wine stains. Klippel-Trenaunay syndrome is characterized by a port-wine stain, typically involving one extremity, overlying venous and lymphatic malformations. Skeletal hypertrophy may also be seen. Although patients with Parkes-Weber syndrome have findings similar to Klippel-Trenaunay syndrome, arteriovenous fistulas are a distinguishing feature. Port-wine stains are most frequently seen in conjunction with Sturge-Weber syndrome. The malformation usually occurs in the distribution of the first and second branches of the trigeminal nerve (V_1 and V_2), and is associated with focal motor seizures, hemiparesis, and visual field defects, especially glaucoma. Mental retardation may result from leptomeningeal venous malformations.

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200

In a 50-year-old woman who has a history of allergic reaction to tetracaine, which of the following anesthetics should NOT be used?

(A) Bupivacaine
(B) Etidocaine
(C) Lidocaine
(D) Mepivacaine
(E) Procaine

The correct response is Option E.

All local anesthetics can be classified as either ester- or amide-type. Ester-type local anesthetics, including procaine, benzocaine, chloroprocaine, and tetracaine, can produce allergic reactions. These anesthetics are metabolized by pseudocholinesterase, forming para-aminobenzoic acid (PABA). This compound triggers antibody formation and lymphocyte stimulation to elicit a hypersensitivity reaction. In one study of patients who had no known history of allergy to local anesthetics, 30% of patients developed a positive skin reaction following intradermal injection of an ester-type anesthetic.

Amide-type local anesthetics, including bupivacaine, etidocaine, lidocaine, and mepivacaine, are used more frequently for local infiltration than ester-type agents. These are stable solutions that do not cause true allergic reactions. Any "allergic" reaction to amide-type local anesthetics is most likely caused by methylparaben, a preservative that is structurally related to PABA. Preservative-free local anesthetics are currently available for use in any patient who has sensitivity to methylparaben. In the same study mentioned above, there were no allergic reactions to the amide-type agents. A trick to help remember which complexes belong to which group is that all amides have an "i" in the prefix before the "caine" (ie, bupivacaine, etidocaine, lidocaine, and mepivacaine).

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201

Which of the following compounds should NOT be used for skin preparation prior to surgery?

(A) Alcohol
(B) Chlorhexidine gluconate
(C) Glutaraldehyde
(D) Hexachlorophene
(E) Povidone-iodine

The correct response is Option C.

Although glutaraldehyde (Cidex) has antimicrobial, bactericidal, tuberculocidal, fungicidal, sporicidal, and virucidal properties, it can significantly damage the skin and thus should not be used for skin preparation in a patient who is to undergo surgery. It is used instead as a disinfectant for endoscopes, rubber masks, and other medical equipment. This agent has a pH of 7.5 to 8.5 and is effective even in the presence of organic material. If inadvertent contact with skin does occur, irrigation should be performed immediately.

Alcohol is an effective antiseptic that has been used for many years. It is bactericidal and does not irritate the skin. Bacterial spores are typically resistant to alcohol.

Chlorhexidine gluconate (Hibiclens) is a antimicrobial agent that demonstrates a wide range of action against gram-positive, gram-negative, and *Pseudomonas* organisms. Hypersensitivity reactions have been associated. This agent should not be used for skin preparation on the face because of the risk for permanent eye injury.

Hexachlorophene (pHisoHex) is a bacteriostatic agent that is active against staphylococci and other gram-positive bacteria. Cumulative antibacterial action has been shown to develop with repeated use. However, this agent should

not be used in premature infants with a gestational age of younger than 35 weeks or a body weight of less than 1200 g because of the risk for systemic absorption and subsequent development of white-matter brain lesions.

Povidone-iodine (Betadine) is a water-soluble mix in which the iodine is diluted to be less irritating while maintaining its bactericidal activity. Very dilute solutions (ie, 0.5%) have been described as safe for use in ophthalmic surgery.

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HAND AND EXTREMITIES — 1998

1

Treatment of digital ischemia with localized sympathectomy involves which of the following procedures?

(A) Dissection of the epineurium of the digital nerves
(B) Dissection of the perineurium of the digital nerves
(C) Removal of the adventitia of the digital arteries
(D) Removal of the adventitia and media of the digital arteries

The correct response is Option C.

A digital artery sympathectomy is a localized sympathectomy that is used as treatment for patients with digital ischemia or sympathetic mediated vasospasm unresponsive to conventional medical therapy. The technique involves the microsurgical removal and dissection of the adventitia of the digital arteries of the affected digit, where the sympathetic fibers lie. The media is not removed.

Other options such as dissection of the epineurium or perineurium of the digital nerves would have no effect on the sympathetic fibers.

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2

The plantaris muscle belly is located in which of the following muscle compartments of the lower leg?

(A) Anterior
(B) Lateral
(C) Deep posterior
(D) Superficial posterior

The correct response is Option D.

The plantaris muscle and tendon of the lower extremity comprise a vestigial muscle tendon complex that is analogous to the palmaris muscle and tendon of the upper extremity. The plantaris muscle may be harvested easily through the use of a tendon stripper inserted at the medial ankle. A tendon of approximately 25 to 35 centimeters may be harvested. The plantaris muscle belly is found in the superficial posterior muscle compartment along with the gastrocnemius and soleus muscles. The plantaris muscle rises from the lower lateral supracondylar line of the femur immediately above the lateral head of the gastrocnemius muscle and from the oblique popliteal ligament. It is a short (10 cm) muscle belly and the tendon runs between the gastrocnemius and soleus muscles and then along the medial border of the calcaneal tendon to insert into the calcaneus and plantar fascia.

The anterior (extensor) compartment contains the tibialis anterior, extensor digitorum longus, and extensor hallucis longus. The lateral (peroneal) compartment contains the peroneus longus and brevis. The deep posterior (flexor) compartment consists of the flexor hallucis longus, flexor digitorum longus, and tibialis posterior.

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3

A 30-year-old woman with systemic lupus erythematosus has swelling, morning stiffness, and pain with motion in both hands. Examination shows subluxation of the basilar joints of both thumbs. Which of the following is the most likely cause of the thumb deformities?

(A) Extensor tenosynovitis
(B) Flexor tenosynovitis
(C) Joint destruction
(D) Ligamentous laxity

The correct response is Option D.

Systemic lupus erythematosus (SLE), an autoimmune disorder that produces anti-cell nucleus antibodies, has a number of clinical presentations. The arthralgia and arthritis experienced by this patient constitute the most common musculoskeletal manifestations of SLE. Acute arthritis typically involves the wrist and small hand joints and may be migratory or persistent and chronic. Most cases are symmetric, but some involve asymmetric polyarthritis. The involved joints are swollen, more painful with motion, and stiff in the morning. The disease process directly affects the periarticular ligaments and surrounding soft tissue rather than the articular cartilage within joints. There is no aggressive intra-articular pannus formation, so the articular cartilage is grossly normal. The joints usually become deformed, not from joint destruction but from ligamentous laxity, making this the hallmark of SLE. This pattern of deforming but nonerosive disease is also known as Jaccoud's arthritis.

Because of high recurrence rates of deformities in patients with SLE after implant arthroplasty or soft-tissue reconstruction of the thumb basilar joints, these procedures are not indicated. Despite relatively preserved articular surfaces seen on radiographs, arthrodeses of the thumb basilar joint is often necessary to control thumb deformities in patients with SLE. Treatment is further complicated for SLE patients with septic arthritis or osteonecrosis.

Tenosynovitis, or inflammation of synovium along tendon sheaths, can lead to erosion of tendon substance or impair tendon excursion. While flexor or extensor tenosynovitis sometimes occur in SLE, severe substantial synovitis is unusual.

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4

A 35-year-old man lacks sensation in the first dorsal web space of the foot after sustaining a high-grade fracture of the midtibia. Which of the following nerves is most likely injured?

(A) Deep peroneal
(B) Lateral plantar
(C) Saphenous
(D) Sural

The correct response is Option A.

This patient has an injury of the terminal branch of the deep peroneal nerve, which innervates the adjacent side of the great and second toes. The deep peroneal nerve arises from the bifurcation of the common peroneal nerve between the fibula and peroneus longus in the lateral compartment, then continues deep to the extensor digitorum longus to the anterior surface of the interosseous membrane. It meets the anterior tibial artery in the proximal third of the leg and continues with it distally, passing deep to the extensor retinaculum and medial to the dorsalis pedis artery. It enters the dorsum of the foot, where it divides into terminal, medial, and lateral branches.

The superficial peroneal nerve divides into medial and lateral branches. The medial branch innervates the medial aspect of the great toe and adjacent side of the second and third toes. The lateral branch innervates the contiguous sides of the third through fifth toes.

The lateral plantar nerve supplies sensation to the fifth and lateral half of the fourth toe. It is a terminal branch of the tibial nerve.

The saphenous nerve innervates the medial aspect of the foot, while the sural nerve innervates the dorsolateral aspect.

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5

A 40-year-old woman has pain in the dorsum of the right thumb that has not responded to immobilization or corticosteroid injections. The pain is exacerbated by ulnar deviation of the wrist with the thumb clenched in the palm. Tinel's sign is negative. Radiographs are normal.

The most appropriate treatment is release of which of the following tendons?

(A) Abductor pollicis longus and extensor carpi radialis longus
(B) Abductor pollicis longus and extensor pollicis brevis
(C) Extensor carpi radialis brevis and longus
(D) Extensor pollicis brevis and extensor pollicis longus
(E) Extensor pollicis longus only

The correct response is Option B.

This patient has de Quervain's tenosynovitis, or stenosing tenosynovitis of the first dorsal compartment of the wrist. The typical patient with this condition is a middle-aged woman, although men are also affected. Physical findings of de Quervain's tenosynovitis include a positive Finkelstein's test (ulnar deviation of the wrist with the thumb held inside a clenched fist), pain and swelling localized over the first dorsal compartment, crepitus with movement of the tendons, and pain with resisted extension of the thumb interphalangeal (IP) and carpometacarpal (CMC) joints.

The components of the extensor wrist compartments are listed below.

First dorsal compartment: abductor pollicis longus and extensor pollicis brevis
Second dorsal compartment: extensor carpi radialis longus and brevis
Third dorsal compartment: extensor pollicis longus
Fourth dorsal compartment: extensor indicis proprius and extensor digitorum communis
Fifth dorsal compartment: extensor digiti quinti proprius
Sixth dorsal compartment: extensor carpi ulnaris

Because de Quervain's tenosynovitis involves the first dorsal compartment, the abductor pollicis longus and extensor pollicis brevis should be released. Frequently, the abductor pollicis longus will have two to three slips. The extensor pollicis brevis is within its own subcompartment. The superficial sensory radial nerve should be carefully protected.

de Quervain's tenosynovitis is often difficult to differentiate from basal joint arthritis. Both occur frequently in middle-aged women, and they can occur simultaneously. A positive grind test or pain localized to the CMC joint on the palmar side of the hand is more likely to be caused by arthritis. A Finkelstein's test can be positive in patients with basal joint arthritis.

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6

Which of the following arteries supplies blood to a pedicled groin flap?

(A) Deep circumflex iliac
(B) Deep inferior epigastric
(C) Lateral femoral circumflex
(D) Superficial circumflex iliac
(E) Superficial inferior epigastric

The correct response is Option D.

Despite clinical drawbacks such as bulkiness and the need for the second stage to divide, the pedicled groin flap remains a viable reconstructive option. Its main landmarks are the pubic tubercle and the anterosuperior iliac spine.

The blood supply to the pedicled groin flap comes from the superficial circumflex iliac artery (SCIA), a branch of the femoral artery. The SCIA is located two finger widths below the junction of the inguinal ligament and the femoral artery. The upper border of the pedicled groin flap is identified medially two finger widths above the inguinal ligament parallel to the SCIA. The lower border is also parallel to the SCIA, two finger widths below the SCIA origin. Laterally, length-to-width ratios should be kept 1:1 beyond the anterosuperior iliac spine because of the random nature of the blood supply.

To ensure protection of the SCIA, dissection should begin laterally and include the sartorius fascia. Free tissue transfer is possible. However, vessel diameter may be too small for safe microvascular anastomosis.

The deep circumflex iliac artery supplies the iliac crest osteocutaneous flap. The deep inferior epigastric artery and the superior epigastric artery supply the rectus abdominis flap. The lateral femoral circumflex artery supplies the rectus femoris and vastus lateralis muscles. The superficial inferior epigastric artery supplies the inferior epigastric skin flap.

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7

Which of the following is the most likely diagnosis for a 1-year-old child with an isolated flexion deformity of the proximal interphalangeal joint?

(A) Arthrogryposis
(B) Camptodactyly
(C) Clinodactyly
(D) Poland's syndrome
(E) Symphalangism

The correct response is Option B.

This patient with an isolated flexion deformity of the proximal interphalangeal joint most likely has congenital camptodactyly. This nontraumatic flexion deformity has a predilection for the little finger and tends to be nonprogressive after puberty. Splinting may improve mild deformities and prevent moderate deformities from progressing. Surgery is indicated if marked contracture interferes with function.

In patients with arthrogryposis, both active and passive motion may be limited in all joints of the upper extremities. In severe cases, the shoulders are fixed in adduction and are internally rotated. The elbows can be rigid in either flexion or extension, but the wrists are usually flexed and ulnarly deviated with the forearm and hand in pronation. The fingers are often stiff, and the thumb is clutched in the palm.

Clinodactyly, a deviation of a digit in a radioulnar direction, is caused by an abnormally shaped bone that may be triangular or trapezoidal instead of rectangular. The middle phalanges are the most commonly involved bones.

Poland's syndrome is characterized by absence of the sternocostal head of the pectoralis major muscle, hypoplasia of the arm and forearm, and brachysyndactyly of the hand.

Symphalangism is congenital stiffness of the finger, usually involving the PIP joint. The joint is actively and passively stiff in extension, and the middle phalanx is usually short and deformed. The affected joint may demonstrate undifferentiated capsular or ligament apparatus, cartilage, or bony ankylosis.

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8

A 24-year-old man sustains a gunshot wound to the dominant right forearm. After immediate debridement of the wound, the surgeon notes that primary repair of a transected ulnar nerve will not be possible without anterior transposition because of loss of length. To prevent future compression on the ulnar nerve, which of the following anatomic structures should be released?

(A) Arcade of Frohse
(B) Fibrous arch of the flexor digitorum superficialis muscle
(C) Ligament of Struthers
(D) Medial intermuscular septum
(E) Vascular leash of Henry

The correct response is Option D.

When the ulnar nerve is transposed anteriorly at the elbow, the surgeon must pay careful attention to surrounding anatomic structures to prevent kinking of the ulnar nerve and the subsequent development of neuritis. Transposition may be subcutaneous, submuscular, or intramuscular. In this patient, the medial intermuscular septum must be excised completely to prevent future compression.

The Arcade of Frohse and the vascular leash of Henry are potential sources of compression of the radial nerve.

The fibrous arch of the flexor digitorum superficialis muscle can compress the anterior interosseous branch of the median nerve.

The ligament of Struthers, which envelops the median nerve at the humerus, is a potential site of compression of that nerve.

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9

Which of the following is the function of the Merkel cell-neurite complex?

(A) Arteriovenous regulation
(B) Constant touch and pressure
(C) Moving touch
(D) Nociception
(E) Vibration

The correct response is Option B.

The Merkel cell-neurite complex, located just deep to the glabrous skin of the palmar side of the finger, is a slowly adapting nerve fiber receptor that transmits constant touch and pressure sensation. Also found exclusively deep to the glabrous skin are the Meissner's and pacinian corpuscles, which mediate moving touch and vibration within specific frequency ranges. In nonglabrous skin, sensory receptors for moving touch and vibration are located at the base of the hair follicles, as are the quickly and slowly adapting receptors (lancinate and Ruffini end organs).

The glomus body is an arteriovenous anastomosis located in the reticular layer of the dermis that has a role as a peripheral vasoregulator engaged in the control of peripheral body temperature.

The receptors for pain stimulus (nociception) are unencapsulated free nerve endings of A-delta and C afferents located in various body tissues.

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10

A 50-year-old woman with scleroderma has deformities of the ring and little fingers of the dominant hand. Examination shows the proximal interphalangeal (PIP) joints fixed in 90 degrees of flexion with ulcers on their dorsal aspects. Photographs are shown above. Which of the following is the most appropriate management?

(A) Coverage of the ulcers with a cross-finger flap
(B) Implant arthroplasty of the involved joints
(C) Arthrodesis of the involved joints in moderate flexion
(D) Capsulotomy of the involved joints
(E) Amputation of the involved fingers

The correct response is Option C.

Raynaud's phenomenon and fingertip ulcers are the most common findings in patients with scleroderma (systemic sclerosis). Some patients also develop progressive joint contractures, including adduction contractures of the thumb and fixed flexion contractures of the PIP joints with secondary extension contractures of the metacarpophalangeal (MP) joints. Ulceration secondary to ischemia occurs over the PIP joints from pressure and from minor trauma. Mild contractures are treated with physical therapy. However, as the process progresses, surgical treatment is often necessary.

The most appropriate treatment of this patient is arthrodesis of the PIP joints into a more functional position, approximately 45 degrees of flexion. Bone shortening performed during the arthrodesis allows closure of the ulcers.

Coverage of the wound with a cross-finger flap does not address the position of the PIP joints. In fact, it may worsen the problem of joint contractures. This procedure is likely to fail in any case in a patient with Raynaud's phenomenon.

Implant arthroplasty would not be indicated in this case, in part because of the overlying ulcer but mainly because of the poor range of motion achieved and the high incidence of postoperative wound complications.

Capsulotomy does not address the primary disease process of progressive fibrosis, central slip attenuation, and lateral band subluxation.

Because the fingers can provide useful function in an appropriate position when fused, amputation is unnecessary.

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11

A 40-year-old man has generalized pain of his dominant hand one month after surgical release of a trigger finger affecting the middle digit. The hand is swollen and moist to the touch. There is minimal active motion of the fingers, and the finger joints are stiff on attempted passive motion. The pain is exacerbated by light touch both directly over and away from the incision.

Which of the following is the most appropriate next step in management?

(A) Range of motion exercises
(B) Antibiotic therapy
(C) Immobilization in an intrinsic-plus splint for three weeks
(D) Injection of corticosteroids into the finger flexor tendon sheath
(E) Iontophoresis

The correct response is Option A.

This patient most likely has reflex sympathetic dystrophy (RSD), a dystrophic pain response. Clinical hallmarks include diffuse pain, loss of hand function, and sympathetic dysfunction. The most appropriate management is a program of active and passive range of motion exercises. To prevent the development of frozen shoulder, a common complication of RSD, it is important for the patient to include the entire extremity in this exercise program. Other therapeutic steps that might also be necessary include stellate ganglion block(s) and administration of drugs that decrease sympathetic tone or improve nutritional blood flow by decreasing abnormal arteriovenous shunting.

The overall symptom complex and the length of time that has elapsed since this patient's surgery make infection an unlikely cause of his condition. Therefore, antibiotic therapy is not indicated.

Immobilization in a splint or cast is contraindicated because it would increase joint stiffness.

Because symptoms are generalized over the entire hand, local corticosteroid injections are not indicated. However, systemic corticosteroids are sometimes administered to treat intractable cases of RSD.

Iontophoresis is a modality for transcutaneous delivery of medication such as corticosteroids. It is used by therapists to treat localized areas of tendon irritation. Consequently, it would be inadequate for this patient's problem.

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12

A 2-year-old African American girl has had fever and irritability for the past three days. Examination shows swelling and tenderness of the right index finger and both feet. Temperature is 37.7EC (100EF). Hematocrit is 22% and leukocyte count is 18,000/mm^3. Which of the following tests is most likely to confirm the diagnosis?

(A) C-reactive protein
(B) Cultures of blood and joint fluid aspirate
(C) Differential leukocyte count
(D) Hemoglobin electrophoresis
(E) Radiographs of the hands and feet

The correct response is Option D.

Sickle cell dactylitis, or hand and foot syndrome, affects 10% to 20% of children who have sickle cell disease, with some studies reporting an incidence of up to 80%. It can occur in SS or SC disease as well as sickle thalassemia.

Characteristics of this syndrome include swelling of the hands, feet, and shoulders. The condition can be mistaken for osteomyelitis. Children from age 6 months to 2 years are most commonly affected, and it rarely appears after age 4 years. Onset is sudden. Findings include fever, mild anemia, and leukocytosis. The condition is self-limiting, and spontaneous improvement can be expected without medical or surgical treatment, although symptoms may last from several days to one month.

Physicians who evaluate African American children with these symptoms should consider sickle cell dactylitis as a possible diagnosis and order sickle cell screening and hemoglobin electrophoresis. A peripheral blood smear usually contains sickled cells, and hemoglobin electrophoresis will detect the presence of hemoglobin S or C. The most appropriate treatment is bed rest until symptoms subside.

C-reactive protein (CRP) is an acute phase reactant, like the erythrocyte sedimentation rate, and is a nonspecific indicator of inflammatory activity. It is elevated in many diseases including acute rheumatic fever, sickle cell anemia, and rheumatoid and bacterial arthritis.

Cultures of blood and joint fluid aspirate would not confirm the diagnosis because this is a noninfectious process resulting from infarction of bone marrow within the carpal and tarsal bones and the phalanges.

Differential leukocyte count would not confirm the diagnosis because it shows only a predominance of neutrophils, a nonspecific finding.

Characteristic radiographic findings are usually not evident until one to two weeks after onset of sickle cell dactylitis. These findings initially include evidence of subperiosteal new bone, with later findings of cortical thinning and irregular intermedullary density in the involved bone. These changes are completely reversible, usually in six weeks to eight months.

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13

Which of the following tendons is most likely to rupture in association with a fracture of the distal radius?

(A) Brachioradialis
(B) Extensor carpi radialis longus
(C) Extensor pollicis longus
(D) Flexor carpi radialis
(E) Flexor pollicis longus

The correct response is Option C.

The extensor pollicis longus (EPL) travels in the third extensor compartment and loops around Lister's tubercle. The tendon passes over the distal third of the radius in a fascial sheath. The blood supply to the tendon is delicate and easily disrupted. In cases of fractures of the distal radius, the EPL ruptures because of mechanical factors or disruption of the blood supply. However, because rupture occurs even in nondisplaced fractures, the disruption of the blood supply may be the primary contributing factor. After closed manipulation of a fracture of the distal radius, the function of the EPL should always be assessed.

The brachioradialis muscle inserts over a wide area on the radial aspect of the distal third of the radius and so its tendon is unlikely to rupture in fractures of the distal radius.

The extensor carpi radialis longus, the flexor carpi radialis, and the flexor pollicis longus tendons do not travel in tight compartments and rarely sustain damage in association with distal radius fractures.

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14

Which of the following preservation methods is most appropriate for transporting a single amputated finger to the emergency department for possible replantation?

(A) Irrigating and soaking in sterile saline solution
(B) Irrigating and soaking in University of Wisconsin solution
(C) Wrapping in a dry sponge and placing on ice
(D) Wrapping in a saline-soaked sponge and placing in a plastic bag on ice
(E) Wrapping in a sterile dressing and storing with dry ice

The correct response is Option D.

Because the decision to reimplant or fully amputate a finger can only be made by an experienced microsurgeon, the amputated digit should be sent with the patient as expeditiously as possible to the emergency department or replantation center. The goal of replantation is restoration of circulation to the amputated part before irreversible tissue changes occur. Tolerance of warm ischemia varies, with skeletal muscle the most vulnerable tissue in the extremities, tolerating from four to six hours. In a digit that does not contain muscle, the acceptable warm ischemia period is around eight hours. These periods can be substantially extended by cooling, which slows metabolic processes. To avoid desiccation or freezing of the digit during transport, the finger should be wrapped in a moist saline-soaked sponge and placed in a plastic bag on crushed ice.

Some studies have shown a marginal benefit when amputated digits are irrigated with solid-organ storage solutions such as sterile saline and University of Wisconsin solutions, but the delay before transport necessary for preparation of these solutions makes this approach impractical.

Wrapping the finger in a dry sponge can lead to its desiccation, making replantation impossible. Similarly, preserving the finger on dry ice is likely to result in its freezing with associated tissue damage and decreasing likelihood of salvageability.

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15

A 25-year-old violinist who does not smoke cigarettes sustains a transverse amputation of the dominant middle fingertip at the metaphyseal flare of the distal phalanx when she cuts herself with a razor. Which of the following is the most appropriate management?

(A) Replantation
(B) Thenar flap coverage with matrix ablation
(C) Thenar flap coverage without matrix ablation
(D) Volar V-Y flap coverage with matrix ablation
(E) Volar V-Y flap coverage without matrix ablation

The correct response is Option A.

Transverse fingertip amputations occur in patterns. The following four-stage classification is useful in determining the prognosis for nail sequelae. Type I or distal amputations only include soft tissue. Distal amputations including the middle third of the nail comprise type II amputations, which generally have adequate bony support for straight nail growth. In type III amputations, which include the fingertip up to the nail fold, hook-nail deformity progresses because of inadequate bony support. Type IV amputations extend to the distal interphalangeal (DIP) joint.

The 25-year-old violinist has sustained a type IV amputation. Given the patient's age, lack of tobacco use, profession, and mechanism of injury, replantation is the most appropriate management. Distal replantation preserves length and provides the best appearance. Sensibility after digital nerve repair is as good or better than with other types of closure, such as a thenar flap, and replantation avoids neuroma formation seen after tip amputation. In this patient, whose occupation requires precision handling, replantation results in the best function.

In the proximal type IV level injury treated by primary closure, nail matrix remnants must be removed or a hook nail deformity results.

A thenar flap will cover a type IV amputation of the fingertip but will result in significant stiffness.

A V-Y or advancement flap will allow skin closure without additional bone shortening. Lack of a nail and fingertip shortening would impair finger function in this musician.

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16

A 40-year-old man sustains a complete laceration of the ulnar nerve at the wrist. Which of the following muscles is most likely to continue functioning?

(A) Abductor pollicis brevis
(B) Adductor pollicis
(C) Flexor pollicis brevis, deep head
(D) Palmaris brevis
(E) Second interosseous

The correct response is Option A.

The abductor pollicis brevis would still function in this patient with a laceration of the ulnar nerve because the muscle is innervated by the median nerve, not the ulnar nerve.

The ulnar nerve supplies the adductor pollicis, the deep head of the flexor pollicis brevis, the palmaris brevis, the abductor digiti minimi, the flexor digiti minimi, the opponens digiti minimi, and all interosseous muscles. Consequently, the adductor pollicis, the deep head of the flexor pollicis brevis, the palmaris brevis, and the second interosseous are likely to cease functioning if the ulnar nerve is lacerated. The median nerve supplies the abductor pollicis brevis muscle, the opponens pollicis muscle, the first and second lumbricals, and the superficial head of the flexor pollicis brevis.

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17

A right-handed 42-year-old man sustained a deep stab wound to the volar wrist three weeks ago. A photograph is shown on the previous page. During planned microsurgical repair of the median nerve, the motor fasciculus is most likely to appear in which of the following orientations?

(A) Dorsal and radial
(B) Dorsal and ulnar
(C) Palmar and radial
(D) Palmar and ulnar
(E) Mixed within the sensory fascicles

The correct response is Option C.

The motor fasciculus is most likely to be found in a palmar and radial orientation with respect to the rest of the nerve. This anatomic detail is crucial since the perineural and intraneural vessels may not be present to allow correct orientation. Knowledge of the fascicular pattern is also important to allow application of the techniques of awake stimulation or fascicular dissection of neuromas in continuity.

Classic studies show that the motor branch of the median nerve is located in a palmar and radial position from the bi-styloid line of the distal forearm proximally for approximately 2 cm. As the median nerve continues proximally in the forearm, the orientation of the motor fasciculus changes, and substantial plexus formation occurs.

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18

During pollicization of the index finger, the first dorsal interosseous muscle becomes the

(A) abductor pollicis brevis
(B) abductor pollicis longus
(C) adductor pollicis
(D) extensor pollicis brevis
(E) extensor pollicis longus

The correct response is Option A.

During pollicization of the index finger, the first dorsal interosseous muscle becomes the new abductor pollicis brevis (APB). The most commonly used technique of pollicization consists of a series of eight steps, all of which are required to successfully perform this procedure.

1) The palmar arch must be divided just radial to the long finger.
2) The common digital nerve to the second web space is split.
3) All the index metacarpal joint is removed except for the metacarpal head. The epiphysis is destroyed, and the metacarpal head is rotated 90 degrees.
4) The extensor digitorum communis (EDC) is cut at the level of the index metacarpophalangeal joint and is shortened and resutured at the base of the proximal phalanx to become the abductor pollicis longus (APL).
5) The extensor indicis proprius (EIP) is then shortened and resutured to become the extensor pollicis longus (EPL).
6) The flexor tendons are left intact since they do not require shortening.
7) The first dorsal interosseous muscle reattaches to the radial lateral bands of the pollicized index finger to become the APB.
8) The first palmar interosseous muscle of the index finger reattaches to the ulnar lateral bands to become the adductor pollicis.

The postoperative results of this procedure are shown below.

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19

After undergoing open reduction and internal fixation of a calcaneal fracture, a patient develops a postoperative wound infection that requires debridement. The wound measures 4 × 4 cm. Hardware and the calcaneus are exposed. Which of the following local flaps will provide adequate coverage without loss of function?

(A) Abductor digiti minimi
(B) Abductor hallucis
(C) Dorsalis pedis
(D) Flexor digitorum brevis
(E) Flexor pollicis brevis

The correct response is Option D.

Posttraumatic foot and ankle wound coverage is problematic. Although local foot and ankle flaps are sometimes adequate, they can be compromised by the injury mechanism, in which case coverage must be derived from outside the zone of injury.

The best type of flap to use on this patient with a calcaneal fracture and postoperative wound infection is a flexor digitorum brevis flap, a type II muscle flap that can adequately cover the heel and foot. If the flexor digitorum longus is intact, the flexor digitorum brevis is functionally expendable. The dominant vascular pedicle is the proximal branch of the medial plantar artery and venae comitantes. This flap, which can be reversed, can be sensate by either the medial or lateral plantar nerve.

The abductor digiti minimi flap is a type II muscle or myocutaneous flap. The flap can cover the lateral ankle, posterior heel, and dorsal foot. The lateral plantar nerve supplies motor and sensory branches. However, abduction of the little toe is lost with use of this flap. The dominant pedicle is the proximal branch of the lateral plantar artery and the venae comitantes. The flap can be distally based, reversed, and sensate.

The abductor hallucis flap is also a type II muscle or myocutaneous flap. The flap can cover the medial ankle and posterior plantar foot. The medial plantar nerve supplies motor and sensory branches. As with the abductor digiti minimi flap, great toe abduction is lost with use of the abductor hallucis flap. The dominant pedicle is the medial plantar artery proximal branch and venae comitantes. The flap can be reversed and sensate.

The dorsalis pedis flap is a type B fasciocutaneous flap. The flap can cover the lower third of the leg, ankle, and foot. The nerve supply is from both peroneal nerves. The dominant vascular pedicle includes the dorsalis pedis artery and first metatarsal artery septocutaneous perforating branches, the venae comitantes, the short saphenous vein, and the long saphenous vein. The flap can be reversed and expanded. The second metatarsophalangeal (MTP) joint or components can be elevated as a vascularized graft. The extensor digitorum longus (EDL) tendon or superficial peroneal nerve can be included in the flap.

The flexor pollicis brevis is a thenar or hand muscle.

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20

Which of the following diagnostic studies has the highest reliability in diagnosing glomus tumors of the hand?

(A) CT scan
(B) MRI
(C) Nuclear bone scan
(D) Thermography
(E) Ultrasonography

The correct response is Option B.

Glomus tumors are benign growths containing all the cells of the normal glomus apparatus. The normal glomus is an arteriovenous anastomosis found in the reticular dermis throughout the body; its function is to regulate skin circulation. Most glomus tumors are located in the fingertips, usually beneath the nail.

The early diagnosis of glomus tumors is challenging. Although the classic triad of symptoms of paroxysmal pain, point tenderness, and cold hypersensitivity often leads to diagnosis, precise tumor localization is often difficult. A faint blue spot beneath the nail and nail ridging are distinguishing physical findings, but over 50% of cases lack objective signs. Plain radiographs may show a scalloped erosion of the distal phalanx.

Several recent reports have described visualization of glomus tumors with MRI. Tumors are "dark" on T1-weighted images and "bright" on T2-weighted images. Tumors as small as 5 mm have been identified.

CT scan, nuclear bone scan, thermography, and ultrasonography have all been used to diagnose glomus tumors but do not possess high enough sensitivity and specificity to make their use routine.

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21

A 60-year-old patient has wound dehiscence and exposure of the anterior part of a prosthetic implant seven days after total knee arthroplasty. Which of the following flaps is most appropriate for coverage of the defect?

(A) Biceps femoris flap
(B) Gastrocnemius flap
(C) Latissimus dorsi free flap
(D) Soleus flap
(E) Tibialis anterior flap

The correct response is Option B.

The most appropriate flap for coverage of this patient's wound is a gastrocnemius flap. The medial and lateral gastrocnemius flaps are the workhorses for vascularized coverage over the distal femur, the knee, and the proximal third of the tibia. Either head can be rotated as a muscle or myocutaneous flap. The medial head is bulkier and longer than the lateral, so it is preferred. The lateral head is shorter, with a more limited arc, so its use is confined to small, laterally placed defects.

The biceps femoris muscle is the most lateral and largest of the posterior thigh (hamstring) group. Its arc will cover the ischial and perineal areas as well as the trochanter.

The latissimus dorsi or other free flaps are used for coverage of defects of the lower third of the tibia. Free tissue transfer is also used for middle third tibial defects from high-energy wounds with a large local zone of injury or with significant bone loss.

The soleus muscle is a posterior calf muscle that can be used in closure of middle third tibial defects.

The tibialis anterior, located lateral to the tibia, can be transposed surgically to cover the middle third of the tibia.

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22

A patient has neurogenic thoracic outlet syndrome. Physical examination shows normal two-point discrimination and absence of intrinsic atrophy. Which of the following is the most appropriate initial management?

(A) Physical therapy
(B) Injection of corticosteroids
(C) Anterior scalenotomy
(D) Neurolysis of the brachial plexus
(E) Resection of the first rib

The correct response is Option A.

The most appropriate first step in treatment of this patient with neurogenic thoracic outlet syndrome is physical therapy aimed at muscle rebalancing, scalene muscle lengthening, and brachial plexus gliding. Postural correction and strengthening exercises for the shoulder girdle muscles (particularly the trapezius, levator scapulae, and rhomboids) are key elements of the therapy program.

Patients with neurogenic thoracic outlet syndrome report upper extremity pain and paresthesia. The diagnosis is made largely on the basis of history and physical examination. Electromyographic nerve conduction velocity (EMG/NCV) studies, MRIs, and arteriograms are usually not reliable in making the diagnosis.

Injection of corticosteroids is usually not necessary unless there is concern over possible reflex sympathetic dystrophy.

If physical therapy is ineffective in patients with neurogenic thoracic outlet syndrome, then anterior scalenotomy, brachial plexus neurolysis, and first rib resection are all possible surgical options. Results following surgical intervention are highly variable, however, and each procedure has its associated risks and complications.

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23

A 35-year-old man sustains a gunshot wound to the left hand. A photograph and radiograph are shown above. Which of the following is the most appropriate first step in the management of the fracture?

(A) Application of an external fixator
(B) Application of a thumb spica cast
(C) Application of a T-plate for stabilization of the metacarpal base
(D) Longitudinal immobilization and fixation with 0.62 Kirschner wires
(E) Wide debridement and bone grafting

The correct response is Option A.

Initial definitive management of this patient with an open missile injury consists of application of an external fixator. This step avoids placement of hardware into a highly contaminated wound harboring an unknown amount of devitalized tissue. Although gunshot wounds may initially appear benign, the amount of destruction and contamination may be severe. An external fixator allows easy access to open wounds for wound care and clinical monitoring for

edema, compartment syndrome, and infection. Application of an external fixator with three points of fixation will additionally enable preservation of metacarpal length, allow correction of any rotational deformity, and protect the first web space from contraction. After removal of the external fixator, no further surgery should be required.

Cast application would not afford protection from foreshortening of the metacarpal and would interfere with routine access to the entrance and exit wounds.

A plate and screw technique is not likely to be effective in this patient because of the absence of satisfactory bony stock to afford purchase for the screws. In addition, it would be unwise to initially manage this open wound with insertion of hardware.

Kirschner (K) wires are the most versatile devices available for the fixation of fractures of the hand. However, longitudinal K wires in this case will not protect against rotational deformity and would provide suboptimal protection against foreshortening of the unstable metacarpal base. Whether using a crossed K-wire technique or a longitudinal K-wire technique, a transverse K wire would also be needed to protect the first web space.

If the appropriate external fixation hardware is not initially available, then splinting would be an effective temporizing measure after the initial operative debridement. Bone grafting is contraindicated in the presence of open wounds.

The safest management of this patient's wound is to allow it to heal while protecting the hand against progressive deformity. The multiple comminuted fractures present in this particular case have some similarities to a Rolando type of fracture pattern. The "bag of bones" concept seems applicable, as these multiple fracture fragments will likely coalesce to form a stable and painless carpometacarpal joint.

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24

A 22-year-old man sustains a crush-avulsion injury of the right hand in an automobile accident. Examination shows complete loss of the tissue over the dorsal aspect of the hand, including the extensor tendons to the long and ring fingers and the dorsal cortices of the third and fourth metacarpals. There is profuse bleeding from a longitudinal laceration of the palm.

Following irrigation and debridement of the wound, which of the following types of flaps should be used in reconstruction for one-stage coverage?

(A) Contralateral free radial forearm flap
(B) Full-thickness skin graft from the groin
(C) Ipsilateral lateral arm free flap
(D) Pedicled groin flap
(E) Reverse radial forearm flap

The correct response is Option C.

This 22-year-old man who sustained a crush-avulsion injury of the right hand should undergo reconstruction of the avulsed extensor tendons with a flap, using one-stage coverage. After the wound has been treated and is ready for closure, the surgeon must choose between immediate reconstruction or reconstruction at a later stage.

An ipsilateral lateral arm free flap is the best choice for this patient because the extensor tendons can be reconstructed in one stage using a vascularized palmaris longus tendon or vascularized triceps fascia.

The contralateral free radial forearm flap can also be used for one-stage coverage. However, the donor site of the lateral arm flap is preferred because it is less disfiguring. Also, it avoids impairment of another extremity.

The presence of exposed bone precludes the use of skin grafts.

A pedicled groin flap is an excellent choice to close a dorsal hand wound, but requires a second stage to divide and inset the flap.

The mechanism of injury (crush-avulsion) and the palm wound with profuse bleeding raises the possibility that the superficial palmar arch is not patent, increasing the risk for failure of a reverse radial forearm flap.

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25

A 30-year-old man has a closed dislocation of the proximal interphalangeal (PIP) joint of the index finger. A radiograph is shown on the previous page. Which of the following is the most appropriate management?

(A) Closed reduction and extension block splinting
(B) Closed reduction and Kirschner-wire fixation
(C) Open reduction and Kirschner-wire fixation
(D) Volar plate arthroplasty
(E) Volar plate repair

The correct response is Option A.

The most appropriate management for this patient's dislocation is closed reduction and extension block splinting. This patient has a type II dorsal dislocation of the proximal interphalangeal (PIP) joint. There has been avulsion of the volar plate from the proximal volar lip of the middle phalanx accompanied by major bilateral splits in the collateral ligament system; these injuries cause complete dorsal displacement of the middle phalanx. Typically in type II injuries, the base of the middle phalanx rests on the dorsal condyles of the proximal phalanx, usually in a bayonet alignment, with the shaft of the phalanges essentially parallel. There is no contact between the articular surfaces.

A type I dorsal dislocation of the PIP joint is a hyperextension injury in which there has been avulsion of the volar plate from the proximal volar base of the middle phalanx and a minor longitudinal split in the collateral ligaments. The articular surfaces remain in contact. In type III injuries, there has been sufficient force to shear away a portion of the volar base of the middle phalanx producing a fracture dislocation. A small subset of patients have unstable type III fracture dislocations in which more than 40% of the volar articular surface of the middle phalanx is avulsed. In type III unstable fracture dislocations, most of the collateral ligament remains with the volar fragment; thus, ligamentous support of the middle phalanx is lost and therefore dorsal dislocation recurs.

Most dorsal dislocations and fracture dislocations of the PIP joint are treated nonoperatively. Techniques that should be used to assist with relocation include regional nerve blocks at the wrist, and decreasing the tone in the extrinsic flexor tendons and the intrinsic tendons by flexion of the wrist and metacarpophalangeal joint.

After a closed reduction of any dorsal PIP joint or fracture dislocation is attempted, joint congruity should be documented radiographically. Failure to obtain a congruous reduction is an indication for open reduction as a trapped collateral ligament or volar plate may be blocking relocation of the digit. If joint congruity has been reestablished, then the stability of the relocated joint should be checked. This should include stress in the mediolateral and dorsovolar directions. In addition, the patient should be able to flex and extend the joint up to the terminal 15 degrees of extension without recurrent dislocation.

Types I and II injuries are usually stable to active and passive testing. These injuries, as well as stable type III injuries, respond well to a protocol of extension block splinting.

Kirschner-wire fixation is necessary after closed reduction only if the joint dislocation recurs during stability testing.

In the unstable type III fracture dislocation, treatment options include open reduction and Kirschner-wire fixation, dynamic skeletal traction, and volar plate arthroplasty. In the latter, advancement of the fibrocartilaginous volar plate into the area of articular irregularity can be used to resurface the joint.

Volar plate repair is used to correct symptomatic chronic hyperextension deformities of the PIP joint. This is reinforced by tenodesis of one or both slips of the flexor superficialis tendon.

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26

A right-handed 55-year-old man sustains an amputation of the pulp of the left thumb tip in an industrial accident, resulting in bony exposure. The defect encompasses approximately 50% of the tactile thumb pad and measures approximately 1 cm in length. Radiographs show no associated fractures. Which of the following is the most appropriate management?

(A) Secondary intention healing
(B) Split-thickness skin graft
(C) Full-thickness skin graft
(D) Volar advancement flap with or without relaxing incision
(E) Cross-finger flap from the index finger

The correct response is Option D.

The most appropriate treatment of this patient with an amputation of the pulp of the left thumb tip is coverage with a volar advancement flap. Fingertip injuries are the most common hand condition encountered by the plastic surgeon. In such injuries, especially when the thumb is involved, the primary goal of reconstruction is maintenance of length and of a stable, durable, and sensate tip without residual pain or donor site morbidity, as well as a minimal loss of function. A volar advancement flap in the thumb (Moberg flap) is ideal for reconstructing the soft tissue of the pulp in defects less than 2 cm long or defects that encompass 50% of the palmar portion of the distal phalanx. With this procedure, like tissue replaces like, the flap is sensate and durable, and the interphalangeal joint of the thumb can tolerate the moderate flexion required with minimal residual adverse sequelae.

A cross-finger flap would add more bulk but would be minimally sensate and leave a very unsightly dorsal defect on the donor finger.

Full- or split-thickness skin grafting of this patient's wound would leave an unacceptable contour deformity with inadequate soft-tissue padding for the pulp pad as the graft heals to bone.

In this large pulp defect with bone exposure, treatment by conservative management with dressing changes and healing by secondary intention would risk impaired thumb function. Coverage of the exposed bone of the distal phalanx by skin that is hypesthetic, dysesthetic, or tender may cause the patient to exclude the tip of the thumb from activities, resulting in a functional amputation.

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27

The radiograph and photograph shown above are of a 10-month-old infant with duplication of the thumb. Which of the following is the most appropriate surgical management?

(A) Central excision of soft tissue and bone with midline approximation
(B) Excision of the radial thumb
(C) Excision of the radial thumb with reconstruction of the radial collateral ligament and realignment of tendons
(D) Excision of the ulnar thumb
(E) Excision of the ulnar thumb, ulnar collateral ligament reconstruction, and realignment of the tendons

The correct response is Option C.

This patient has a type IV thumb duplication, according to Wassel's classification. The term duplication is slightly misleading because the structures in the thumbs are not precisely duplicated. Usually neither thumb in patients with this condition has all the normal structures, and those structures that are present often are abnormal in location and/or size. Neither thumb is as large as a normal contralateral thumb.

In the past, treatment was by excision of the redundant thumb. However, numerous reports have described persistent deformities that resulted years after such excision, including the Z deformity. This deformity involves collapse of the longitudinal alignment of the thumb, with the distal phalanx angling radially and the proximal phalanx tilting ulnarly, and most likely results from abnormal insertions of the flexor and extensor tendons, lax or unrepaired collateral ligaments, and abnormal tilt of the metacarpophalangeal or interphalangeal joints.

In order to prevent the Z deformity, or at least lessen its tendency to develop, the smaller duplicated thumb (usually the radial thumb) is removed. However, parts of it are saved to reconstruct the thumb that remains. The radial collateral ligament is carefully reconstructed, and the intrinsic muscles are reattached to the MP joint. Occasionally, separation of the joined extensor and flexor tendons and realignment of the tendons is necessary. The radial head of the metacarpal bone needs to be trimmed, and occasionally an osteotomy is indicated to make the bone level.

Central excision of equivalent portions of adjacent parts of distal segments with midline approximation to form one distal phalanx has been advocated for type I and II duplications (incomplete or complete separation of the distal phalanges). This technique, known as the Bilhaut-Cloquet procedure, is best suited to distal duplications with symmetry in size and shape. Problems resulting from this procedure include stiffness due to entrance into the joint space, tendon scarring, size or angulatory deformity due to physis damage, and nail deformity.

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28

Following zone 2 reconstruction of the flexor digitorum superficialis and flexor digitorum profundus, a 24-year-old man is unable to fully flex his ring finger. There is palpable bowstringing. Passive extension and flexion are normal. Which of the following flexor tendon-sheath pulley systems is most likely to be injured?

(A) A1
(B) A2
(C) A3
(D) C1
(E) C2

The correct response is Option B.

Knowing the anatomy and function of the flexor tendon sheath is vital to the hand surgeon. Within the sheath are areas of increased collagen condensation: the annular (A1-A5) and cruciate (C1-C3) pulleys. The odd numbered annular pulleys (A1, A3, and A5) sit over the metacarpophalangeal (MP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints, respectively. The A2 pulley is positioned over the proximal half of the proximal phalanx and the A4 pulley is located over the middle of the middle phalanx. The C1 pulley is situated between the A2 and A3 pulleys. C2 is between A3 and A4, and C3 is between A4 and A5.

These pulleys hold the tendons close to the bone and joints, preventing bowstringing. The closer the tendon is to the bone, the less tendon excursion is needed to bend that joint. The annular pulleys are strong, while the cruciate pulleys work in an accordion fashion to keep the tendon sheath tight throughout joint motion. Studies have shown that the A2 and A4 pulleys in the fingers and the oblique pulley in the thumb are the most essential pulleys to prevent bowstringing.

In tendon reconstruction, repair (and sometimes reconstruction) of the A2, A4, and oblique pulleys is necessary to prevent bowstringing. If a patient cannot fully and actively flex a finger after tendon repair in a zone where the important pulleys may have been injured, the tendon should be felt to determine if it is sitting next to the bone. This patient above has good passive motion but cannot fully flex his finger because the A2 is damaged.

Stenosing tenosynovitis or trigger fingers occur at the A1 pulley. The release of the pulley can be performed safely in most patients, except those with rheumatoid arthritis. Its release alone will not cause bowstringing.

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29

A 49-year-old woman who works at an ice cream parlor has had pale, cold fingers and a bluish discoloration of the fingertips of both hands for the past two years. Symptoms are particularly pronounced after she scoops several servings of ice cream. Examination shows trophic changes that are limited to the skin of the distal aspect of the fingers.

Which of the following is the most likely diagnosis?

(A) Buerger's disease
(B) Fibromuscular dysplasia
(C) Giant cell arteritis
(D) Raynaud's phenomenon
(E) Takayasu's arteritis

The correct response is Option D.

This patient has Raynaud's phenomenon, a condition characterized by pallor of the digits on exposure to cold that occurs without a demonstrable or causative disease. When it occurs in association with another disease or is caused by another disease, it is known as Raynaud's syndrome or secondary Raynaud's phenomenon. Raynaud's phenomenon is seen mainly in young women, often having its onset in the late teens. Episodes are precipitated by exposure to cold and by emotional upset. Criteria that must be met to confirm a diagnosis of the disease include intermittent episodes of discoloration of the acral parts of the body, symmetric or bilateral involvement, absence of clinical occlusion of peripheral arteries, and absence of an organic disease to which the vasomotor changes may be attributed. Gangrene or trophic changes, if present, are limited to the distal skin. Symptoms must be present for a minimum of two years.

Buerger's disease (thromboangiitis obliterans) is a vasculitis involving medium- and small-sized arteries and veins of the distal lower extremities and, less commonly, the upper extremities. It occurs mainly in young men who smoke. Clinical presentations include recurrent migratory thrombophlebitis and varying degrees of ischemia of the distal limb with digital artery occlusion, ulcerations of the fingers, and gangrene affecting the fingers.

Takayasu's arteritis, also known as "pulseless disease," is an unusual disorder involving the aorta and its primary branches. Women are affected eight times more frequently than men, and most patients are first affected between the ages of 10 and 30 years. The aortic arch and carotids develop stenoses that cause postural and exercise-related ischemic symptoms.

Fibromuscular dysplasia is a noninflammatory arterial occlusive disease most commonly involving the renal artery, causing renovascular hypertension. In the extremities, it has been reported in the brachial artery.

Giant cell arteritis, like Takayasu's arteritis, often involves the subclavian and proximal axillary vessels. Women are predominantly affected, usually after age 50 years. Findings include an elevated erythrocyte sedimentation rate and anemia. Symptoms rapidly diminish with corticosteroid therapy.

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30

A 25-year-old man has severe burning of the right hand after dipping it in a bucket of cleaning fluid containing hydrofluoric acid. Which of the following is the most appropriate management?

(A) Application of a thick layer of silver sulfadiazine cream
(B) Application of cold compresses along with topical application of dimethyl sulfoxide in 90% alpha-tocopherol succinate
(C) Irrigation with glycerol, propylene, or polyethylene glycol
(D) Subcutaneous injection of 10% calcium gluconate into the affected area
(E) Water lavage followed by copper sulfate rinse (1% or less)

The correct response is Option D.

Hydrofluoric acid produces a caustic skin injury, eventually resulting in liquification necrosis. In addition to prompt water irrigation, 10% calcium gluconate gel, applied topically for less severe injuries or injected as a solution locally into the subcutaneous tissue for more severe injuries, will control the progress of injury and pain. Because this patient has severe burning pain, a subcutaneous injection is most appropriate.

Silver sulfadiazine (Silvadene) is a topical antibiotic that controls bacterial proliferation on the surface of a burn wound. It can be used as an adjunct in the overall treatment of this particular burn, but it does not specifically counteract the effects of the hydrofluoric acid, so it would be insufficient as management in this case.

Application of cold compresses along with topical dimethyl sulfoxide in 90% alpha-tocopherol succinate is of some benefit after extravasation of a doxorubicin burn.

Glycerol, propylene, or polyethylene glycol should be used for a phenol burn.

Water lavage and copper sulfate rinse should be used for a phosphorus particle burn.

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31

A 34-year-old man who works as a carpenter has impaired ability to actively flex the index finger. Three months ago, he sustained a traumatic amputation of the nondominant index finger just proximal to the distal interphalangeal joint. The stump was debrided and then repaired by primary closure. There was minimal bone shortening. Current examination of the finger shows paradoxical extension of the proximal interphalangeal (PIP) joint with attempted flexion of the metacarpophalangeal (MP) joint.

Which of the following is the most appropriate next step in management?

(A) Continued physical therapy with blocking exercises
(B) Extensor tenolysis and PIP joint capsulotomy
(C) Flexor tenolysis with excision of the flexor digitorum profundus tendon
(D) Flexor tenolysis with preservation of the flexor digitorum profundus tendon
(E) Surgical sectioning of the lumbrical tendon

The correct response is Option E.

This patient has a "lumbrical plus" deformity as a result of loss of the terminal insertion of the flexor digitorum profundus tendon. The lumbrical tendon of the index finger has an independent origin from the radial side of the profundus tendon inserting into the radial lateral band of the extensor mechanism. If the profundus tendon is lacerated within the finger, the normal tension in the muscle will retract the cut tendon and attached lumbrical muscle proximally. The retracted lumbrical results in increased tension on the radial lateral band and an imbalance of forces at the proximal interphalangeal joint favoring extension. Surgical sectioning of the lumbrical tendon will correct the problem.

Blocking exercises are useful in restoration of tendon excursion in patients with flexor tendon adhesions. They are not useful in restoring the balance of forces across the proximal interphalangeal joint.

Extensor tenolysis and PIP joint capsulotomy are indicated for adhesions and joint contracture that limit passive flexion.

Flexor tenolysis is indicated for flexor tendon adhesions and so would be unnecessary in this setting. Excision of the profundus tendon, including the lumbrical origin, would correct the tendon balance but would result in additional scarring.

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32

A 45-year-old man has dense anesthesia in the areas marked on the photograph shown above two years after undergoing reconstruction of the posterior and lateral cords of the brachial plexus. Which of the following techniques will be most appropriate for sensate reconstruction of the thumb?

(A) Ring finger pollicization
(B) Sensate free flap from the first web space of the foot
(C) Toe-to-thumb transfer
(D) Use of a neurosensory island flap from the ring finger
(E) Wraparound procedure

The correct response is Option D.

The most appropriate technique for sensate reconstruction of the thumb in this patient is use of a neurosensory island flap from the ring finger, as illustrated in the photograph shown on the following page. Littler's neurosensory island flap from the ulnar aspect of the ring finger is composed of a paddle of skin pedicled on the ulnar digital neurovascular bundle. The flap is tunneled subcutaneously across the palm of the hand and inset into the area of critical sensation on the thumb. This technique will provide the patient with instant two-point discrimination and instant protective sensation. The skin of the area of the thumb into which the flap is inset is saved and placed on the donor area on the ulnar aspect of the ring finger as a full-thickness skin graft. A cuff of subcutaneous tissue should be preserved around the neurovascular bundle to safeguard against venous compromise, a potential problem with this flap. Because

sensory reorientation may be a problem in the older patient, sensory reeducation is essential for patients undergoing this procedure. The Littler neurosensory island transfer can also be considered in the older patient who has segmental nerve loss to the thumb or for whom sensory return may take a long time and be incomplete.

Because this patient's thumb has sufficient structure and stability, pollicization of the ring finger is not justified.

Although great toe-to-thumb transfer, wraparound procedure, and transfer of the glabrous first web space skin of the foot are all excellent techniques for thumb reconstruction, they are not applicable in this situation because the recipient nerves have all been damaged by the patient's past brachial plexus injury.

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33

A 23-year-old man has a "jammed finger." He has full active range of motion of the fingers but, with the proximal interphalangeal (PIP) joint passively flexed at 90 degrees, he is unable to actively extend the distal interphalangeal (DIP) joint. Which of the following is the most likely explanation?

(A) Extrinsic extensor tightness
(B) Intact central slip
(C) Intrinsic tightness
(D) Oblique retinacular ligament tightness
(E) Ruptured terminal extensor tendon

The correct response is Option B.

Finger flexion and extension is a finely coordinated motion. The PIP and DIP joints normally move in concert resulting in a smooth flexion and extension arc. This synergistic motion is the result of balanced intrinsic and extrinsic forces acting at each joint. The loss of extensor or flexor tone at a given joint produces an imbalance of forces that results in abnormal posturing and poorly coordinated motion.

This patient with a "jammed finger" must be evaluated for possible bone and joint injuries as well as tendon ruptures. Forced flexion injuries can result in a closed rupture of the central slip or terminal extensor tendon. A closed central slip rupture can be difficult to diagnose early in its presentation. The inability to fully actively extend the DIP joint with the proximal interphalangeal joint passively flexed indicates an intact central slip. PIP joint flexion normally results in volar migration of the lateral bands. In this position, the lateral bands are ineffective at extending the distal interphalangeal joint. In the case of a central slip rupture, attempted extension of the DIP joint with the PIP joint passively flexed results in proximal migration of the extensor mechanism caused by the loss of the normal "check" effect of the central slip. The lateral bands tighten and the DIP joint extends. This posture of PIP joint flexion and DIP joint extension is known as the boutonnière deformity.

Extrinsic extensor tightness is a limitation of PIP joint flexion produced by metacarpophalangeal (MP) joint flexion. Intrinsic tightness is a limitation of PIP joint flexion produced by MP joint hyperextension. Oblique retinacular ligament tightness is a manifestation of a fixed boutonnière deformity. A patient with a ruptured terminal extensor tendon (mallet deformity) would not have full active extension of the distal interphalangeal joint.

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34

The photograph shown on the previous page is of the hand of a 27-year-old man who has painful swelling of the right hand one week after sustaining a puncture wound of the palm. Examination shows swelling, erythema, and tenderness in the third web space. The long and ring fingers are held in abduction, and there is pain on passive adduction. Which of the following is the most likely diagnosis?

(A) Collar button abscess
(B) Horseshoe abscess
(C) Hypothenar space infection
(D) Parona's space infection
(E) Thenar space infection

The correct response is Option A.

Deep space infections of the hand typically involve closed potential spaces. Dorsal hand swelling often predominates, despite the relatively volar nature of the infection. Knowledge of the potential sites of infection and their routes of spread is essential for appropriate treatment.

This patient has a collar button abscess, a web space infection, as a result of a penetrating wound to the palm. The infection originates in the palmar subcutaneous fat and eventually tracks around the superficial transverse intermetacarpal ligament through the web space to present dorsally. Even though the greater swelling often occurs dorsally, the abscess must be drained through separate palmar and dorsal incisions.

A horseshoe abscess is an infection that spreads from the ulnar bursa (small finger) to the radial bursa (thumb) through a communication in the palm. It typically begins as a tendon sheath infection of the thumb or small finger. In the case of the small finger, proximal spread is into the ulnar bursa, which subsequently ruptures into the radial bursa. It should be drained through separate approaches for each bursa.

A hypothenar space infection is confined to the ulnar side of the palm and is an uncommon infection that is caused by a penetrating injury or subcutaneous abscess.

Parona's space is located in the deep flexor compartment of the forearm and is bordered by the pronator quadratus dorsally and the flexor digitorum profundus and flexor pollicis longus volarly. Infections can arise directly from localized trauma (e.g., distal radius fracture or penetrating wound) or indirectly from proximal spread of a bursal infection.

A thenar space infection is located radial to a vertical septum between the third metacarpal and the long finger profundus and extends to the lateral edge of the adductor pollicis. A thenar space infection, which can involve the subcutaneous thenar region and extend distally and dorsally to the first web space, should be drained through separate volar and dorsal incisions.

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35

A 43-year-old dental technician has pain and swelling of the tip of the index finger. Which of the following is the most appropriate management?

(A) Observation
(B) Administration of antifungal medication
(C) Elevation of the hand, intravenous administration of antibiotics, and observation
(D) Incision and drainage followed by administration of antibiotics
(E) Radical debridement of the affected tissues

The correct response is Option A.

The most likely diagnosis in this patient is a herpetic whitlow, a primary herpes simplex infection that affects the distal phalanx. This condition usually occurs in medical and dental workers or other persons exposed to oral secretions. Early symptoms include itching, pain, and erythema, with deep coalescing vesicles developing later. The diagnosis can be confirmed by examining a Tzanck smear for multinucleated giant cells. Observation is the most appropriate management.

An antifungal drug is appropriate for the treatment of a fungal infection of the nail.

Elevation of the hand and intravenous administration of antibiotics are effective treatments for soft-tissue infections such as cellulitis.

Incision and drainage will not effectively treat this condition and may actually worsen the infection.

Radical debridement is appropriate for treatment of severe necrotizing infections.

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36

A 34-year-old man sustained a below-knee, degloving amputation of the left leg one year ago. A 10-cm section of the tibia is intact. He has had recurrent ulceration. The tibia is currently exposed at the distal portion of the stump. Which of the following is the most appropriate management?

(A) Conversion to an above-knee amputation
(B) Conversion to a through-knee amputation
(C) Coverage with a distally based vastus lateralis muscle flap
(D) Free tissue transfer
(E) Shortening and revision of the stump

The correct response is Option D.

Free tissue transfer is the most appropriate management for this patient with recurrent ulceration after below-knee amputation of the leg. A free flap provides stable soft-tissue coverage while preserving maximum length. Sensation can be provided by using a sensory free flap. However, the latter flap may not be required if the patient has good deep pressure sensation.

In most patients, approximately 15 cm of tibia is required for adequate function of a below-knee amputation. However, in younger patients, tibial stump lengths of 5 cm or more are associated with improved function.

Conversion to either an above-knee or a through-knee amputation would have a significant detrimental effect on the patient's function and would increase his expenditure of energy when ambulating.

Coverage with a distally based vastus lateralis flap is not advisable in this patient. Because of their tenuous blood supply, distally based muscle flaps are generally unreliable in adults.

Because tibial length is correlated to function, any procedure that shortens the tibia is inappropriate.

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37

Four months after undergoing an uncomplicated zone 4 repair of the extensor tendon, a 29-year-old auto mechanic has persistent pain and swelling of the long finger. Examination shows a nondiscrete area of firm swelling over the dorsal aspect of the proximal phalanx. He has difficulty flexing the proximal interphalangeal (PIP) joint. A radiograph and a bone scan are shown on the previous page.

Which of the following is the most likely diagnosis?

(A) Calcific tendinitis
(B) Calcinosis circumscripta
(C) Heterotopic ossification
(D) Osteochondroma
(E) Turret exostosis

The correct response is Option E.

This patient has a turret exostosis, a benign extracortical bony proliferation that results from injuries to the dorsum of the fingers. The designation "turret" refers to its shape. The usual mechanism of injury is a deep laceration through the digital extensor mechanism. A breach of periosteum leads to the formation of a subperiosteal hematoma that subsequently undergoes ossification.

Calcific tendinitis is unusual in the fingers and manifests more frequently in the wrist tendons. Calcinosis circumscripta involves deposits of calcium in the digital pulp of patients with CREST syndrome (calcinosis, Raynaud's, esophageal disorders, sclerodactyly, telangiectasia). Heterotopic ossification is extracortical juxta-articular bony proliferation seen more commonly about the elbow in patients with burns and severe closed head injuries. Osteochondromas are benign lesions with similar histologic appearance.

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38

A 34-year-old man has pain and snapping at the metacarpophalangeal (MP) joint of his left long finger. He caught the finger on an opponent's jersey 10 days ago while playing football. Examination shows tenderness along the radial surface of the MP joint. There is ulnar subluxation of the extensor tendon and snapping with extension of the digit.

Which of the following is the most appropriate management?

(A) Observation
(B) Injection of corticosteroids
(C) Splint immobilization of the middle finger in extension
(D) Crossed intrinsic transfer
(E) Sagittal band repair

The correct response is Option C.

The most appropriate management of this patient with an injury to the radial sagittal band of the long finger is splint immobilization of the long finger in extension. The long finger is most commonly involved in sagittal band injuries and usually is associated with ulnar subluxation of the extensor digitorum communis (EDC) tendon. Acute injuries that are seen within two weeks of injury can be managed conservatively with splinting in extension or with a flexion block splint.

Observation will not have any beneficial effect in this patient and will ultimately commit the patient to surgical repair.

Corticosteroid injection is not appropriate management because there is disruption of tissue leading to mechanical displacement of the extensor tendon. Injection of a corticosteroid would delay healing of the torn sagittal fibers.

Crossed intrinsic transfer is a procedure commonly used in patients with rheumatoid arthritis to control/correct ulnar drift of the digits. This procedure would not address the injury to the sagittal band.

Sagittal band repair is indicated in patients with chronic subluxation, congenital subluxation, or rheumatoid arthritis.

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39

A 34-year-old man has burning, numbness, and tingling of the dorsal aspect of the first web space of the left hand. The symptoms frequently occur when he wears a wristwatch. There is no history of trauma. Which of the following is the most likely diagnosis?

(A) Anterior interosseous nerve syndrome
(B) Posterior interosseous nerve syndrome
(C) Pronator syndrome
(D) Radial tunnel syndrome
(E) Wartenberg's disease

The correct response is Option E.

The most likely diagnosis for this patient is Wartenberg's disease, or compression of the radial nerve at the wrist. This condition is characterized by burning, numbness, or tingling over the dorsal aspect of the first web space. Causes of nerve compression typically include a direct blow to the wrist or too tight a cast or band, such as a wristwatch. The nerve can be tethered where it pierces the fascia between the brachioradialis and extensor carpi radialis tendons. Patients with Wartenberg's disease may be misdiagnosed as having de Quervain's disease (tenosynovitis of the first dorsal compartment) because of the similarity of symptoms.

Anterior interosseous syndrome is characterized by weakness of pinch of the thumb and index finger caused by weakness of the flexor pollicis longus tendon of the thumb and the flexor profundus tendon of the index finger. Pain in the proximal forearm that increases with motion is also characteristic.

Posterior interosseous syndrome is caused by compression of the radial nerve in the proximal forearm. Wrist extension results in radial deviation because of paralysis of the extensor carpi ulnaris. There is loss of extension of the metacarpophalangeal (MP) joints. There are no associated sensory abnormalities.

Pronator syndrome is characterized by pain in the proximal volar forearm and loss of sensation in the thumb, index, and middle fingers.

Radial tunnel syndrome is characterized by pain that occurs with extension, supination against resistance, or passive flexion and pronation of the wrist. Pain is localized just below the elbow in the extensor mass and along the course of the radial nerve.

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40

A 35-year-old woman sustains a crush injury of the right hand after slamming it in the tailgate of a pickup truck. She has a history of chronic fatigue syndrome and a severe, ill-defined functional platelet syndrome. Examination shows ecchymoses, edema, and tension in the hand and distal forearm. There is paresthesia of the little finger and the dorsoulnar aspect of the hand as well as weakness of the ulnar intrinsic tendons. Pain is caused by passive motion of the intrinsic and extrinsic tendons. Radiographs are shown on the previous page. Which of the following is the most likely diagnosis?

(A) Acute carpal tunnel syndrome
(B) Acute compartment syndrome
(C) Acute ligament tear of the scapholunate
(D) Galeazzi fracture
(E) Scaphoid fracture

The correct response is Option B.

This patient most likely has acute compartment syndrome, which results from increased pressure within a confined anatomic space that limits circulation and tissue function. Patients with compartment syndrome have a local arteriovenous pressure gradient of nearly 0 and a lack of localized blood flow. Oxygen is not delivered to the affected compartment, resulting in a loss of muscle and nerve function. Compartment syndrome is characterized by pain that is exacerbated by passive motion of the involved muscles. Diminished sensation and muscle function are also typical.

Distal pulses may still be present. Prompt measurement of compartment pressures can assist in making a diagnosis. Although acute carpal tunnel syndrome can result from blunt injury, sensory and motor changes in the median, not ulnar, nerve distribution of the hand would be present.

This patient's radiographs preclude a diagnosis of scapholunate disruption, Galeazzi fracture, or scaphoid fracture.

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A 50-year-old man with scapholunate advanced collapse (SLAC) arthritis of the carpal bone has severe, incapacitating pain in the wrist. Physical examination shows wrist extension to 30 degrees and wrist flexion to 20 degrees. Radiographs are shown on the previous page. Which of the following is the most appropriate management?

(A) Proximal row carpectomy
(B) Revascularization of the lunate
(C) Scaphoid excision
(D) Scaphoid-trapezium-trapezoid arthrodesis (triscaphe fusion)
(E) Total wrist arthrodesis

The correct response is Option E.

The most appropriate management for this patient who has calcium pyrophosphate deposition disease (CPPD) is total wrist arthrodesis. Patients with CPPD, or pseudogout, often have a scapholunate advanced collapse (SLAC) pattern of degenerative arthritis in the wrist. Radiographs show chondrocalcinosis, or the presence of calcium salts in the cartilaginous structure of the joints, which especially affects the triangular fibrocartilage complex. Total wrist arthrodesis is appropriate for management of arthritis affecting the radioscaphoid and capitolunate articulations. A capitate-lunate-hamate-triquetrum partial wrist arthrodesis with scaphoid excision may also be performed in this patient.

A proximal row carpectomy is likely to result in the diseased capitate being inserted into the fossa.

Revascularization of the lunate is more appropriate for treatment of Kienböck's disease.

A scaphoid excision does not treat the diseased capitolunate joint.

A scaphoid-trapezium-trapezoid arthrodesis (triscaphe fusion) would not treat the radioscaphoid and capitolunate joints.

References

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42

A 30-year-old electrician has delayed capillary refill of the index finger after sustaining a high-voltage injury while working on power lines. The remainder of the hand and all other digits are well vascularized. A photograph of the hand is shown on the previous page. Which of the following is the most appropriate management?

(A) Arteriography
(B) Application of an enzymatic debrider
(C) Burn excision
(D) Escharotomy
(E) Observation

The correct response is Option D.

This patient has delayed capillary refill, which typically indicates vascular compromise in the presence of burn wounds. The most appropriate management is immediate escharotomy to salvage the limb. Because this procedure should not be delayed, a comprehensive evaluation is not required. Local or regional anesthesia may not be required because the eschar is frequently insensate. Escharotomy may also be performed on the trunk if full-thickness burns restrict breathing or limit chest wall movement. Fasciotomy may also be needed to treat compartment syndrome in patients with deep burn wounds with significant subfascial edema.

Obtaining an arteriogram will only delay appropriate treatment.

Enzymatic debridement removes nonviable tissue without causing additional bleeding. However, it will not adequately decompress the fascial compartments in this patient's hand.

Burn excision is not used to treat vascular compromise secondary to burn eschar.

Observation is inappropriate in the presence of an ischemic digit since delay can result in tissue death.

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43

A 50-year-old man has a clawing deformity of the ring and little fingers of the right hand. He underwent repair of a laceration of the volar right wrist 10 years ago. Which of the following tendon transfers is most appropriate?

(A) Extensor carpi radialis longus
(B) Flexor carpi ulnaris
(C) Flexor digitorum profundus of the ring finger
(D) Palmaris longus
(E) Pronator teres

The correct response is Option A.

This 50-year-old man with a clawing deformity has a distal ulnar nerve palsy. Loss of flexion of the proximal phalanges and loss of extension of the middle and distal phalanges occur from intrinsic paralysis. In the presence of intact extrinsic muscle function, the ring and little fingers will claw, with hyperextension of the metacarpophalangeal (MP) joints and flexion of the interphalangeal (IP) joints. To correct the deformity and increase power for gross grip, the most reliable method is to add an extra muscle-tendon unit to augment flexion of the proximal phalanx. The extensor carpi radialis longus tendon transfer with tendon grafting is the most commonly used technique to help prevent clawing and improve the integration of MP and IP joint motion. The extensor carpi radialis brevis has also been used with tendon grafts, while an alternate technique uses the flexor carpi radialis as the motor.

The flexor digitorum superficialis of the middle and ring fingers can be used as transfers into the intrinsic apparatus but do not increase gross grip power. The flexor digitorum profundus is not used as a motor because its loss sacrifices too much flexor function.

The pronator teres, flexor carpi ulnaris, and palmaris longus are standard tendons used for transfers for radial nerve palsy. The pronator teres is transferred to the extensor carpi radialis brevis, the flexor carpi ulnaris to the extensor digitorum communis, and the palmaris longus to the extensor pollicis longus.

References

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44

A 33-year-old woman is undergoing excision of a volar wrist ganglion while receiving intravenous regional (Bier block) anesthesia. There is a leak in the tourniquet, resulting in a gradual decrease in blood pressure. The patient develops a metallic taste in the mouth and ringing in the ears, followed by the onset of seizures.

Which of the following is the LEAST appropriate next step in management?

(A) Administering lidocaine intravenously
(B) Administering sodium thiopental intravenously
(C) Establishing an airway and ventilating the patient
(D) Hyperventilating the patient
(E) Infusing fluids intravenously, elevating the legs, and administering vasopressors intravenously

The correct response is Option A.

This patient has had a reaction to an overdose of local anesthetics. These reactions typically develop approximately 20 minutes after injection, when levels of anesthetics in the blood peak. Early symptoms include headache, ear ringing, a metallic taste in the mouth, tongue and perioral numbness, facial muscle twitching, and restlessness. Generalized

convulsions follow, often resulting in cardiac arrest because of the toxic effect on the respiratory center in the medulla. Cardiovascular depression can occur, resulting in bradycardia and impaired conduction, leading to asystole with vascular dilatation resulting in further hypotension.

Treatment of patients who undergo toxic reactions with convulsions requires establishment of an airway and initiation of ventilation; prevention of further injury is paramount. Hyperventilation with oxygen reduces arterial CO_2, often terminating the convulsion. At times, no further treatment is necessary because the blood level of the anesthetics rapidly decreases with redistribution.

However, if convulsions continue, a small dose of an intravenous benzodiazepine (such as diazepam or midazolam) or 50 to100 mg of sodium thiopental may also terminate the convulsion. Muscle relaxants, such as succinylcholine, may be used in resistant situations.

If there is hypotension, intravenous infusion of fluids, leg elevation, and administration of vasopressors (such as ephedrine) will correct it by vasoconstriction and cardiac stimulation.

Administration of lidocaine to control the bupivacaine-induced arrhythmias associated with more prolonged and difficult resuscitation is not extremely effective; studies have shown bretylium to be the more effective drug. Bupivacaine-induced ventricular fibrillation has been treated with cardiopulmonary bypass.

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45

Which of the following precautions is NOT effective in decreasing the incidence of adverse systemic reactions to a local anesthetic?

(A) Avoidance of epinephrine in the anesthetic solution
(B) Adding sodium bicarbonate to the anesthetic solution
(C) Administering a test dose of the anesthetic
(D) Administering the lowest possible dose and concentration of the anesthetic
(E) Premedicating with a benzodiazepine

The correct response is Option A.

Local anesthetics are not metabolized at the site of injection, so systemic effects are produced only after these drugs enter the circulation. The ester-anesthetics are broken down by plasma pseudocholinesterase while the amides are metabolized in liver cells. The main systems affected by toxic doses of local anesthetics are the central nervous system and the circulatory system.

The addition of epinephrine to the local anesthetic agent results in local vasoconstriction and, therefore, retards the systemic absorption of the drug, resulting in prolonged but lower blood level of local anesthetic. Its use is effective in decreasing the incidence of adverse systemic reaction and should not be avoided.

Administering a test dose of the anesthetic will help decrease the incidence of adverse reactions because the rapid onset of early symptoms of overdose such as perioral numbness or tinnitus indicates intravascular placement of the needle. Similarly, administering the lowest possible dose and concentration of the anesthetic will result in fewer drug reactions because toxic blood levels are less likely to occur.

Premedicating the patient with a benzodiazepine before administering anesthesia is effective in decreasing the risk for adverse reactions because it raises the seizure threshold for these drugs.

Addition of sodium bicarbonate to the anesthetic solution raises the pH and increases the percentage of nonionized base, which is more lipid soluble and easily penetrates the nerve membrane. This increases the speed of onset of action and allows smaller concentrations to be used. A secondary benefit from raising the pH is decreased pain of injection.

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46

Which of the following structures is NOT likely to be affected by Dupuytren's contracture?

(A) Cleland's ligament
(B) Grayson's ligament
(C) Lateral digital sheath
(D) Natatory ligament
(E) Superficial palmar fascia

The correct response is Option A.

Dupuytren's contracture is caused by abnormal fibroblast activity that affects the superficial fascia of the palm and fingers. Grayson's ligament, the lateral digital sheath, the natatory ligaments, and the superficial palmar fascia are frequently involved, while Cleland's and Landsmeer's ligaments are not.

The normal parts of the fascia that produce the spiral cord are the pretendinous and spiral bands, lateral digital sheath, and Grayson's ligament. The pretendinous bands of the palmar aponeurosis are a common site of disease. Consequently, the convention is to call the normal fascia "bands" and the diseased fascia "cords." A palpable nodule is pathognomonic of Dupuytren's contracture.

The presence of significant joint contractures is an indication for an operation. The metacarpophalangeal (MP) and proximal interphalangeal (PIP) joints are treated separately because the results of treatment are so different. The pretendinous contractory cord is the only cause of MP joint contracture. MP joint contracture is almost always correctable, with approximately 30 degrees of contracture an indication for elective surgery. With 30 degrees or more of PIP joint contracture, an operation within a few months is advised because of problems of joint fixation with the likelihood of some degree of residual contracture.

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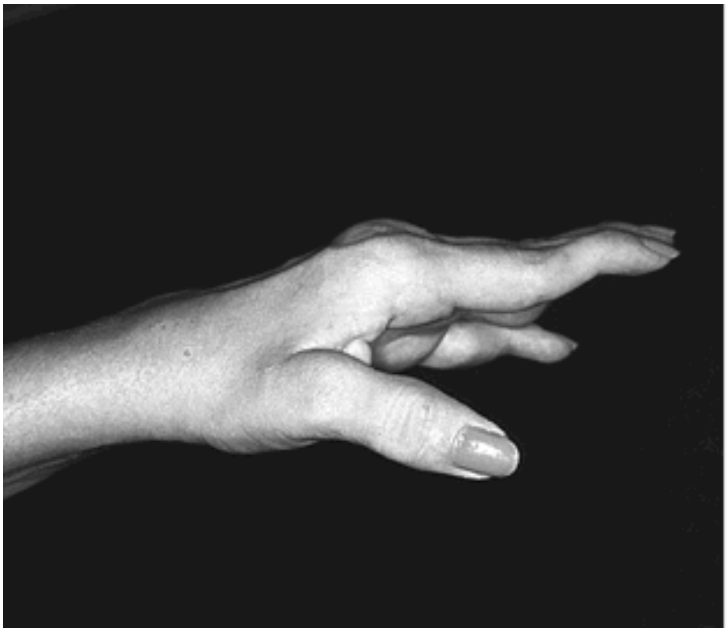
47



The photograph and radiograph shown above are from a 21-year-old woman with multiple swan-neck deformities and intrinsic tightness resulting from juvenile-onset rheumatoid arthritis. Passive flexion of the proximal interphalangeal (PIP) joint is limited with the metacarpophalangeal (MP) joints extended but improves when an MP joint flexes. She is scheduled to undergo silicone replacement arthroplasty of the metacarpophalangeal joint.

Each of the following is appropriate for treatment of the swan-neck deformities EXCEPT

(A) flexor digitorum superficialis tenodesis
(B) intrinsic release and silver ring splints
(C) oblique retinacular ligament reconstruction
(D) PIP joint dermodesis
(E) PIP joint replacement arthroplasty

The correct response is Option E.

Swan-neck deformity results from an imbalance of forces at the PIP joint favoring hyperextension and a "zigzag" flexion deformity of the distal interphalangeal (DIP) joint. Depending on the site of origin of the imbalance, the MP joint may assume a fixed-flexion posture. The deformity may originate at the DIP or PIP joints. In patients with rheumatoid arthritis, synovitis at the PIP joint can produce volar plate laxity and/or rupture of the flexor digitorum superficialis tendon. These effects, combined with intrinsic tightness, result in an imbalance favoring hyperextension of the PIP joint. The DIP joint secondarily assumes a flexed posture. In other patients, the deformity originates at the DIP joint with either a stretching or rupture of the terminal extensor tendon attachment resulting in a mallet deformity. Secondarily, the PIP joint assumes a posture of hyperextension. Attenuation of the transverse retinacular ligaments allows dorsal subluxation of the lateral bands. Laxity of the oblique retinacular ligament and terminal extensor mechanism favors flexion of the DIP joint. Attempted flexion results in snapping of the lateral bands over the PIP joint as they migrate from dorsal to volar.

This patient has type 2 (Nalebuff) swan-neck deformity. Restriction of finger flexion occurs only in certain positions, and the swan-neck deformity is secondary to MP joint involvement. Surgical treatment should be directed towards rebalancing the forces at the PIP joint. PIP joint replacement arthroplasty is not indicated since this patient has a passively correctable swan-neck deformity. It is generally recommended when the ulnar digits have significant stiffness and there are radiographic signs of end stage joint involvement.

Both flexor digitorum superficialis tenodesis and PIP joint dermodesis are used to correct the hyperextension of the PIP joint. Silver ring splints are low-profile extension blocking splints that allow full flexion and can be worn after surgery as an adjunct to intrinsic release, normally a standard procedure performed in arthroplasty involving replacement of the MP joint. Oblique retinacular ligament reconstruction uses the lateral band to reconstruct the natural tenodesis link between the PIP and DIP joints and in so doing rebalances the forces.

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48

Each of the following sensory evaluations is considered a threshold test EXCEPT

(A) light touch
(B) Semmes-Weinstein monofilament testing
(C) 256 cycles-per-second tuning fork testing
(D) two-point discrimination
(E) vibrometry

The correct response is Option D.

Tests of sensibility can be categorized as threshold tests or innervation density tests. Innervation density tests, which measure overlapping peripheral receptor fields and the density of innervation in the region being tested, are highly dependent on cortical integration of peripheral impulses and may remain normal in nerve compression syndromes. Threshold tests evaluate a single nerve fiber innervating a receptor or group of receptor cells. Threshold tests are more sensitive for the evaluation of sensibility in patients with nerve compression.

Evaluation of two-point discrimination (static and moving) is an innervation density test, not a threshold test, whereas evaluation of light touch, Semmes-Weinstein monofilament testing, 256 cycles-per-second tuning fork test, and vibrometry are all threshold tests.

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HAND AND EXTREMITIES — 1999

49

A 35-year-old construction worker sustains the thumb fracture shown in the above radiograph. On examination, the fracture is markedly unstable; closed reduction cannot be performed successfully. There is comminution of the distal fragments. Which of the following procedures is most likely to result in a stable anatomic fixation?

(A) Application of a buttress plate with casting
(B) Application of an external fixator
(C) Single lag screw fixation
(D) Single lag screw fixation with application of a buttress plate

The correct response is Option D.

The most appropriate management of this patient's spiral fracture of the proximal phalanx of the thumb is single lag screw fixation and application of a buttress plate. The instability of this fracture is due to the lack of adjacent supporting structures combined with the distracting forces of the extrinsic extensor and flexor tendons. Any open

procedure must provide sufficient strength for early range of motion of the digit. Options for stable fixation in a patient with this type of fracture include fixation with two lag screws alone or a single screw combined with application of a buttress or neutralization plate. However, placement of two lag screws requires a fracture obliquity of at least twice the diameter of the diaphysis. The lag screws, which should each have a diameter of 2 mm, must be placed a minimum of three times the diameter of the screw (6 mm) apart. Because this patient lacks the necessary fracture obliquity and has multiple fracture lines, use of a second lag screw will most likely lead to further comminution of the fragments.

Use of a single lag screw will allow for anatomic reduction and compression across the fracture site, resulting in primary bone healing. Supplementation with a buttress plate will permit early motion of the thumb.

Application of an external fixator is an inferior technique in a patient who is eligible for internal fixation. Use of this device should be reserved for patients with significant bone loss. Fixation with a single lag screw alone will not provide the stability needed for early motion. Use of a buttress plate alone will not provide compression across the fracture and, unless perfectly applied, may hold the fragments apart. This method of fixation would require external support with a cast, which would preclude early mobilization.

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50

A patient with a Volkmann's ischemic contracture is scheduled to undergo transfer of the gracilis neurovascular muscle to provide flexion of the finger. Which of the following is the most important prerequisite in a patient undergoing this procedure?

(A) Age younger than 40 years
(B) No history of smoking
(C) Normal sensation
(D) Supple passive motion of the joints

The correct response is Option D.

Prior to scheduling transfer of the gracilis muscle for correction of a Volkmann's ischemic contracture, the surgeon should be assured that the patient has supple passive motion of the joints and that tendon gliding is sufficient. This transfer is used most frequently in patients with Volkmann's contractures to restore flexion to the finger. Adequate skin coverage is also essential. Transfer of the muscle requires an intact motor nerve, artery, and vein.

Patient age and a history of smoking may affect the success of the transfer but are not absolute contraindications in a person with adequate joint motion.

In a patient undergoing this procedure, sensation of the fingers does not need to be normal but should at least be good.

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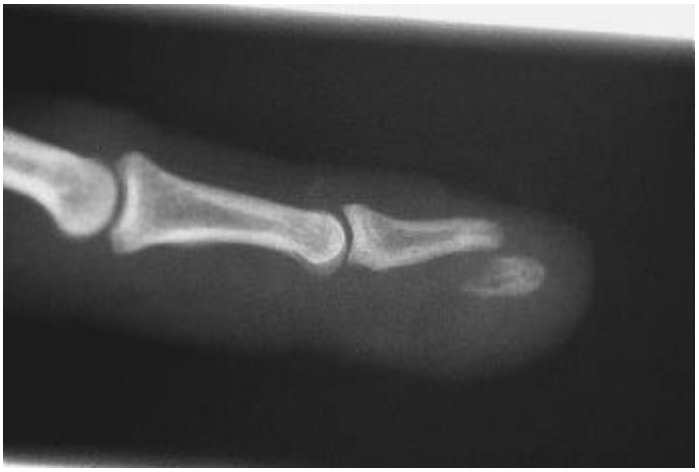
51



A right-handed 24-year-old man has painful swelling of the tip of the nondominant middle finger that resulted from a work-related injury. Examination shows dark discoloration under the nail. Passive motion of the fingertip causes extreme pain. Radiographs show a displaced transverse fracture of the distal phalanx.

Following closed reduction of the fracture, which of the following is the most appropriate management?

(A) Cast immobilization
(B) Drainage of the hematoma with a hot paper clip and cast immobilization
(C) Drainage of the hematoma with a hot paper clip and percutaneous Kirschner wire fixation
(D) Removal of the nail plate and repair of the nailbed

The correct response is Option D.

This patient who has a fracture of the distal phalanx caused by a crush-type injury and a resultant subungual hematoma is most likely to have a laceration of the nailbed. The most appropriate management is removal of the nail plate and drainage of the hematoma. After the underlying fracture is reduced, the nailbed should be repaired to avoid a posttraumatic nail deformity. The nail should then be placed back in the eponychial fold to prevent synechia.

Cast immobilization of the fracture is not appropriate because it does not address the nailbed laceration.

It is not sufficient to drain the hematoma with a hot paper clip without further examining the status of the nailbed. Moreover, transverse fractures of the distal phalanx do not usually require fixation with Kirschner wire unless there is instability of the fracture following reduction.

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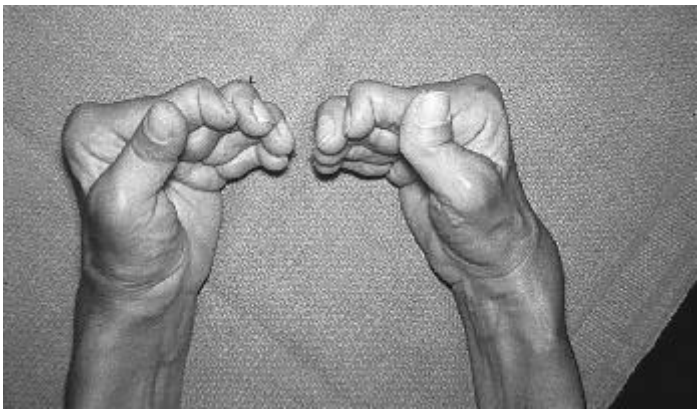
52

A 53-year-old woman with rheumatoid arthritis has stage IV disease of the metacarpophalangeal (MP) joint. Which of the following is the most characteristic posture of this patient's MP and proximal interphalangeal (PIP) joints?

	MP joint	**PIP joint**
(A)	Extended	Extended
(B)	Extended	Flexed
(C)	Flexed	Extended
(D)	Flexed	Flexed



The correct response is Option C.

This patient with rheumatoid arthritis has a characteristic posture of flexion of the MP joint with extension of the PIP joint due to intrinsic tightness.

Rheumatoid disease involving the MP joints can be classified as one of four types. Stage I is associated with synovitis and is typically treated with corticosteroid injections and splinting. In stage II, narrowing of the joint space occurs and bony erosions develop; synovectomy is recommended. Stage III involves moderate joint destruction and limited ulnar-volar subluxation of the MP joint. Management includes splinting; soft-tissue reconstruction is effective for patients with adequate articular surfaces on both sides of the MP joint.

Stage IV disease, as exemplified by this patient, is characterized by severe destruction and deformity of the MP joints. Other findings include attenuation of the sagittal band, capsule, and collateral ligaments due to synovitis. The MP joint is subluxed and the wrist is often deviated radially. Arthroplasty is frequently recommended to relieve pain and improve hand function.

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53

A 38-year-old fireman undergoes repair of a ruptured calcaneal tendon of the right foot. He develops necrosis of the skin overlying the dissected tendon; following debridement, he has a 6.0 × 4.5-cm wound with exposed repaired tendon. Which of the following is most appropriate for coverage of the wound?

(A) Abductor hallucis brevis flap
(B) Dorsalis pedis pedicle flap
(C) Radial forearm skin free flap
(D) Rectus abdominis myocutaneous free flap

The correct response is Option C.

This 38-year-old fireman who has a calcaneal wound with exposed tendon should undergo coverage of the wound using a radial forearm skin free flap. Even in the absence of diabetes mellitus or peripheral vascular disease, patients often have difficulties with wound healing following repair of the calcaneal tendon. Excessive undermining and dissection will result in further devascularization in the area of the wound. Many local flaps do not provide ample coverage. The radial forearm skin free flap has the required size and vascularity. The skin of the flap is thin and pliable, ensuring proper fitting of shoes.

The abductor hallucis brevis flap is appropriate for smaller defects over the medial malleolus and heel. The dorsalis pedis pedicle flap can also be used to cover malleolar defects but is too short for this patient's large wound. Although the rectus abdominis flap is large enough, it would be too bulky.

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54

A 30-year-old man sustains a full-thickness circumferential burn to the right leg in an industrial accident. Examination shows diminished pulses of the distal aspect of the leg. Which of the following is the most appropriate initial step in management?

(A) Application of collagenase
(B) Application of a collagen-impregnated biosynthetic dressing
(C) Early excision of eschar with skin grafting
(D) Medial and lateral escharotomies

The correct response is Option D.

In patients who sustain full-thickness burns of the extremities, intramuscular swelling and lack of skin distensibility often lead to circulatory compromise. In this patient, diminished pulses of the distal aspect of the affected leg indicate elevated compartment pressures. Therefore, the most appropriate initial step in management is performing medial and lateral escharotomies. In addition, a topical antimicrobial agent such as silver sulfadiazine (Silvadene) or mafenide acetate (Sulfamylon cream) should be applied.

Collagenase can be used for enzymatic debridement; however, its enzymatic activity occurs slowly and restoration of adequate perfusion may be delayed.

Although collagen-impregnated biosynthetic dressings help prevent fluid loss and minimize the risk for infection following wound excision, they are not appropriate as initial management.

Early excision and skin grafting may hasten wound healing and stabilize the patient's condition, but is excessively aggressive and therefore is not appropriate as initial management.

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55

A 24-year-old man has sharp pain over the ulnar aspect of the metacarpophalangeal (MP) joint of the thumb after falling while skiing. There is no evidence of a Stener lesion; there is a rotated fracture fragment of the ulnar aspect of the thumb. Radiographs are shown above. Which of the following is the most appropriate management?

(A) Short-arm thumb spica casting
(B) Long-arm thumb spica casting
(C) Closed reduction and percutaneous pin fixation
(D) Excision of the fracture fragment
(E) Internal fixation of the fracture and reinsertion of the ulnar collateral ligament

The correct response is Option E.

The most appropriate management of this 24-year-old man's injury is internal fixation of the fracture fragment and reinsertion of the ulnar collateral ligament (UCL). Injuries to the UCL of the thumb are commonly seen with skiing accidents; 20% to 30% include avulsion fractures. Patients with this type of injury should undergo complete physical examination of the injured thumb to rule out the presence of a Stener lesion. This is characterized by a raised, tender mass that results from interposition of the adductor aponeurosis between the torn UCL and the MP joint. The ligament does not heal properly because the interposed tissue prevents contact at the site of the rupture.

Avulsion fractures associated with displacement of less than 2 mm are often treated with immobilization in a short-arm cast; however, if the fragment is malrotated, casting alone (either long-arm or short-arm) will not correct the alignment and the fracture will not heal adequately. Chronic pain and weakness of pinch may result. Instead, open reduction of the fractures should be performed; the fragments should be rotated into their proper position and fixed. The UCL should then be reinserted.

Closed reduction of a rotated fracture fragment followed by percutaneous pin fixation is technically difficult to perform.

Excision of the fracture fragment alone will not restore joint stability.

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56

A positive finding on intrinsic tightness testing is indicated by resistance to

(A) flexion of the distal interphalangeal joint with extension of the metacarpophalangeal (MP) joint
(B) flexion of the distal interphalangeal joint with flexion of the metacarpophalangeal (MP) joint
(C) flexion of the metacarpophalangeal (MP) joint with radial deviation of the digit
(D) flexion of the proximal interphalangeal (PIP) joint with extension of the metacarpophalangeal (MP) joint
(E) flexion of the proximal interphalangeal (PIP) joint with flexion of the metacarpophalangeal (MP) joint

The correct response is Option D.

A patient with positive findings on intrinsic tightness testing will have impaired flexion of the PIP joint with extension of the MP joint. The intrinsic tightness test, or Bunnell test, is used to determine whether limited flexion of the PIP joint is caused by adhesions of the extensor tendon, joint stiffness, or intrinsic muscle contracture. Causes of intrinsic contracture include trauma, inflammation, tumor, disorders of the central nervous system, or joint destruction. Affected patients have diminished flexion of the PIP joint with extension of the MP joint; full flexion of the MP joint allows for greater flexion of the PIP joint. This phenomenon is due to the increase in tension of the intrinsic muscles that occurs with extension of the MP joint, resulting in limited PIP joint flexion.

Extrinsic muscle tightness would result in limited flexion of the PIP joint when the MP joints are flexed.

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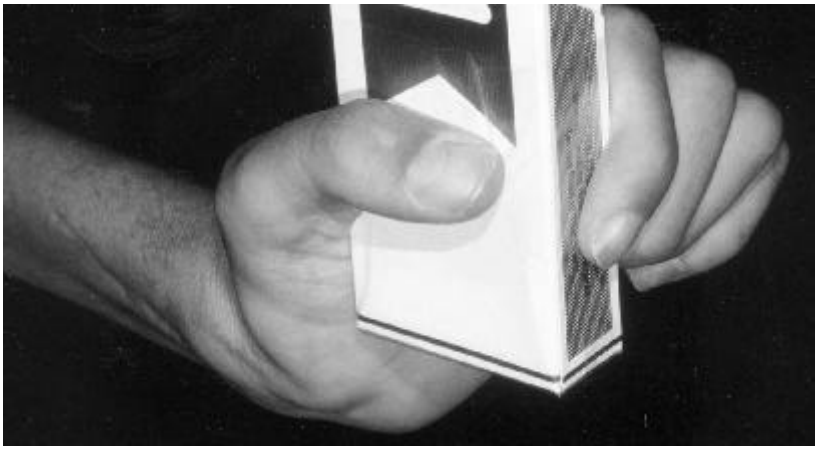
57

A 35-year-old man who has tetraplegia to a sensory level of C6-7 desires functional improvement of his left hand. On examination, he has strong active elbow flexion and wrist extension; a photograph is shown above. There is no active flexion of the wrist or fingers or extension of the fingers; the thumb is "floppy." Elbow extension is weak. He is able to use the heel of his hand to operate a toggle switch on his electric wheelchair.

Which of the following procedures will provide the greatest benefit to this patient?

(A) Moberg procedure to provide thumb key pinch
(B) Tenodesis of the flexor digitorum profundus (FDP) and flexor digitorum superficialis (FDS) tendons of the index finger to the distal radius, and fusion of the carpometacarpal (CMC) and interphalangeal (IP) joints of the thumb to provide tip-to-tip thumb and index pinch
(C) Tenodesis of the profundus flexor tendons of the fingers to the distal radius to provide digital grasp during wrist extension
(D) Transfer of the extensor carpi ulnaris (ECU) tendons to the flexor digitorum profundus (FDP) tendons of the ulnar four digits using a four-tailed plantaris graft to provide active digital flexion
(E) Transfer of the pronator teres tendon to the flexor pollicis longus (FPL) tendon to provide active thumb flexion



The correct response is Option A.

This patient with tetraplegia will most likely benefit from a Moberg procedure, which is a reliable, highly functional reconstruction to provide thumb key pinch. In addition, because of the low level of tetraplegia, he will not require any supplementary procedures. Patients with tetraplegia at higher levels often need to undergo additional reconstructive procedures to provide elbow extension, pronation of the forearm and hand, and active wrist extension.

In the Moberg procedure, the annular ligaments of the FPL tendon are released to allow bow-stringing. Following this, tenodesis of the FPL tendon to the distal radius is performed. Dorsal tenodesis of the extensor pollicis longus (EPL) tendon to the dorsal aspect of the thumb metacarpal is then established, and the IP joint of the thumb is fused in extension. If the procedure is successful, there will be contact between the thumb pad and the radial aspect of the index finger on extension of the wrist.

Restoration of tip-to-tip thumb and index pinch involves a complex procedure and is not as essential as thumb key pinch. Tenodesis of the FDP and FDS tendons to the distal radius is not generally required to obtain the tenodesis effect of wrist extension on the digital flexor tendons.

In patients with tetraplegia, function of the ECU tendon is typically weak or absent; therefore, transfer to the FDP tendon will not provide adequate function. In addition, establishing finger flexion is less important than establishing thumb key pinch.

Transfer of the pronator teres to the FPL tendon can be performed in a patient with an intact flexor carpi radialis tendon. However, in a patient without active control of wrist flexion, maintaining active pronation will enhance the effect of gravity on wrist-activated tenodeses.

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58

A 65-year-old man with non-insulin-dependent diabetes mellitus sustains a closed head injury, pulmonary and cardiac contusions, and a compound comminuted fracture of the right distal tibia with gross contamination in a high-speed motor vehicle accident. He is brought to the emergency department in shock and requires resuscitation, intubation, and ventilation. After initial stabilization, it is noted that the right foot is cold, has no pulse, and is insensate; reflexes cannot be elicited from the foot. Manipulation of the fracture in the emergency department fails to re-establish the peripheral pulses. An emergency angiogram of the extremity shows a complete block of the anterior tibial and posterior tibial arteries at the site of the fracture with proximal obstruction of the peroneal trunk.

Which of the following is the most appropriate next step in management?

(A) Application of an external fixator, revascularization, and free flap coverage
(B) Further stabilization of the patient and delayed amputation
(C) Immediate exploration and microvascular repair of the anterior tibial artery
(D) Saphenous vein bypass grafting from the popliteal artery to the dorsalis pedis
(E) Immediate amputation of the leg

The correct response is Option B.

Because of the presence of life-threatening injuries, the further stabilization of this patient is imperative before any operative procedure is performed. The patient has been intubated, is being mechanically ventilated, and is receiving intravenous fluids for resuscitation. Examination of the foot shows no pulse and no reflexes, indicating nerve damage; the foot is cold and the vascular supply has been compromised. According to the Gustilo classification, a severe open fracture of the tibia with associated neurologic injury is classified as grade IIIC. Once the patient has been completely stabilized, a below-knee amputation can be performed.

Revascularization and reconstruction using a free flap is appropriate for patients with grade IIIC fractures without associated nerve injuries or life-threatening complications.

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59

The palmaris longus tendon can be found in the forearm in what percentage of persons?

(A) Less than 50%
(B) 51% to 60%
(C) 61% to 70%
(D) 71% to 85%
(E) Greater than 86%

The correct response is Option D.

Approximately 71% to 85% of persons have a palmaris longus tendon in the forearm. This tendon can be used for free grafting and is long enough to bridge gaps from the fingertip to the palm. It may be absent in one or both forearms.

The plantaris longus tendon, which is located in the lower extremities, provides a longer donor graft but is more difficult to locate prior to surgery. Ultrasonography may be helpful. Approximately 81% to 93% of persons have this tendon. Other tendons appropriate for use as grafts include the long toe extensor tendons, which provide multiple tendon slips.

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60

A 60-year-old man has had a progressive flexion deformity of the proximal interphalangeal (PIP) and metacarpophalangeal (MP) joints of the ring and little fingers for two years. There is no history of trauma. Physical examination shows some nodularity in the palm over the middle, ring, and little fingers. He has an adduction contracture of the digits and is unable to abduct the fingers.

The most likely cause of this patient's limited abduction is contracture of which of the following cords?

(A) Isolated digital
(B) Lateral
(C) Natatory
(D) Pretendinous
(E) Spiral

The correct response is Option C.

This patient who has Dupuytren's disease is unable to abduct the fingers due to contracture of the natatory cord. The natatory ligament passes transversely across the palm at the level of the web spaces and becomes the natatory cord. It connects the flexor tendon sheaths, resulting in an adduction contracture.

The isolated digital cords are located volar to the neurovascular bundles at the level of the mid proximal phalanx and lie dorsal to the neurovascular bundles more proximally. They act in conjunction with the spiral cords to displace the neurovascular bundles medially.

Contracture of the PIP joint would be caused by the lateral cord.

The pretendinous cords cause contracture of the MP joint. They are formed from the pretendinous bands; contracture of these bands results in pitting in the palm.

The spiral cords are composed of the spiral band, lateral digital sheath, and Grayson's ligament. Contraction results in medial and superficial displacement of the neurovascular bundle.

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61

A 25-year-old man lacerates the thumb and fingers of the dominant right hand with a table saw. Examination shows soft-tissue loss involving portions of the proximal and distal phalanges and a 2.5-cm soft-tissue loss including avulsion of the digital nerve over the distal aspect of the ulnar side of the thumb. Portions of the interphalangeal joint capsule and the flexor pollicis longus tendon are exposed.

In the treatment of the thumb injury, which of the following is most appropriate for reconstruction of the deformity?

(A) Cross-finger flap from the index finger
(B) Digital neurovascular island flap from the middle finger
(C) Palmar advancement flap from the thumb
(D) Reverse radial forearm flap
(E) Skin graft

The correct response is Option B.

In this patient who has sustained a serious injury to the manipulative surface of the hand, the most appropriate treatment option for reconstruction of the thumb is coverage with a digital neurovascular island flap raised from the ulnar side of the middle finger. This flap is based on one digital artery of the donor digit; the ipsilateral digital nerve is included with the flap. It will provide vascularized, innervated coverage of the defect and will preserve thumb length. Sensation to the ulnar side of the middle finger only is sacrificed.

A cross-finger flap will restore tissue but is initially insensate. Also, because of the size of this defect, a cross-finger flap is not likely to provide adequate coverage.

Because of the extent and configuration of this defect, a palmar advancement flap is inappropriate for reconstructive surgery. This flap usually cannot be advanced more than 2 cm.

Use of a reverse radial forearm flap is an excessively extensive procedure for this patient's small deficit; a less invasive procedure is sufficient.

A skin graft is unlikely to survive over this wound. If it did survive, it would result in a rigid, unpadded, insensate working surface.

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62

A 48-year-old man sustains an avulsion injury involving the dorsal aspect of the metacarpophalangeal joint of the nondominant left thumb. Following debridement, there is a defect of 2.1 cm with exposure of the extensor pollicis longus (EPL) tendon. A photograph is shown above.

Following repair of the EPL tendon, which of the following is most appropriate for coverage of the wound?

(A) Limberg flap
(B) Neurovascular skin kite flap from the index finger
(C) Reverse radial forearm flap
(D) Rhomboid-to-W-plasty
(E) Skin graft

The correct response is Option D.

In this patient, closure should be initially attempted with local tissue because of the increased recipient site morbidity associated with the transfer of a distant flap. A rhomboid-to-W-plasty should be used for coverage of the wound. This technique includes tissue from four directions, preventing the development of a "dog ear" deformity.

A Limberg flap uses tissue from one direction; use of this flap would result in a large deformity. A neurovascular skin kite flap is appropriate for large defects involving the dorsal aspect of the thumb. This flap can be combined with a reverse radial forearm flap for management of degloving injuries of the thumb. Skin grafting is inappropriate for management of a defect involving exposed tendons.

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63

A 58-year-old man has had a 15 × 7-cm nonhealing wound of the distal right lateral leg for 10 months. Radiographs show tibial osteomyelitis. He has insulin-dependent diabetes mellitus and smokes one pack of cigarettes daily. Examination shows a 5 × 5-cm exposure of the tibia with purulent drainage at the base of the wound; noninvasive vascular studies show a brachial-ankle index of 0.4. Renal function is adequate.

Which of the following is the most appropriate surgical management?

(A) Cross-leg flap reconstruction
(B) Gastrocnemius flap coverage with skin grafting
(C) Vascular bypass and free flap closure
(D) Below-knee amputation
(E) Above-knee amputation

The correct response is Option C.

The most appropriate management of this patient with chronic osteomyelitis is vascular reconstruction followed by free flap coverage. Noninvasive vascular studies indicating a brachial-ankle index less than 0.7 suggest ischemic peripheral vascular disease. In a patient with diabetes mellitus who has vascular calcinosis and noncompressible vessels, a falsely high value may result. Arteriography with attention to minimizing renal dye toxicity should be performed to identify treatable disease in any patient with clinically suspected ischemic disease. A vascular bypass followed by transfer of a free flap will provide revascularized tissue for coverage of the wound. Following closure, antibiotics can be administered intravenously to treat the osteomyelitis.

Reconstruction of the deformity with a cross-leg flap will not provide a vascularized blood supply; therefore, a patient with poor vascularity would be at increased risk for flap failure. In addition, division of this flap requires an immobilization period of two to three weeks, which increases the patient's risk for deep vein thrombosis.

In patients with chronic osteomyelitis, debridement of the tibia and coverage with a gastrocnemius flap is performed only in the absence of significant vascular disease. In this patient, the wound is too distal for coverage with a pedicle flap, especially the gastrocnemius muscle flap.

Amputation of the lower extremity above or below the knee is not advised in patients with insulin-dependent diabetes mellitus. A recent study has shown that half of patients with insulin-dependent diabetes mellitus who undergo amputation of one extremity are at increased risk for complications requiring amputation of the contralateral extremity within a subsequent two-year period.

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64

A 64-year-old man has had a 10-mm^2 nodule on the radial tip of the thumb for the past two years. Plain radiographs show periostitis of the underlying tuft. A specimen of the affected area obtained on punch biopsy indicates squamous cell carcinoma. A specimen obtained on bone biopsy confirms involvement of the periosteum. No metastatic nodes are palpable.

Which of the following is the most appropriate management?

(A) Laser ablation
(B) Excision with 5-mm margins and skin grafting
(C) Mohs' excision and skin grafting
(D) Amputation of the thumb at the level of the interphalangeal (IP) joint
(E) Ray amputation of the thumb

The correct response is Option D.

The most appropriate treatment of this patient with squamous cell carcinoma of the thumb is amputation of the thumb at the level of the IP joint. This technique addresses the bony involvement as well as the soft-tissue components. Appropriate amputation in this case is likely to be curative. The most common paronychial malignancy, squamous cell carcinoma, usually involves the thumb and has a higher incidence in men. It is often simply mistaken for paronychia.

Laser ablation is more appropriate for superficial cutaneous lesions without bony involvement.

Excision of the lesion with 5-mm margins and skin grafting is appropriate for treatment of patients with Bowen's disease. Patients with more extensive skin involvement or bony involvement, such as this patient, require a more proximal amputation.

In one study, Mohs' excision produced an unacceptable five-year cure rate of 75%. In contrast, amputation at the level of the IP joint is associated with a cure rate of 90% to 92%.

Ray amputation is too radical a procedure for this patient because it sacrifices the function of the thumb without improving the cure rate.

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65

A 70-year-old man has a 4-mm raised lesion on the dorsal aspect of the right hand. The lesion increases to 10 mm after seven weeks and decreases to 5 mm after four months. Which of the following is the most likely diagnosis?

(A) Arsenic keratosis
(B) Bowen's disease
(C) Eccrine poroma
(D) Keratoacanthoma
(E) Pilomatricoma

The correct response is Option D.

This patient most likely has a keratoacanthoma, a benign follicular lesion that may be confused with squamous cell carcinoma. All keratoacanthomas undergo three phases: rapid proliferation, maturation, and involution, each lasting up to eight weeks. This lesion has a central crater containing a keratin plug, which is expelled during involution. Excision is curative.

Patients with arsenic keratosis have multiple firm nodules on the palm due to prolonged ingestion of nonfatal doses of arsenic. Surgical extirpation is recommended because of the risk for development of Bowen's disease or squamous cell carcinoma.

Bowen's disease, or squamous cell carcinoma in situ, is frequently associated with an internal malignancy. These lesions appear on the dorsal aspect of the hand and progressively enlarge; 10% to 15% of affected patients develop invasive squamous cell carcinoma. Surgical excision is generally recommended. Topical therapy with 5% 5-fluorouracil may also be effective.

Eccrine poromas are lesions smaller than 2 cm that typically appear on the palm in patients older than 50 years. Malignant degeneration is rare.

Pilomatricoma (calcifying epithelioma of Malherbe) is a firm, subdermal lesion that arises from the lower dermis and is seen on the face and upper extremities. Local excision should be performed if the lesion becomes disfiguring or repeated inflammation occurs.

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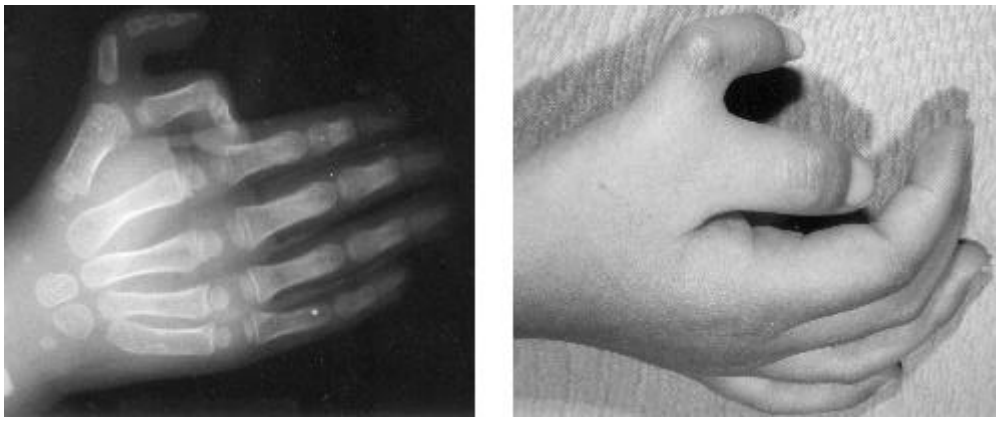
66



A 2-year-old girl has the congenital abnormality shown in the photograph and radiograph above. Which of the following procedures should be included in reconstruction?

(A) Extensor indicis proprius (EIP) tendon opponensplasty
(B) On-top plasty using the proximal phalanx of the radial duplicate and distal phalanx of the ulnar duplicate
(C) Reconstruction of the ulnar collateral ligament of the retained duplicate
(D) Transfer of the abductor pollicis brevis (APB) tendon of the radial duplicate to the ulnar duplicate
(E) Transfer of the flexor digitorum superficialis (FDS) tendon of the ring finger to the adductor tubercle of the thumb

The correct response is Option D.

Reconstruction of this child's thumb deformity should include transfer of the APB tendon from the radial duplicate to the ulnar duplicate. This patient has a Wassel type VII thumb duplication. Wassel's system is used to classify duplicate thumbs based on the extent of skeletal union. A patient with a type VII deformity has a duplication involving triphalangeal digits.

In a child with a Wassel type VII deformity, reconstruction should include the following procedures:

1. Identification and preservation of the APB muscle-tendon unit
This structure can be found at the radial base of the proximal phalanx in the radial duplicate thumb. It is then transferred into the ulnar duplicate to prevent the development of a "Z" deformity, in which the proximal phalanx is deviated ulnarly while the distal phalanx is deviated radially.

2. Reconstruction of the radial collateral ligament of the ulnar duplicate thumb
In this procedure, periosteal soft tissue is harvested from the radial proximal base of the radial duplicate thumb and reattached to the radial proximal base of the ulnar duplicate thumb.

3. Elimination of the extra-articular facet of the thumb metacarpal at the distal radial thumb
This will permit the metacarpal and proximal phalanges of the thumb to align properly, resulting in a straight digit.

4. Inventory and centralization of the extrinsic flexor and extensor tendons
These tendons should be harvested from the radial duplicate and used for augmentation of the ulnar duplicate, if necessary. Centralization will prevent progressive angular deformity of the phalanges.

This child has a highly functional ulnar duplicate thumb; tendon augmentation is not required. The photograph on the previous page shows skin incisions performed to allow for zigzag closure, which will prevent the development of deforming scar contractures typically seen with a straight-line closure.

EIP tendon opponensplasty and transfer of the FDS tendon of the ring finger are appropriate procedures for management of Blauthe grade II or III thumb hypoplasia, in which the thenar muscles are not fully developed. On-top plasty is performed for correction of an asymmetrical triphalangeal thumb. Reconstruction of the ulnar collateral ligament is not appropriate because the radial duplicate of the thumb should be excised.

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67

Which of the following is the most likely site of entrapment of the ulnar nerve in the arm?

(A) Arcade of Frohse
(B) Arcade of Struthers
(C) Lacertus fibrosus
(D) Ligament of Struthers
(E) Vascular leash of Henry

The correct response is Option B.

Although there are several potential sites of entrapment of the ulnar nerve, it is most likely to occur within the arcade of Struthers. This is a group of fascial folds within the medial intermuscular septum that can entrap the nerve, most commonly following anterior transposition. Another potential site of entrapment is the band of Osborne, which constricts the ulnar nerve as it passes through the cubital tunnel. Release of this band is critical during neuroplasty.

The arcade of Frohse and vascular leash of Henry are potential sites of entrapment of the deep branch of the radial nerve.

The median nerve may become entrapped beneath the lacertus fibrosus, which is a dense sheet of fascia that extends from the antebrachial fascia proximally to the biceps tendon, or the ligament of Struthers, which forms between the supracondylar humeral process and the medial epicondyle.

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68

A 65-year-old man has a 7-mm elevation just distal to the distal interphalangeal (DIP) joint of the left index finger and nail grooving. Physical examination shows no other abnormalities. Which of the following is the most likely diagnosis?

(A) Glomus tumor
(B) Mucous cyst
(C) Osteoblastoma
(D) Osteoid osteoma
(E) Schwannoma

The correct response is Option B.

This 65-year-old man most likely has a mucous cyst, a round, fluid-filled ganglion of the DIP joint that is most commonly seen in older persons. Nail grooving is frequently associated. Bone spurs may be seen on radiographs; however, bony deformities rarely occur with this lesion. Management includes excision of the cyst and surgical removal of any arthritic spurs.

A glomus tumor manifests as a small subungual mass with purple discoloration of the overlying skin. Symptoms include pain with pinpoint touch and cold sensitivity. MRI may be used in diagnosis.

Osteoid osteomas typically affect patients younger than age 20 years. These benign bony lesions are smaller than 1 cm and are associated with pain that is greatest at night and is relieved with administration of acetaminophen. Radiographs show a radiolucent zone surrounded by a distinctive area of cortical sclerosis. The metaphyseal-diaphyseal region of the hand, flat carpal bones, and large bones of the axial skeleton are most frequently affected.

Osteoblastomas are rare tumors that appear to be large osteoid osteomas. They have a nidus of 1 to 2 cm with a surrounding rim of cortical bone.

Schwannomas are common benign nerve tumors of Schwann cell origin. They are first seen in adults as asymptomatic soft-tissue masses along the course of a peripheral nerve. Surgical management involves an excisional biopsy. Nerve fascicles do not enter the lesion, so the tumor can be removed from the nerve without deficit.

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69

A 58-year-old automobile mechanic has had progressive wrist pain and decreased grip strength for two years. He sustained a severe wrist injury 30 years ago that was treated with cast immobilization for two months. A radiograph is shown above.

Which of the following is the most likely diagnosis?

(A) Advanced rheumatoid arthritis
(B) Kienböck's disease, stage 4
(C) Pantrapezial arthritis
(D) Psoriatic arthritis
(E) Scapholunate advanced collapse (SLAC)

The correct response is Option E.

This patient has findings consistent with scapholunate advanced collapse (SLAC) of the wrist, a common pattern of degenerative arthritis of the wrist. Causes of this condition include rotary subluxation or nonunion of the scaphoid, Preiser's disease, and Kienböck's disease. This patient's radiograph shows advanced radioscaphoid arthritis, osteophyte formation, and cystic degeneration of the scaphoid. There are degenerative changes between the scaphoid, lunate, and capitate. The capitate is migrating proximally between the scaphoid and lunate.

The patient subsequently underwent scaphoidectomy and four-corner arthrodesis; results are shown in the radiograph above.

Rheumatoid arthritis of the wrist is characterized by involvement of the ulnar carpal joint and subsequent supination of the carpus on the hand. A patient with rheumatoid arthritis would have involvement of the metacarpophalangeal (or, less commonly, the interphalangeal) joints of the hand, with resulting tenosynovial hypertrophy and ulnar drift of the digits.

Kienböck's disease is believed to result from microfractures of the lunate, which lead to ischemic changes and avascular necrosis. A patient with stage 4 (advanced) Kienböck's disease would have collapse of the lunate and loss of carpal height on radiographs.

Pantrapezial arthritis is an advanced type of basal joint arthritis of the thumb that involves the carpometacarpal joint and scaphotrapeziotrapezoid joints.

Patients with psoriatic arthritis typically have carpal collapse and consolidation and involvement of the metacarpophalangeal joint.

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70

A 28-year-old student sustains a sharp amputation of the volar pad of the nondominant index finger. No bone is exposed; there is an 8 × 5-mm defect. Which of the following is the most appropriate management of the defect?

(A) Dressing changes
(B) Cross-finger flap
(C) Moberg advancement flap
(D) Neurovascular island flap
(E) Thenar flap

The correct response is Option A.

This patient has a small (less than 10 × 10-mm) defect of the fingertip without exposed bone, tendon, or nerve. Dressing changes are effective in the management of this type of injury and will prevent the need for additional surgery and a secondary donor site.

A cross-finger flap is appropriate for amputations of the finger with exposed bone, tendon, or nerve. This flap can be lifted from the dorsal aspect of a healthy finger and transferred to cover the palmar aspect of the affected finger.

In patients who have palmar oblique amputations of the thumb, the Moberg advancement flap can be used to preserve as much length as possible. However, the flap cannot be advanced more than 2 cm. Contractures of the interphalangeal joint may occur.

A neurovascular island flap is typically transferred from the ulnar side of the ring or long finger to cover amputations involving the thumb. Complications with venous congestion are associated.

Thenar flaps are used for amputations involving the tip of the index or long finger to provide adequate soft-tissue padding over exposed bone and to preserve as much length as possible. Stiffness of the proximal interphalangeal joint and painful donor site scarring are frequent postoperative findings.

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71

A 33-year-old man has persistent weakness of the thenar muscles 18 months after undergoing repair of the median nerve at the wrist. Which of the following is the most appropriate transfer for thumb opposition?

	Donor	Pulley	Insertion
(A)	Brachioradialis	Palmaris longus	Extensor pollicis brevis
(B)	Extensor indicis proprius	Ulnar side of wrist	Proximal phalanx
(C)	Flexor carpi radialis	Transverse carpal ligament	Abductor pollicis longus
(D)	Flexor digitorum profundus (ring)	Flexor carpi ulnaris	Opponens pollicis
(E)	Flexor pollicis brevis	Free graft	Abductor pollicis brevis

The correct response is Option B.

In this patient who has a low median nerve palsy that has persisted despite attempts at surgical correction, the most appropriate procedure is transfer of the extensor indicis proprius tendon to the proximal phalanx. During surgery, the tendon graft is wrapped around the ulnar side of the wrist and inserted into the proximal phalanx to effectively restore thumb opposition.

Transferring the brachioradialis to the extensor pollicis brevis will not restore thumb opposition. The flexor carpi radialis and flexor pollicis brevis tendons do not provide adequate mechanical opposition of the thumb.

The flexor digitorum profundus tendon of the ring finger can be an alternate donor in a patient undergoing opponensplasty; however, use of the flexor digitorum profundus tendon results in decreased strength and flexion of the distal joint.

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72

A 32-year-old construction worker has the transverse fracture shown in the above radiograph. Which of the following best describes the displacement that typically occurs with this fracture?

(A) Apex dorsal
(B) Apex volar
(C) Radial translocation
(D) Ulnar translocation
(E) No displacement

The correct response is Option B.

This patient has a transverse fracture of the proximal phalanx with associated apex volar angulation. In this fracture, the proximal fragment is flexed and the distal fragment is extended. The proximal fragment is displaced via the flexion forces of the intrinsic muscles. Extension forces transmitted through the central slip of the extensor tendon would displace the distal fragment.

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73

A 50-year-old man has the deformity shown in the above photograph one year after sustaining a deep laceration to the proximal left forearm. Which of the following tendon transfers will restore power grasp in this patient?

(A) Crossed intrinsic tendon transfer of the involved digits
(B) Extensor indicis proprius tendon opponensplasty
(C) Transfer of the extensor carpi radialis longus (ECRL) tendon with prolongation grafts to the radial lateral bands of the ring and little fingers
(D) Transfer of the intrinsic tendons onto the dorsal aspect of the extensor tendon expansions of the involved digits
(E) Transfer of the flexor digitorum sublimis tendon around the A2 pulley (Zancolli II lasso procedure)

The correct response is Option C.

This patient has a high ulnar nerve palsy. The clawing of the ring and little fingers that is the hallmark of this condition results from dysfunction of the interosseous muscles and the two lumbrical muscles on the ulnar aspect of the hand. The hand is positioned with the metacarpophalangeal (MP) joints in extension and the proximal interphalangeal (PIP) joints in flexion; this is due to loss of intrinsic muscle function. Other aspects of a high ulnar nerve palsy include absence of distal interphalangeal joint flexion of the ring and little fingers, weakened thumb adduction, flattening of the transverse palmar arch, and weakness of grip due to paralysis of the innervated ulnar muscles.

Restoration of power grasp can be accomplished using the Brand's transfer, which adds an extra muscle-tendon unit to augment flexion of the proximal phalanx. In this procedure, the ECRL tendon is prolonged with tendon grafts, which are inserted into the radial lateral bands. This restores MP joint flexion and PIP joint extension and improves integration of MP and interphalangeal joint motion.

A crossed intrinsic transfer can be performed for correction of ulnar drift associated with rheumatoid arthritis. Because the intrinsic tendons are paralyzed in a patient with high ulnar nerve palsy, they should not be used for tendon transfer.

Opponensplasty is not indicated in a patient who has functioning thenar intrinsic muscles.

Transfer of the flexor digitorum sublimis tendon around the A2 pulley (Zancolli II lasso procedure) will move the clawed fingers into a more functional position. It does not add power for gross grip. This procedure is inappropriate for a patient with a high ulnar nerve palsy because it involves transfer of the functioning flexor tendons of the involved fingers.

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74

Two days after sustaining a superficial laceration of the left palm, a 44-year-old man has intense pain in the left hand. He is afebrile. Examination shows mild tachycardia and marked swelling and warmth of the hand, with tenderness on palpation. There is crepitus and generalized, poorly demarcated erythema of the palm and dorsal aspect of the hand that gradually fades into the more proximal uninvolved skin.

After administration of broad-spectrum antibiotics, which of the following is the most appropriate management?

(A) Splinting and observation
(B) Monitoring of compartment pressures
(C) Hyperbaric oxygen therapy
(D) Early surgical debridement
(E) Amputation

The correct response is Option D.

The patient most likely has a necrotizing soft-tissue infection of the hand. Because his symptoms are consistent with gangrene caused by group A ß-hemolytic streptococcus, he should undergo early surgical debridement. Prompt recognition and treatment of a necrotizing infection with surgical debridement markedly decreases the likelihood of subsequent amputation. Therefore, amputation is not an appropriate step in management at this time.

If a soft-tissue necrotizing infection is suspected, prompt treatment is required; therefore, observation and conservative management, including splinting, are inappropriate.

Although compartment pressure may be elevated secondarily in this patient, invasive monitoring is contraindicated because of the risk for contamination of uninvolved spaces.

Hyperbaric oxygen therapy is a useful adjunct in the treatment of clostridial gangrene. However, it is not appropriate as primary treatment of necrotizing infections and should not be used in the treatment of ß-hemolytic streptococcal infections.

Although purely hemolytic streptococcus pathogens were reported in a classic paper, most necrotizing infections that involve hemolytic streptococcus also involve other pathogens, including staphylococcus and gram-negative organisms. Until definitive culture results are available, broad-spectrum antibiotic therapy should be started immediately. Single agent therapy is insufficient.

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75

Which of the following groups of muscles in the upper extremity has double innervation?

(A) Brachialis, flexor digitorum superficialis, adductor pollicis
(B) Brachialis, flexor pollicis longus, brachioradialis
(C) Brachialis, flexor pollicis longus, flexor pollicis brevis
(D) Flexor digitorum profundus, flexor pollicis brevis, pectoralis major
(E) Flexor digitorum profundus, flexor pollicis longus, biceps brachii

The correct response is Option D.

Muscles of the upper extremity that have dual innervation include the brachialis, flexor digitorum profundus, flexor pollicis brevis, and pectoralis major. The flexor digitorum profundus and flexor pollicis brevis are both innervated by the median and ulnar nerves. The brachialis is innervated by the radial and musculocutaneous nerves, while the pectoralis major is innervated by the lateral and medial pectoral nerves.

Innervation is provided to the biceps brachii by the musculocutaneous nerve, to the brachioradialis by the radial nerve, and to the adductor pollicis by the ulnar nerve. The anterior interosseous nerve arises from the median nerve to supply innervation to the flexor pollicis longus. The flexor digitorum superficialis is innervated by the median nerve.

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76

A 64-year-old woman sustains an avulsion injury of the nondominant left ring finger when her wedding ring becomes caught on a nail. A photograph is shown above. Which of the following is the most appropriate management?

(A) Coverage with a groin flap
(B) Replantation with fusion of the distal interphalangeal (DIP) joint
(C) Replantation with skeletal shortening
(D) Revision amputation
(E) Split-thickness skin grafting

The correct response is Option D.

This 64-year-old woman has sustained an avulsion injury involving the left ring finger. These injuries can be classified into three types:

Class I	Incomplete avulsion with adequate perfusion
Class II	Incomplete avulsion with inadequate perfusion
Class III	Complete avulsion

Although some success has been reported following replantation of a completely avulsed digit, revision amputation is still the most appropriate management because the long-term function of the digit following replantation is often inadequate. Replantation with fusion of the DIP joint and/or skeletal shortening should only be attempted in certain patients, such as children and young women.

In patients with class II injuries, revascularization should be attempted.

The groin flap has no sensation and is too bulky for coverage of this patient's wound.

Split-thickness skin grafting over exposed tendon and bone would not provide adequate soft-tissue padding and would result in a painful amputation stump.

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77

A 24-year-old man sustains an injury to the dominant right index finger when he cuts his finger with a saw. On examination, he has a 2.5-cm defect of the finger with associated nerve injury; autografting is required. Which of the following nerves is most appropriate for grafting?

(A) Dorsal branch of the ulnar nerve
(B) Medial antebrachial cutaneous nerve
(C) Superficial radial nerve
(D) Sural nerve
(E) Terminal branch of the posterior interosseous nerve

The correct response is Option E.

The terminal branch of the posterior interosseous nerve is most appropriate for grafting of this patient's defect. The posterior interosseous nerve can be found deep to the extensor tendons at the level of the wrist. It lies in the floor of the fourth extensor compartment on the radial side, ulnar and deep to the extensor pollicis longus tendon and muscle. The terminal branch is frequently harvested for defects of the digital nerve because one fascicular strand can be transferred to replace a single digital fascicle. Because it is an articular branch of the nerve, there is no associated sensory deficit.

The dorsal branch of the ulnar nerve provides 15 cm of nerve for grafting, but harvest of this branch is associated with numbness on the dorsoulnar aspect of the hand.

Harvest of the median and lateral antebrachial cutaneous nerves can be associated with significant donor site morbidity. This is a less favored site for grafting due to the large amount of interfascicular tissue surrounding the nerves.

The superficial radial nerve is best used for nerve reconstruction in a patient with a pre-existing lesion of the high radial nerve with degeneration. Harvest of this nerve is associated with numbness of the forearm and hand.

Use of the sural nerve for grafting involves harvest from the lower leg and ankle with an associated donor site defect. Approximately 40 cm of nerve graft can be obtained from this site.

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78

A 46-year-old man has pain in the forearm that is exacerbated by resisted supination of the forearm. Which of the following is the most likely diagnosis?

(A) Anterior interosseous syndrome
(B) Intersection syndrome
(C) Medial epicondylitis
(D) Pronator syndrome
(E) Radial tunnel syndrome

The correct response is Option E.

The most likely diagnosis in this patient with forearm pain is radial tunnel syndrome, or compression of the radial nerve within the radial tunnel. This condition is characterized by pain that occurs with extension, supination against resistance, and passive flexion and pronation of the wrist. Pain is localized just below the elbow in the extensor mass and along the course of the radial nerve.

Anterior interosseous syndrome results from compression of the anterior interosseous branch of the median nerve in the deep volar compartment. Affected patients have poorly defined pain in the forearm and weakness of the profundus tendon of the index finger and the flexor pollicis longus tendon, but no sensory deficit.

Intersection syndrome results from tenosynovitis of the second dorsal compartment. There is pain and swelling of the muscle bellies of the abductor pollicis longus and extensor pollicis brevis tendons as they cross over the extensor tendons in the radial wrist.

Medial epicondylitis ("golfer's elbow") is characterized by tenderness over the medial elbow at the origin of the flexor pronator muscle that is exacerbated with wrist flexion and resisted pronation.

Pronator syndrome is caused by compression of the median nerve in the proximal forearm and is characterized by pain in the forearm and sensory symptoms in the thumb, index finger, and middle finger. Symptoms increase with resisted pronation.

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79

The photograph shown above is of a 65-year-old man who has had chronic paronychia since sustaining an injury to the fingertip 20 years ago. Which of the following is the most appropriate management?

(A) Biopsy of the fingertip
(B) Bone scan
(C) Culture and sensitivity of the fingertip
(D) Prolonged course of oral antibiotic therapy
(E) Unroofing of the eponychial fold

The correct response is Option A.

Because of the close association between chronic paronychia and squamous cell carcinoma, this patient should first undergo biopsy of the fingertip to rule out the presence of a malignant tumor.

Many patients with primary squamous cell carcinomas are mistakenly diagnosed initially with chronic paronychia; however, malignant transformation of a chronic paronychia infection may also occur, leading to the development of squamous cell carcinoma. If the biopsy specimen shows no indication of malignant transformation, other potential causes of the infection may then be explored.

Bone scan can be used to diagnose osteomyelitis, which may be another cause of this patient's findings. Culture and sensitivity may also be performed to determine the appropriate antibiotic therapy in the absence of a malignant tumor.

A radical incision and drainage procedure involving unroofing of the eponychial fold, followed by prolonged oral antibiotic therapy, is effective in treating recurrent nail infections.

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80

An 8-year-old girl has stiffness of the digits and loss of the flexion crease at the proximal interphalangeal (PIP) joint. These findings are most consistent with

(A) camptodactyly
(B) clinodactyly
(C) ectrodactyly
(D) macrodactyly
(E) symphalangism

The correct response is Option E.

This 8-year-old girl has symphalangism, or congenital stiffness of the interphalangeal joints. The PIP joint is most frequently affected. Flexion creases are typically absent.

Camptodactyly is a developmental flexion contracture of the PIP joint, resulting in an anteroposterior deviation of the finger. It is typically bilateral and usually affects the little finger.

Clinodactyly involves radioulnar deviation of one or more fingers. It may be caused by abnormal development of bone, and most commonly affects the middle phalanx of the little finger. Deviation of the distal phalanx occurs at the level of the distal interphalangeal joint.

Ectrodactyly is total or partial absence of one or more fingers or the entire hand. Typical cleft hand is classified as the absence of digits or metacarpals within the central portion of the hand. This condition is familial and is associated with syndactyly and clubfoot. The middle fingers are most commonly absent. In patients with atypical cleft hand, there is sporadic involvement of several fingers; the foot is not affected. This condition is sometimes referred to as a lobster-claw hand.

Patients with macrodactyly have a disproportionate overgrowth of one digit, most commonly the index finger. Stiffness is a frequent finding.

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81

A 33-year-old man is found in bed after taking an overdose of street drugs. His left forearm has been wedged between a wall and a bedpost for approximately 10 hours. On examination, the forearm and hand are diffusely swollen. Which of the following findings is most helpful in establishing the diagnosis of compartment syndrome?

(A) Accentuation of pain with passive muscle stretching
(B) Diminished sensation on two-point discrimination
(C) Obliteration of distal pulses by compartmental swelling
(D) Pallor
(E) Tenseness and tenderness on palpation

The correct response is Option A.

This patient has compartment syndrome, which is due to prolonged limb compression, resulting in muscle and nerve ischemia. Pain is the hallmark of this condition and is accentuated by passive stretching of the involved muscle compartment, which is the most consistent early sign. Patients with injuries of the upper and lower extremities should be closely monitored for the presence of muscle, nerve, and tissue ischemia.

In some patients with compartment syndrome, central or peripheral sensory deficits or late nerve ischemia may preclude the presence of pain as a diagnostic finding.

Measurement of compartment pressures is an important step in the diagnosis of compartment syndrome, especially in patients who have sustained head trauma or spinal cord injuries. Decompressive fasciotomy should be performed in normotensive patients when compartment pressures are greater than 30 mmHg and the duration of symptoms is longer than eight hours or is unknown, or the patient is unconscious or uncooperative. Patients with hypotension and compartment pressures greater than 20 mmHg should also undergo surgery within six hours.

In compartment syndrome, distal pulses may still be present. The affected extremity may appear cyanotic, pale, or normal. Sensation may be normal or diminished.

Tenseness and tenderness of the injured extremity are nonspecific findings that are not necessarily associated with ischemic tissue damage.

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The above photograph is of a 37-year-old roofer who sustained burn injuries to the right hand when he fell and inadvertently immersed his hand in roofing tar that had a temperature of 260.2EC (500EF). Which of the following is the most appropriate initial management?

(A) Leaving the tar on and splinting
(B) Removing the tar with butter and splinting
(C) Excision of the tar, debridement of the burned tissue, skin grafting, and splinting
(D) Escharotomy followed by splinting
(E) Fasciotomy followed by splinting

The correct response is Option B.

The most appropriate management of this 37-year-old roofer who has sustained tar burns to the right hand is removal of the tar using butter followed by splinting of the hand. Because tar used in the roofing industry is normally heated to 260.2EC (500EF), it adheres easily to the skin. Such injuries typically result in second-degree burns on the palmar aspect of the hand and deep second-degree or third-degree burns on the dorsal aspect. Although the tar can be left on in extreme circumstances, it should be removed to decrease the patient's discomfort and allow the surgeon to adequately assess the underlying tissue damage. Butter is readily available in the hospital setting and will remove the adherent tar without difficulty. Neomycin sulfate ointment can also be used, but it is more costly. The hand should then be splinted to allow for primary epithelialization of the burn wound, and occupational therapy should be started as soon as possible.

Escharotomy is performed in patients with circumferential third-degree burns following prolonged exposure to the burn-inducing agent. If the tar is not removed promptly, excision followed by skin grafting and/or fasciotomy may be required.

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83

A 35-year-old woman sustains a full-thickness avulsion of the skin on the dorsal aspect of the dominant left hand and wrist. Examination shows a 12 × 5-cm wound with exposed extensor tendons at its base. Which of the following is most appropriate for soft-tissue reconstruction?

(A) Full-thickness skin graft
(B) Immediate tissue expansion with closure
(C) Porcine xenograft
(D) Rectus abdominis myocutaneous free flap
(E) Temporoparietal fascia flap with skin graft

The correct response is Option E.

The most appropriate management of this patient's soft-tissue defect of the hand and wrist is reconstruction using a temporoparietal fascia flap and skin graft. Because the skin on the dorsal aspect of the hand is thin, nonglabrous, and mobile, the replacement tissue used should be similar. The temporoparietal fascia flap is easily harvested and allows for smooth tendon gliding.

A full-thickness skin graft or a porcine xenograft should not be used in a patient with exposed tendon because of the inadequate blood supply. Tissue expansion would be technically difficult in this location due to the size of the defect and the time required to complete the expansion. The rectus abdominis myocutaneous flap is excessively bulky and would not provide optimal tendon gliding.

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84

A 49-year-old man with diabetes mellitus has diffuse erythema, pain, and swelling over the dorsal aspect of the left ring finger 24 hours after scraping the finger on a door. Which of the following is the most appropriate management?

(A) Observation
(B) Administration of an antifungal drug
(C) Elevation of the hand, intravenous administration of antibiotics, and observation
(D) Incision and drainage followed by administration of antibiotics
(E) Radical debridement of the affected tissues

The correct response is Option C.

The most likely diagnosis in this patient with diabetes mellitus is cellulitis, an infection of the soft tissues characterized by swelling, pain, and erythema. Appropriate management includes elevation of the hand and intravenous administration of antibiotics. Splint immobilization may also help to rest the hand. Careful observation for the patient's response to antibiotics or any signs of abscess formation is also appropriate.

Observation alone will not effectively treat this patient's cellulitis. An antifungal drug is appropriate for the treatment of a fungal infection of the fingernails. Incision and drainage is effective for treatment of bacterial infections with abscess formation, such as those resulting from human bite injuries. Radical debridement is used for treatment of severe infections (eg, necrotizing fasciitis).

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85

A 58-year-old man requests definitive relief of severe wrist pain. A radiograph is shown above. Which of the following is the most appropriate management?

(A) Arthroplasty with a silicone implant
(B) Intercarpal arthrodesis
(C) Proximal row carpectomy
(D) Radial shortening
(E) Total wrist arthrodesis

The correct response is Option E.

This patient who has severe pain resulting from rheumatoid deformities should undergo total wrist arthrodesis, which will relieve pain and provide stability of the joint. Although wrist mobility is sacrificed with this procedure, it is often performed in patients with severe radiocarpal-hand instability and severe rheumatoid arthritis of both wrists. Total arthrodesis should also be considered if joint replacement is unsuccessful or results in the development of sepsis.

Hinge arthroplasty with a silicone implant will provide some mobility but requires near total absence of stress on the wrist. This procedure places the patient at greater risk for the development of silicone synovitis associated with breakage of the implant.

Intercarpal arthrodesis is most effective in patients with mild to moderate midcarpal involvement. Proximal row carpectomy is not recommended for patients with rheumatoid arthritis. Radial shortening is most appropriate for treatment of Kienböck's disease (avascular necrosis of the lunate).

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86

A 45-year-old machinist with suspected radial tunnel syndrome is undergoing evaluation prior to surgical decompression. Which of the following is most likely to confirm the diagnosis?

(A) Extensor indicis proprius muscle strength of grade 4/5
(B) Fibrillation of the extensor digiti quinti muscle/tendon on EMG
(C) Injection of corticosteroids into the lateral epicondyle
(D) Selective anesthetic block of the posterior interosseous nerve
(E) Tinel sign radiating distally to the dorsal radial hand

The correct response is Option D.

Radial tunnel syndrome involves compression of the deep branch of the radial nerve, or posterior interosseous nerve, within the radial tunnel. This can occur at the leash, or fan, of radial recurrent vessels, the tendinous edge of the extensor carpi radialis brevis (ECRB) tendon, or the arcade of Frohse, which is the free, fibrous edge of the superficial belly of the supinator muscle. Symptoms include an aching pain that is localized just below the elbow along the extensor and supinator muscles within the proximal forearm. Approximately 5% of patients with lateral epicondylitis ("tennis elbow") also have symptoms consistent with radial tunnel syndrome.

This condition is primarily diagnosed on clinical evaluation. Findings seen on physical examination include tenderness directly over the supinator muscle and tenderness with resisted supination and resisted extension of the middle finger. Selective anesthetic block of the radial tunnel will confirm the diagnosis.

Patients with radial tunnel syndrome have no sensory or motor deficits; therefore, muscle strength is likely to be unaffected and EMG will show no abnormalities.

Injection of a corticosteroid into the radial tunnel is appropriate treatment of lateral epicondylitis but would be ineffective for diagnosing a patient with radial tunnel syndrome.

Tinel sign of nerve irritability is generally not present in patients with radial tunnel syndrome.

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87

A 73-year-old woman who is a recreational gardener sustains a sharp amputation of the tip of the thumb. The amputated tip measures 1.5 cm. There is no exposure of the underlying bone or tendon. Which of the following is most appropriate for coverage of the wound?

(A) Primary closure
(B) Graft using the defatted amputated part
(C) Hypothenar flap
(D) Moberg flap
(E) Sensate heterodigital island flap

The correct response is Option B.

This 73-year-old woman has a 1.5-cm sharp amputation of the tip of the thumb. Because of this patient's age, the moderate amount of tissue loss, and her use of the thumb for recreational (nonwork) activities only, the most appropriate management is grafting using the defatted amputated part. This will allow good function of the hand without performing any unnecessary or excessive procedures.

Primary closure can be used for small defects with minimal tissue loss (less than 1 cm). Direct closure should not be performed if it will result in tension, shortening, or matrix deformity.

A cross-finger or hypothenar flap should be considered if pulp loss is greater than 1.5 cm in diameter and bone is exposed. These procedures often require multiple stages and may not be the best option for an older patient. The Moberg flap is often used for reconstruction of a thumb amputation because of the dual vascular supply of the thumb. A sensate heterodigital island flap is most effective in a patient who has a durable, sensate thumb tip and partial pulp loss. This procedure requires removal of a digital nerve, which results in a sensory deficit at the donor site.

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88

A 26-year-old man sustains an unstable type III dorsal fracture-dislocation of the proximal interphalangeal (PIP) joint of the middle finger while playing basketball. Anatomic reduction is not possible because the fracture fragments are comminuted. A radiograph is shown above. Which of the following is the most appropriate management?

(A) Arthrodesis of the joint
(B) Closed reduction and percutaneous pin fixation
(C) Delayed vascularized toe joint transfer
(D) Implant resection arthroplasty of the joint
(E) Palmar plate advancement arthroplasty

The correct response is Option E.

The most appropriate management of this patient's injury is palmar plate advancement arthroplasty. One study reported that patients with unstable type III dorsal fracture-dislocations of the PIP joint who underwent this type of reconstruction within six weeks of injury achieved an average PIP joint range of motion of 95 degrees. In some patients, successful reconstruction has been performed as late as two years after injury.

Arthrodesis should only be performed in patients who have had no improvement following arthroplasty.

Closed reduction without restoration of articular congruity may result in a painful stiff joint, even if it is temporarily stabilized by a percutaneous pin.

A vascularized toe joint transfer is a complex procedure used for joint salvage. It results in limited range of motion.

Implant resection arthroplasty will sacrifice the uninjured proximal joint surface. This procedure is associated with limited range of motion and increased joint instability.

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89

A 46-year-old man who works as a custodian is brought to the emergency department after spilling bleach on his upper arms and hands. Which of the following is the most appropriate management?

(A) Copious irrigation with water
(B) Topical application of copper sulfate
(C) Topical application of glycerol
(D) Placing the hands in gloves containing 2.5% calcium gluconate gel
(E) Injection of calcium gluconate into the affected areas

The correct response is Option A.

The most appropriate management of this patient's burn injury is copious irrigation with water. Chemical burns are associated with frequent morbidity and mortality and should be treated initially with copious water lavage. Because bleach primarily contains sodium hypochlorite, exposure to skin results in oxidization, leading to tissue damage. Neutralizing agents should not be used because the process of neutralization may produce additional heat, leading to further injury. Acid burns may be irrigated safely for up to six hours; alkaline burns may take longer to stabilize.

Copper sulfate is used in the management of white phosphorus burns to identify the areas of skin that contain residual chemicals following water lavage. The copper sulfate rinse forms a filmy covering of darkened cupric phosphide particles, which can then be removed.

Phenol burns should be treated with topical application of glycerol, propylene, or polyethylene glycol.

Injection or topical application of calcium gluconate is appropriate for hydrofluoric acid burns if burning pain persists following water irrigation.

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90

A 30-year-old woman has a boutonnière deformity after sustaining a forceful closed hyperflexion injury of the proximal interphalangeal (PIP) joint of the right index finger. Radiographs show no evidence of fracture or dislocation. Which of the following is the most appropriate initial management?

(A) Observation for resolution of the deformity
(B) Splinting of the PIP joint in extension for four to six weeks
(C) Splinting of the PIP joint in flexion for four to six weeks
(D) Surgical repair of the central slip
(E) Surgical repair of the lateral bands

The correct response is Option B.

In this patient who has developed a boutonnière deformity, the most appropriate management is splinting the PIP joint in extension for four to six weeks. This deformity occurs following closed blunt trauma to the finger. Disruption of the central slip from its insertion allows the lateral bands to migrate volarly and flex the PIP joint while hyperextending the distal interphalangeal joint. The patient is unable to actively extend the PIP joint. Patients with closed injuries may not develop the deformity until two to three weeks after initial trauma.

Splinting the PIP joint in full extension allows the disrupted ends of the central slip to heal. The distal joint is not immobilized, and should be actively flexed to draw the lateral bands dorsally and distally.

Observation would not be appropriate because this deformity will not resolve spontaneously. Splinting the PIP joint in flexion would not correct the migration of the lateral bands. Surgical repair of the central slip can be performed in patients with open lacerations over the PIP joint. Surgical repair of the lateral bands is not indicated because they are not disrupted.

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91

The radiograph shown on the previous page is from an otherwise healthy 25-year-old man who suddenly developed pain in the right hand after he caught a basketball. Which of the following is the most likely diagnosis?

(A) Enchondroma
(B) Metastatic renal cell carcinoma
(C) Osteogenesis imperfecta
(D) Soft-tissue contusion
(E) Unicameral bone cyst

The correct response is Option A.

This patient has a pathologic fracture originating from a benign enchondroma. These tumors are the most common cause of pathologic fractures in persons age 10 to 30 years. Radiographs show an expansile radiolucency of the metaphyseal-diaphyseal region of the proximal phalanges with thinning of the bony cortex. Appropriate management includes immobilization of the fractured hand, followed by curettage and bone grafting after fracture healing. This patient should also be evaluated for Ollier disease (multiple enchondromatosis) and Maffucci syndrome (multiple enchondromatosis associated with vascular hemangiomas).

Renal cell carcinoma can metastasize to lytic bone lesions of the hand, but this is an extremely rare finding and would be more likely to involve the distal phalanges. Osteogenesis imperfecta is a generalized connective tissue disorder with defects of the intracellular bone matrix. With this condition, radiographs show osteopenia, with thin bony cortices prone to multiple fractures. Unicameral bone cysts are uncommon in the hand and are usually seen in childhood to adolescence. They generally occur centrally in the metaphysis of long bones (eg, the proximal humerus and femur).

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92

A 40-year-old woman develops anxiety and involuntary muscle twitching while undergoing carpal tunnel release during intravenous regional anesthesia (Bier block). Which of the following is the most appropriate management?

(A) Reassuring the patient and continuing with the procedure
(B) Checking the tourniquet pressure and reinflating the tourniquet
(C) Deflating the tourniquet 25 mmHg
(D) Administering lidocaine intravenously and continuing with the procedure
(E) Administering diphenhydramine intravenously and continuing with the procedure

The correct response is Option B.

This 40-year-old woman has most likely developed early lidocaine toxicity following tourniquet failure. Initial signs include anxiety, tinnitus, and perioral numbness; muscular twitching, seizures, and respiratory or circulatory arrest may develop later. This patient's condition is most effectively managed by checking the tourniquet and restoring pressure to prevent additional lidocaine from entering the systemic circulation. Maintenance of the airway is critical. The patient should be ventilated with oxygen, and fluids should be administered intravenously; diazepam or thiopental may be used to treat seizures.

Continuing with the procedure without addressing the patient's distress may lead to the development of more serious complications. Deflating the tourniquet or administering additional lidocaine would worsen this patient's condition by increasing the serum level of lidocaine. Diphenhydramine should not be administered because this patient's symptoms are not consistent with an allergic reaction.

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93

A 25-year-old model has a healed amputation of the nondominant left thumb at the level of the proximal phalanx. She wishes to continue her career and wants to achieve the best cosmetic appearance without sacrificing her current level of function. Which of the following is the most appropriate management?

(A) Pollicization of the index finger
(B) Toe wraparound procedure
(C) Great toe transfer
(D) Second toe transfer
(E) Use of a prosthesis

The correct response is Option E.

Each of the procedures specified above has been used for reconstruction of the thumb, with varying degrees of success. Because this patient wishes to maintain her appearance without sacrificing function of the digit, use of a prosthesis is most appropriate. Although it does not have sensation, the prosthesis provides a natural-looking thumb and is not associated with any donor site morbidity.

Pollicization would require removal of the index finger, leaving an unsightly donor defect, and would not provide a cosmetically acceptable thumb.

Using the toe wraparound procedure would result in an aesthetically pleasing thumb but would also leave an associated donor site defect. Because the harvested site does not involve joints or tendons, it is used for distal amputations.

Transfer of either the great or second toe would provide adequate thumb reconstruction, but would be unacceptable cosmetically.

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94

A 43-year-old woman with CREST syndrome has pain and ulceration of the middle and ring fingers of the left hand. Which of the following is the LEAST effective management?

(A) Cessation of smoking by the patient
(B) Temperature biofeedback
(C) Administration of a calcium channel blocker agent
(D) Peripheral periarterial sympathectomy
(E) Cervicothoracic sympathectomy

The correct response is Option E.

This 43-year-old woman has symptoms typical of Raynaud's phenomenon, a debilitating component of CREST syndrome. Raynaud's phenomenon is characterized by ischemic pain, nonhealing ulcers, and development of gangrene due to inadequate tissue perfusion. Management is complex and involves optimizing nutritional blood flow to the hand relative to thermoregulatory blood flow.

Symptoms may be effectively reduced or controlled through modifications in behavior and environment, including cessation of smoking and avoidance of cold temperatures. Some patients have improvement of symptoms with temperature biofeedback. Nifedipine, a calcium channel blocker, is prescribed initially.

Patients with vasospasm, ulcers, severe pain refractory to administration of calcium channel blockers, or impending gangrene should be considered for peripheral periarterial sympathectomy. Arterial reconstruction may also be performed for treatment of distal occlusive disease.
Improvement is often seen initially following cervicothoracic sympathectomy, but this procedure is associated with a recurrence rate of greater than 50%. Recurrence may be due to incomplete sympathectomy, nerve regeneration, reflex catecholamine hypersensitivity, and alternate sympathetic nerve pathways.

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95

Which of the following patients is the LEAST likely candidate for replantation of a digit?

(A) A 9-year-old boy with an amputation of the index finger through the proximal interphalangeal (PIP) joint
(B) A 22-year-old musician with an amputation of the little finger through the metacarpophalangeal joint
(C) A 37-year-old woman with an amputation of the ring finger through the proximal phalanx
(D) A 39-year-old laborer with an amputation of the index finger through the proximal interphalangeal (PIP) joint
(E) A 68-year-old retiree with an amputation of the thumb

The correct response is Option D.

Indications for replantation of the fingers are variable. Replantation is most successful in patients who have sustained sharp lacerations. Amputated thumbs are more frequently replanted. Replantation of a single digit is usually only performed in patients with special considerations, including children, young women (especially with amputations of the ring finger), patients with cosmetic concerns, and musicians or other persons with occupations requiring five functioning, sensate fingers.

It is important to consider the length of time between injury and replantation before planning surgery. Warm ischemic digits may be replanted as late as eight hours or longer after initial amputation; cooled digits have been successfully replanted several days after injury. However, the replanted digit may be stiff, painful, and intolerant to cold.

The 39-year-old laborer who has an amputation through the PIP joint of the index finger is the least likely candidate for replantation. The index finger is frequently the most expendable; in tasks involving fine grip, the middle finger can be used in its place. In addition, the patient can return to work sooner due to the shortened recovery period following amputation.

Replantation is contraindicated in patients with multiple levels of injury, avulsion injuries, or prolonged warm ischemic time.

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96

A 5-year-old boy has the deformity shown in the above photograph. His family is concerned about the risk for development of similar deformities in his siblings or offspring. Which of the following is the mode of transmission of this disorder?

(A) Autosomal dominant
(B) Autosomal recessive
(C) Sporadic
(D) X-linked

The correct response is Option C.

This 5-year-old boy has constriction band syndrome, a congenital hand deformity that has no known genetic transmission. Congenital band syndrome is thought to occur following rupture of the amniotic membranes caused by oligohydramnios; when this occurs, the digits and/or extremities are compressed and constricted by amniotic tissue bands. This condition can be distinguished from syndactyly by the presence of proximal fenestrations between the digits; it can also be differentiated from syndactyly because the hand architecture and anatomy is relatively normal up to the level of the constriction banding.

Apert and Pfeiffer syndromes are examples of autosomal dominant disorders with hand anomalies. In patients with Apert syndrome, there is symmetric syndactyly of the hands and feet, whereas Pfeiffer syndrome is characterized

by enlarged, bulbous thumbs and halluces. Carpenter syndrome is an autosomal recessive disorder associated with polysyndactyly of the feet and shortened hands with variable soft-tissue syndactyly. Poland syndrome is a sporadically occurring disorder in which there may be syndactyly combined with short, stiff digits. In general, syndactyly also occurs sporadically; however, the cause may be familial in as many as 15% of affected patients.

X-linked disorders with hand involvement include orofacial digital syndrome I, which is characterized by shortened, webbed digits, facial clefting, and oral anomalies, and whistling face syndrome, which is characterized by ulnar deviation of the fingers, contracted thumbs, and orofacial anomalies.

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97

A 24-year-old woman sustains a complete laceration of the ulnar nerve at the elbow. On examination, with the fingers in extension, she is unable to adduct the little finger to the ring finger. This finding is most consistent with which of the following?

(A) Finkelstein test
(B) Froment sign
(C) Tinel sign
(D) Wartenberg sign

The correct response is Option D.

This patient has findings consistent with Wartenberg sign. With the fingers in extension, there is a loss of adduction of the little finger toward the ring finger. This occurs because of paralysis of the third palmar interosseous tendon and the resultant unopposed actions of the extensor digiti minimi tendon.

A positive Finkelstein test is defined as the occurrence of pain with extension of the extensor pollicis brevis and abductor pollicis longus tendons when the wrist is deviated ulnarly. Positive findings on this test typically denote the presence of de Quervain disease.

Froment sign is characterized by adduction of the thumb and hyperflexion of its interphalangeal joint, resulting in closure of the first web space during attempted key pinch. Patients with a positive Froment sign have paralysis of the first and second palmar interosseous tendons and the adductor pollicis tendon. This may also be referred to as the Bunnell "O" sign because the affected patient is unable to make an "O" with the thumb and index finger.

Tinel sign, which is a tingling sensation resulting from regenerating nerve axons, can be elicited by tapping the area overlying an injured nerve.

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98

A 29-year-old construction worker has had persistent pain in the left wrist since he fell from a six-foot platform onto his left hand and wrist two months ago. Radiographs show a dorsiflexed intercalated segment instability (DISI) pattern with 20 degrees of dorsal angulation of the lunate, volar flexion of the scaphoid, and an 85-degree scapholunate angle.

These findings are most consistent with injury to which of the following ligaments?

(A) Lunotriquetral
(B) Radiolunate
(C) Radioscaphocapitate
(D) Scapholunate

The correct response is Option D.

The dorsiflexed intercalated segment instability (DISI) seen in this patient is most likely caused by a complete tear of the scapholunate ligament. The normal, healthy wrist has a scapholunate angle of 30 to 60 degrees (average of 45 degrees), with the scaphoid palmarly flexed at 30 to 60 degrees and the articular surface of the lunate horizontally oriented in neutral (0 degrees). In contrast, a patient with a tear of the scapholunate ligament will have an increased scapholunate gap of greater than 2 mm to 3 mm, a palmarly flexed scaphoid bone with a dorsally extended lunate bone, and an increased scapholunate angle of greater than 80 degrees. Findings on the Watson test will be positive. Anteroposterior radiographs will show shortening of the scaphoid and a cortical ring sign. If the ligament tear is not treated expediently, the patient will experience persistent pain and degenerative arthritis of the wrist, potentially leading to the development of scapholunate advanced collapse (SLAC).

Severe lunotriquetral ligament tears will result in a volar-flexed intercalated segment instability (VISI), in which there is volar flexion of the lunate bone and a decreased scapholunate angle. Tears of the radioscaphocapitate ligament will not produce a DISI pattern of carpal instability in the absence of an associated scapholunate ligament tear. The radiolunate ligaments provide strong palmar forces for stabilization of the lunate against the radius during extension.

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99

During harvest of a plantaris free tendon graft, the incision should be placed anterior to the

(A) lateral malleolus
(B) lateral margin of the Achilles tendon
(C) medial malleolus
(D) medial margin of the Achilles tendon

The correct response is Option D.

Harvest of a plantaris free tendon graft involves placement of an incision anterior to the medial margin of the Achilles tendon; the incision should be 1.5 cm in length and located above the shoe line. The plantaris tendon runs obliquely between the gastrocnemius and soleus muscles and inserts on the medial posterior aspect of the calcaneus. It is used during flexion of the knee and plantar flexion of the foot and is often harvested for grafting, especially if the palmaris longus tendon in the forearm is absent or too short or if multiple tendon grafts are required. However, the plantaris tendon cannot be verified prior to surgery and is in fact absent in 7% to 20% of persons. If the tendon is present, it may be difficult to locate during surgery.

During harvest, the tendon is identified following blunt dissection and then divided near its insertion. With the knee in extension, the distal tendon end is fixed with a holding suture, while the proximal end is advanced under direct vision using a tendon stripper. The tendon stripper will then advance through the muscle belly, allowing the tendon to be drawn out.

Incision anterior to the lateral margin of the Achilles tendon is appropriate for harvest of a sural nerve graft, while incision anterior to the medial malleolus is appropriate for harvest of a great saphenous vein graft. Incising anterior to the lateral malleolus would not be indicated for harvest of any nerve, vein, or tendon.

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100

A 25-year-old woman has dysesthesias, arthralgias, and stiffness of the hands, wrists, and feet associated with swelling and laxity of the joints. These findings are most consistent with

(A) Raynaud disease
(B) Raynaud phenomenon
(C) reflex sympathetic dystrophy
(D) scleroderma
(E) systemic lupus erythematosus

The correct response is Option E.

This 25-year-old woman has findings consistent with systemic lupus erythematosus, an autoimmune disorder characterized by arthralgias of the hands, wrists, and feet and swelling of the joints. Systemic lupus erythematosus typically affects women of child-bearing age. Neurologic involvement is common; a malar rash can also be seen.

Raynaud disease is a vasospastic disorder characterized by triphasic color changes of the skin. This disorder has no gender predilection and typically has its onset in patients ages 30 to 50 years. Hand symptoms are bilateral and dysesthesias of the extremities are associated. Symptoms must be present for two years before a definitive diagnosis can be made.

In patients with the Raynaud phenomenon, there are episodic triphasic color changes of the digits following stress or cold exposure. Digital gangrene may result. This condition often occurs in patients with connective tissue disorders such as scleroderma.

Patients with reflex sympathetic dystrophy have the sudden onset of diffuse pain and hypersensitivity of one extremity following surgery or trauma to the extremity. Signs and symptoms of reflex sympathetic dystrophy include diminished hand function, joint stiffness, color changes, and vasomotor instability.

Characteristic findings in patients with scleroderma include shiny edema of the skin and stiffness of the joints. Vasospasm of the digits may lead to ischemia and ultimately to the ulceration typically associated with the Raynaud phenomenon. These conditions may occur concomitantly as part of the CREST syndrome.

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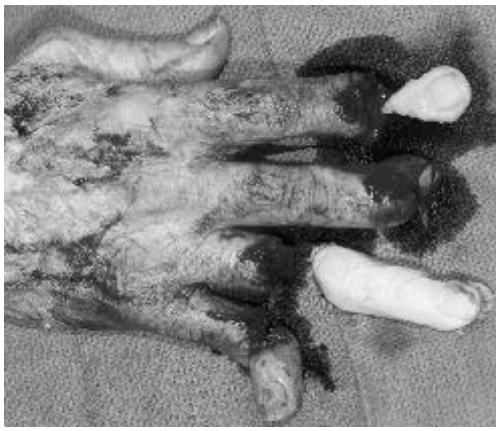

An otherwise healthy 70-year-old cabinet maker sustains complete amputations of the index and ring fingers of his dominant right hand; a photograph is shown above. He wants to return to work as soon as possible. Which of the following is the most appropriate operative management of the index and ring fingers?

(A) Shortening and closure of the ring finger with healing of the index finger by second intention
(B) Shortening and closure of the amputation stumps
(C) Shortening and closure of the ring finger with skin grafting of the index finger
(D) Reconstruction of the index finger using a cross-finger flap from the middle finger, followed by replantation of the ring finger
(E) Composite grafting of the index fingertip and replantation of the ring finger

The correct response is Option B.

The most appropriate operative management is shortening and closure of the amputation stumps of the index and ring fingers. Because this 70-year-old cabinet maker has multiple finger amputations, shortening and closure is the most simple procedure and would have the greatest chance for success. It would also allow the patient to return to work as soon as possible.

Healing by second intention should not be attempted in a patient with bone exposure at the amputation stump. In the same way, skin grafting alone will not take if bone is exposed. The cross-finger flap is not available because the soft tissues of the dorsal aspect of the middle finger have been damaged extensively. Using more proximal tissue from the middle finger could lead to the development of hyperflexion and joint stiffness. In addition, cross-finger flaps are most appropriate for coverage of volar, not dorsal oblique, amputation stumps. Composite grafting involving skin, fat,

and nail matrix is typically performed only in young children. Replantation of a zone II amputation is most likely to result in severe stiffness of the finger and decreased overall hand function.

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102

A 56-year-old woman has a subungual melanoma involving the lunula of the right ring finger. Histologic examination of an excisional biopsy specimen shows an acral lentiginous melanoma with a diameter of 4.2 mm and a Breslow's thickness of 2.2 mm. Complete excision with 1-mm margins has been performed.

Which of the following is the most appropriate next step in management?

(A) Observation
(B) Excision of the nailbed of the ring finger
(C) Amputation through the distal phalanx of the ring finger just distal to the insertion of the flexor digitorum profundus tendon
(D) Amputation through the middle phalanx of the ring finger
(E) Ray amputation of the ring finger

The correct response is Option D.

The most appropriate management of this patient's tumor is amputation through the middle phalanx of the ring finger. This patient has a subungual melanoma, a rare form of cutaneous melanoma that is often initially diagnosed at an advanced stage. As a result, the prognosis for patients diagnosed with subungual melanoma is frequently poor. Surgical management is directly related to the thickness of the tumor and the risk for morbidity associated with its resection.

One study of patients with melanomas with a thickness of 1 mm to 4 mm compared patient findings following tumor excision with 2-cm margins and with 4-cm margins. The results showed no statistically significant differences in rates of local recurrence, distant metastases, or long-term survival. Therefore, the conclusions of this study, incorporated with several other studies, have led to recommendations for a standard of care in patients with melanoma. A table that defines appropriate margins for tumor excision is shown below.

Tumor Thickness	Margin of Excision
In situ	0.5 to 1 cm
0 to 1 mm	1 cm
1 to 2 mm	1 to 2 cm
2 to 3 mm	2 cm
Greater than 4 mm	2 cm or greater

Therefore, in this patient, amputation through the middle phalanx of the ring finger would be required to provide the necessary 2-cm surgical margin. A volarly based flap can be used to cover the amputation stump. Sentinel node biopsy and axillary lymph node dissection may also be indicated.

Observation is obviously inappropriate management of a tumor associated with such a poor prognosis. Excision of the nailbed or amputation through the distal phalanx will not provide an adequate surgical margin and will increase the patient's risk for tumor recurrence. Ray amputation is associated with higher rates of morbidity and not with lower long-term survival rates.

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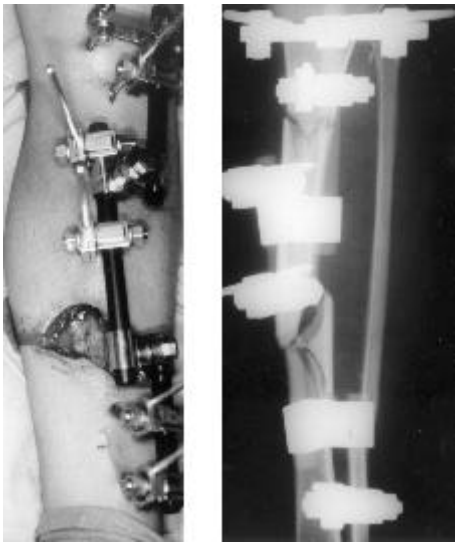

The above photograph and radiograph are from an otherwise healthy 26-year-old man who sustained a multilevel compound fracture of the left tibia and fibula when he fell from a roof. An external fixator is applied and the wound is closed primarily; four days later, the patient has a 6 × 5-cm defect with exposure of the tibia after undergoing excision of an area of nonviable skin.

Which of the following is the most appropriate management?

(A) Dressing changes to allow wound granulation, followed by split-thickness skin grafting
(B) Open cancellous bone grafting (Papineau technique) followed by full-thickness skin grafting
(C) Coverage with a pedicled medial gastrocnemius flap
(D) Coverage with a free muscle flap followed by split-thickness skin grafting
(E) Coverage with a pedicled cross-leg flap

The correct response is Option D.

This patient's open tibial defect is best covered with a free muscle flap and skin graft. Because he has a type III tibial fracture, a reliable flap should be used to close the defect and prevent the development of further complications. A soleus flap is often used for wound coverage in patients with type I or type II fractures; however, in patients with type III fractures a portion of this flap may be involved in the zone of injury. In contrast, the free muscle flap and skin graft will allow an immediate opportunity for coverage of the wound with well-vascularized tissue.

Dressing changes are inappropriate in an otherwise healthy 26-year-old man who is not a surgical risk; if this course of treatment is followed, nonunion and osteomyelitis may develop. Open cancellous bone grafting (Papineau technique) is an outdated procedure requiring the harvest of large amounts of bone and prolonged immobilization following surgery; it is currently only used in patients who are poor surgical risks but refuse amputation. The pedicled medial gastrocnemius flap is used to cover defects of the proximal third of the lower leg but is too short to reach this patient's wound. The pedicled cross-leg flap is no longer used as a first-line treatment option.

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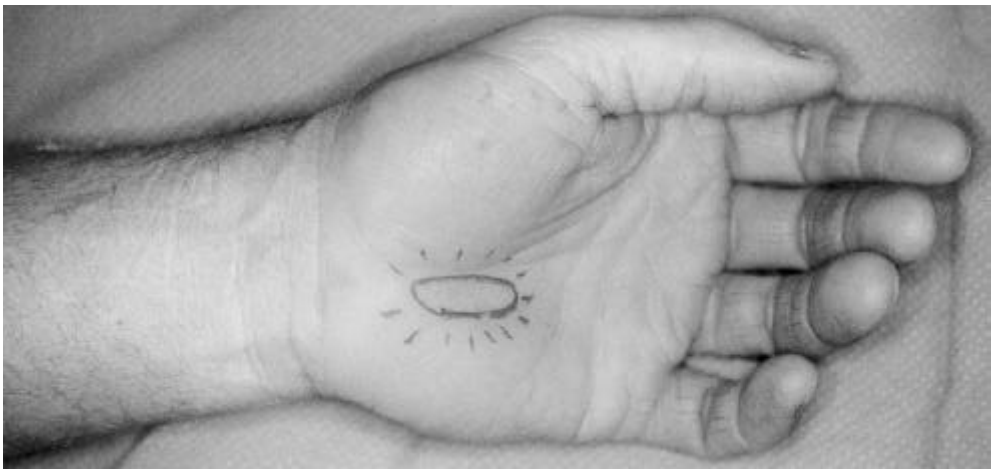

A 54-year-old carpenter has the sudden onset of numbness, tingling, and a cold sensation in the ring and little fingers of his dominant right hand. On examination, he has an area of tenderness in the palm; a photograph is shown above. Two-point discrimination is 12 mm in the ring and little fingers. Temperature in the small finger is 26.7EC (80EF).

Which of the following is the most likely diagnosis?

(A) Cubital tunnel syndrome
(B) Fracture of the hook of the hamate bone
(C) Hypothenar hammer syndrome
(D) Ruptured ganglion in Guyon's canal
(E) Vibration-induced white finger

The correct response is Option C.

The most likely diagnosis in this patient is hypothenar hammer syndrome, or thrombosis of the ulnar artery in Guyon's canal. Hypothenar hammer syndrome is characterized by pain in the region of the hook of the hamate bone and paresthesias and a decrease in digital temperature in the ring and little fingers. Because this condition is caused by repetitive trauma, it is often seen in carpenters who use the hypothenar eminence as a hammer-type device during their work. Management includes surgical exploration of the ulnar artery and resection of the thrombosed segment. The inflammation characteristically seen around the thrombus in patients with hypothenar hammer syndrome has been theorized to result in sympathetic hyperstimulation and irritation of the ulnar nerve; as a result, some surgeons have advocated the use of thrombolytic therapy. Although reconstruction of the ulnar artery with a vein graft is controversial, most surgeons agree that grafting can be used to prevent cold intolerance in certain patients. If the distal ulnar artery pressure is less than 0.7 times the proximal ulnar artery pressure, vein grafting can be beneficial.

Although numbness in the ulnar distribution of the hand is characteristic of cubital tunnel syndrome, tenderness in the palm and decreased digital temperatures are not. Because the markedly decreased temperature in the little finger is consistent with a vascular cause, a fracture of the hook of the hamate bone should not be suspected. If a fracture were present, it could be seen on radiographs of the carpal tunnel or CT scan of the hand. Ulnar nerve compression in Guyon's canal most commonly results from a ruptured ganglion. However, vascular compression is rarely seen. Doppler ultrasonography can be used to confirm this diagnosis. Vibration-induced white finger is characterized by paresthesias and increased two-point discrimination but not by pain in the region of the hook of the hamate.

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105

A 37-year-old woman has focal pain and tenderness of the tip of the dominant right index finger. There is no history of trauma. Her symptoms are exacerbated by exposure to cold temperatures. Examination shows no palpable mass; radiographs show no abnormalities. These findings are most consistent with

(A) glomus tumor
(B) hemangioma
(C) neurofibroma
(D) neuroma
(E) Raynaud disease

The correct response is Option A.

This patient's findings are most consistent with a glomus tumor, a vascular mass that affects the glomus, which is a neuromyoarterial apparatus. This encapsulated, well-organized tumor produces symptoms of pain, tenderness, and

cold sensitivity. Although a mass is not often palpable, an area of extreme tenderness can be delineated. Excision is the most appropriate management of glomus tumors.

Hemangiomas are palpable lesions not associated with pain. Exacerbation of pain with exposure to cold is not a hallmark of a neurofibroma. Neuromas can cause focal tenderness but are specifically associated with trauma. Raynaud disease is characterized by nonfocal pallor and cyanosis in some patients.

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106

Which of the following is the most likely site of entrapment of the posterior interosseous nerve at the forearm?

(A) Arcade of Frohse
(B) Arcade of Struthers
(C) Band of Osborne
(D) Lacertus fibrosis
(E) Ligament of Struthers

The correct response is Option A.

The deep branch of the radial nerve, also known as the posterior interosseous nerve, is most likely to become entrapped within the arcade of Frohse, a fascial band that covers the supinator muscle in the forearm. Another potential site of entrapment is the vascular leash of Henry, which is a fan-shaped collection of radial recurrent vessels that traverses the radial nerve.

The ulnar nerve can become entrapped by fascial folds known as the arcade of Struthers at the medial intermuscular septum or by a constricting band known as the band of Osborne within the cubital tunnel. Release of this band is critical during neuroplasty. The median nerve can become entrapped more distally by the lacertus fibrosis, which is a dense fascial sheet that extends from the antebrachial fascia to the biceps tendon, or more proximally by the ligament of Struthers, which forms between the supracondylar humeral process and the medial epicondyle.

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107

A 20-year-old construction worker has complete radial palsy after sustaining a deep laceration approximately 2 cm proximal to the lateral epicondyle. Following appropriate nerve and muscle repair, reinnervation of which of the following muscles should be expected to occur first?

(A) Abductor pollicis longus
(B) Extensor carpi radialis longus
(C) Extensor digitorum communis
(D) Extensor indicis proprius
(E) Extensor pollicis longus

The correct response is Option B.

In this patient who is undergoing muscle and nerve repair for complete radial nerve palsy, reinnervation of the extensor carpi radialis longus (ECRL) tendon should occur first. This patient has sustained a laceration of the radial nerve approximately 2 cm above the lateral humeral epicondyle, resulting in a loss of extension of the wrist, thumb, and fingers. This nerve, which lies lateral to the brachialis muscle and biceps tendon and medial to the origin of the brachioradialis muscle approximately 2 cm to 3 cm proximal to the epicondyle, supplies one nerve branch to the brachioradialis muscle initially and then another nerve branch to the ECRL tendon. Therefore, after performing appropriate repair, the surgeon should expect neurologic recovery in the brachioradialis tendon first, followed closely by the ECRL tendon. Recovery of the ECRL tendon can be confirmed by the return of wrist extension with slight radial deviation.

The radial nerve then bifurcates into sensory (superficial radial nerve) and motor (deep radial nerve) components approximately 5 cm distally. The nerve to the extensor carpi radialis brevis (ECRB) tendon originates at this bifurcation; therefore, the ECRB would be expected to recover its innervation next.

At this point, the deep branch of the radial nerve has supplied innervation to all of the mobile wad, which consists of the brachioradialis, ECRL, and ECRB tendons. The deep branch of the radial nerve then continues as the posterior interosseous nerve, which courses between the superficial and deep heads of the supinator muscle before dividing further into several branches on the posterior interosseous membrane. Because these branches supply innervation to both the superficial (extensor digitorum communis, extensor digiti quinti, and extensor carpi ulnaris) and deep (abductor pollicis longus, extensor pollicis brevis, extensor pollicis longus, and extensor indicis proprius) muscles of the forearm, it would be difficult to predict the pattern of further muscle reinnervation in this patient. However, because the extensor indicis proprius muscle originates more distally from the shaft of the ulna and interosseous membrane, it will most likely be innervated last.

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108

A 52-year-old man has burning pain and paresthesias in the plantar aspect of the right foot and clawing of the toes associated with shooting pain in the calf. These findings are most consistent with

(A) diabetic neuropathy
(B) Morton's neuroma
(C) peroneal nerve compression
(D) spinal cord tumor
(E) tarsal tunnel syndrome

The correct response is Option E.

The 52-year-old man has findings consistent with tarsal tunnel syndrome, or compression of the lateral and medial plantar branches of the tibial nerve within the fibro-osseous tunnel posterior to the medial malleolus. In patients with tarsal tunnel syndrome, there is burning, numbness, and paresthesias on the plantar surface of the foot or beneath the metatarsal heads. Symptoms are worse at night and can be exacerbated by walking or standing. Rest and elevation of the foot improve symptoms. Prolonged compression of the tibial nerve may result in numbness and clawing of the toes secondary to weakness of the intrinsic muscles, which derive their innervation from this nerve.

Morton's neuroma develops as a result of chronic compression of the common plantar digital nerve within the metatarsal heads. Pain that radiates from the third and fourth metatarsal heads into the toes is the most common initial sign. The patient may have pain between the metatarsal heads with compression of the transverse arch and direct pressure in the affected web space; these symptoms can also be exacerbated by standing or walking. Motor findings are absent.

Because the peroneal nerve lies in a subcutaneous position as it traverses the neck of the fibula, it may easily become compressed by external forces, such as adhesive straps. In addition, sitting with the legs crossed for extended periods may result in compression of the peroneal nerve. Numbness of the lateral aspect of the leg, dorsal aspect of the first web space, and dorsal aspect of the foot are characteristic. Weakness of the ankle dorsiflexor, toe extensor, and evertor tendons may also be seen.

Diabetic peripheral neuropathy is characterized by bilateral diffuse sensory deficiencies with paresthesias in the classic "stocking" distribution and intrinsic muscle weakness, which may lead to clawing of the toes and alterations in the arches of the feet.

Spinal cord tumors would produce pain in the back that radiates down the leg and weakness more proximally. Other organ systems would likely be involved.

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109

During surgical dissection of the plantar aspect of the foot for harvest of a medial plantar artery flap, the proximal portion of the medial plantar artery will be found between the

(A) abductor hallucis and flexor digitorum longus tendons
(B) adductor hallucis and flexor hallucis brevis tendons
(C) flexor digitorum brevis and abductor hallucis tendons
(D) plantar aponeurosis and the flexor digitorum brevis tendon
(E) quadratus plantae and the adductor hallucis tendon

The correct response is Option A.

The proximal portion of the medial plantar artery can be found between the abductor hallucis and flexor digitorum longus tendons. This artery is a branch of the posterior tibial artery and lies deep to the superficial muscles in the plantar aspect of the foot. The superficial muscles, which are located just deep to the plantar aponeurosis, include the abductor digiti minimi laterally, the flexor digitorum brevis centrally, and the abductor hallucis medially. The medial plantar artery courses between the abductor hallucis, flexor hallucis longus, and flexor digitorum longus tendons, while the lateral plantar artery courses between the flexor digitorum brevis tendon and the muscle belly of the quadratus plantae.

The adductor hallucis and flexor hallucis brevis tendons can be found in the distal half of the foot, where they lie deep to the distal half of the medial plantar artery. The deep plantar arch travels deep to the adductor hallucis tendon.

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110

A 54-year-old man with insulin-dependent diabetes mellitus and Dupuytren disease has an isolated 30-degree flexion contracture of the metacarpophalangeal (MP) joint of the right little finger. Which of the following cords is most likely responsible for this deformity?

(A) Central cord
(B) Lateral cord
(C) Natatory cord
(D) Pretendinous cord
(E) Spiral cord

The correct response is Option D.

This patient with diabetes mellitus and Dupuytren disease has a flexion contracture resulting from involvement of the pretendinous cord. This thickened, contracted structure, which evolves from the pretendinous band, is the only

causative cord in patients with MP joint contractures. Resection of the diseased structure is appropriate management. This is achieved with relative ease because the neurovascular bundle lies deep to the cord and therefore is not injured during surgery.

The central, lateral, and spiral cords cause flexion contractures of the proximal interphalangeal (PIP) joints. The central cord has no precursor band but instead arises with the pretendinous cord and attaches to the tendon sheath or bone of the middle phalanx. The lateral cord can also be a primary cause of flexion contractures of the distal interphalangeal joints. The spiral cord develops from several structures, including the pretendinous band, spiral band, lateral digital sheath, and the Grayson ligament, which in the normal human hand form a spiral around the neurovascular bundle. However, in patients with Dupuytren disease, the spiral cord straightens and the neurovascular bundle instead forms a spiral around the cord. Performing fasciectomy in these patients may result in injury to the neurovascular bundle due to its superficial, midline location in the finger.

The development of a natatory cord typically results in loss of finger abduction and flexion contractures of the PIP joints. Some fibers of the natatory cord may pass distally on the sides of the affected finger.

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111

A 60-year-old man sustains a guillotine amputation of the nondominant left thumb 7 mm proximal to the interphalangeal joint when he catches the thumb in a table saw. Which of the following will provide the best functional outcome?

(A) Deepening of the first web space
(B) Distraction-lengthening of the first metacarpal
(C) Revision amputation
(D) Toe-to-thumb transfer
(E) Replantation of the amputated thumb

The correct response is Option E.

In this patient who has sustained a thumb amputation at the interphalangeal (IP) joint, the most appropriate management is replantation of the amputated distal stump as long as it is in good condition and has been preserved effectively. In order for replantation to be a viable option, the amputated part must offer adequate length, protective sensation, and painless mobility and stability. The patient's age and occupation, as well as the extent of trauma to the remainder of the hand, can also influence the physician's management choices. Because the thumb plays an indispensable part in hand usage, it is almost always replanted, even if the amputation is to the level of the IP joint. Functional results are often better than those seen with replantation of other digits. The vessels are typically large; therefore, if any reinnervation occurs, it will provide superior results when compared with reconstruction. Replantation can even be used successfully if IP joint fusion is required. Survival of the replanted thumb is dependent on the type of amputation, the extent of trauma, and total ischemia time.

In a patient who has a more distal amputation with an unusable stump, several options can be considered. For example, the first web space can be deepened to "phalangize" the metacarpal joint; however, thumb length is sacrificed and the aesthetic result is suboptimal. Distraction-lengthening of the proximal phalanx or first metacarpal can also be performed, but it is an extensive process that requires excellent patient compliance. Distraction-lengthening and web space deepening can be carried out consecutively to improve thumb mobility. Revision amputation will further shorten the thumb and may result in significant functional deficits. Toe-to-thumb transfer can be used in amputations to the level of the metacarpophalangeal joint; however, the aesthetic result can be displeasing and a large donor site defect is associated.

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112

A 25-year-old secretary has pain and swelling of the dominant right middle finger after sustaining an injury to the finger while playing basketball. A radiograph is shown above. Which of the following is the most appropriate management?

(A) Buddy taping of the digit followed by immediate active range-of-motion exercises
(B) Closed reduction and plaster splinting of the digit
(C) Application of pulp traction
(D) Closed reduction and percutaneous pin fixation under radiographic control
(E) Open reduction and internal fixation

The correct response is Option D.

Closed reduction and percutaneous pin fixation under radiographic control is the most simple and effective means of repairing this patient's unicondylar fracture. Unicondylar fractures occur most frequently in the middle and proximal phalanges and are typically associated with athletic injury. Common fracture patterns include oblique volar, long oblique, dorsal coronal, and volar coronal; bicondylar Y- and T-shaped fractures are rare. Because even minimally displaced condylar fractures are inherently unstable, adequate stabilization should be ensured through fixation with multiple pins or screws; use of one pin or screw will not control rotation of the fracture fragments. Multiple 0.028-inch or 0.035-inch Kirschner wires and/or minifragment 1.5-mm screws are recommended. Interosseous wire fixation may also be used. For appropriate fixation, the screw diameter must be no larger than one-half of the fracture fragment. The patient can be expected to regain approximately 80% of her preinjury range of motion following fixation but may have flexion contractures as great as 30 degrees. Dynamic splinting can be used to minimize the extension deficit.

Nonoperative management including buddy taping and range-of-motion exercises will not adequately treat this patient's fracture. Splint immobilization is associated with an increased risk for repeat fracture displacement, even if the patient is closely monitored. Although pulp traction will effectively reduce displaced fractures, the compressive forces of the joint will cause recurrent displacement, potentially resulting in angular deformity and articular incongruity. Extension splinting will not prevent the development of these deformities. Although open reduction and internal fixation is often required for displaced fractures that cannot be treated with closed reduction, the small size of this patient's fracture fragment would increase her risk for devascularization of the fragment.

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113

In children, true hand dominance typically develops at how many months of age?

(A) 6 to 12
(B) 13 to 17
(C) 18 to 24
(D) 25 to 30
(E) 31 to 36

The correct response is Option C.

In children, true hand dominance typically does not emerge until 18 to 24 months of age and becomes consistent in most cases by age 3 to 4 years. Development of hand activities first begins at approximately 6 months of age, when the child is initially able to sit up independently. At this time, he/she begins to manipulate objects in the environment,

initially during two-handed activities with bilateral grasp using first the ulnar and then radial portion of the hands. Most infants have refined pinch, or opposition of the thumb to the index finger, by age 12 months; once refined pinch is developed, hand activities then progress from bilateral to unilateral over the next six to 12 months.

Any hand preference or unilateral upper extremity activity seen in an infant younger than age 18 months may signal either a functional problem in the unused extremity or the presence of a brain disorder, such as cerebral palsy. Infants with cerebral palsy typically have cognitive, developmental, and sensory deficits that affect motor function. They may favor one hand and may have problems related to balance. In addition, persistent perinatal tonic reflexes may be seen; in unaffected children these typically disappear by age 6 months.

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114

A 70-kg 49-year-old patient with de Quervain disease is undergoing tendon sheath release during axillary nerve block using a perivascular technique. Twenty minutes after injection of 40 mL of lidocaine 0.5% into the axillary sheath, the patient has dense anesthesia in the entire hand but cannot tolerate incision on the dorsoradial aspect of the forearm.

Which of the following is the most likely cause?

(A) Hematoma formation secondary to inadvertent arterial puncture
(B) Inadequate block of the musculocutaneous nerve
(C) Inadequate block of the posterior cord of the brachial plexus
(D) Inadequate volume and concentration of the local anesthetic agent
(E) Insufficient time for onset of anesthesia

The correct response is Option B.

The most likely cause of this patient's pain is inadequate block of the musculocutaneous nerve. This nerve exits the axillary sheath proximal to the level of the typical axillary block and is located instead in the coracobrachialis muscle. Unless an adequate amount of anesthetic perfuses proximally within the axillary sheath, the musculocutaneous nerve will not be blocked completely. If this occurs, the anesthetic must then be injected directly into the coracobrachialis muscle.

Although inadvertent arterial puncture may occur during axillary block, aspiration of blood would be the more likely result. If this did occur, the anesthesiologist would then correct the injection technique to prevent the development of a hematoma. Any subsequent hematoma formation should be immediately recognized and avoided by the anesthesiologist.

Although the posterior cord of the brachial plexus lies above the level of the axillary sheath, its main terminal branches, which include the axillary and radial nerves, lie directly within the sheath and would thus be blocked using adequate anesthetic technique. If these nerves are not blocked adequately, the patient will have persistent sensation in both the forearm and dorsoradial hand, including the thumb and first web space.

Injecting 40 mL of 0.5% lidocaine (5 mg/mL) would provide adequate anesthesia in a 70-kg patient and would not exceed the maximum total dosage.

Because the effects of lidocaine are rapid, a 20-minute wait between the time of injection and the start of the procedure should allow sufficient time for the onset of full neuromuscular blockade.

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115

The above photograph is of a 20-year-old man who has had purulent drainage from a puncture wound of the nondominant left hand for the past two days. He sustained the puncture injury three days ago. On examination, the index finger is swollen and held in flexion. The patient has severe pain with passive extension of the digits.

Which of the following is the most appropriate next step in management?

(A) Application of warm soaks and oral administration of antibiotics
(B) Irrigation of the wound in the emergency room, followed by splinting and elevation of the hand
(C) Intravenous administration of antibiotics and observation
(D) Emergent drainage and open packing of the wound
(E) Proximal and distal incision into the flexor tendon sheath followed by continuous irrigation

The correct response is Option E.

This patient's puncture wound is best treated by incising the flexor tendon sheath proximally and distally and providing continuous irrigation. Suppurative flexor tenosynovitis should be strongly suspected in any patient who has a penetrating injury of the hand with purulent drainage. The four classic signs of digital flexor tenosynovitis are listed below.

- Fusiform swelling
- Semiflexed posturing
- Pain with passive extension
- Tenderness along the flexor tendon sheath

In a patient who has had symptoms of infection for longer than 48 hours or of unknown duration, surgical exploration of the flexor tendon sheath through proximal and distal incisions is indicated. If there is purulent drainage, the flexor tendon sheath should be irrigated continuously through a catheter. Simple aspiration of the sheath can be performed in a patient with suspected flexor tenosynovitis to confirm the presence of drainage.

Conservative measures including application of warm compresses, administration of antibiotics (either oral or intravenous), and observation can be used in the management of acute infection but require extensive, time-consuming follow-up and monitoring of the patient in a hospital setting.

Irrigation of the wound in the emergency department is not the appropriate treatment of a patient with obvious flexor tenosynovitis.

Although prompt surgical drainage is indicated, open packing of an infected wound is inappropriate.

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116

A 2-year-old child is brought to the emergency department with frostbite after playing in the snow without gloves for more than two hours. Which of the following long-term complications will most likely be seen in this patient?

(A) Angular deformity of the digits
(B) Digital tip ulceration
(C) Loss of sensation of the digits
(D) Nailbed injury
(E) Skin discoloration

The correct response is Option A.

This 2-year-old child who has frostbite is most likely to develop angular deformity of the digits. This long-term complication results from premature closure of the phalangeal epiphyses, which may occur if chondrocytes within the

cartilaginous growth plate are injured during the freezing of tissue. Although epiphyseal closure may not be noted on radiographs for six to 12 months, growth disturbances and angular deformities, such as radial deviation of the distal interphalangeal joint of the little finger, may still occur.

The tissue damage that occurs in patients with frostbite injury results from vasoconstriction and extracellular crystal formation. Appropriate management includes rapid rewarming of the affected areas in water heated to a temperature of 40EC (104EF) followed by delayed surgical debridement.

Several studies have also shown that cold sensitivity, skin discoloration, hyperhidrosis, and pain in the digits may occur following frostbite injury. In children with frostbite injury, findings seen in these studies have included joint pain, stiffness, weakness of the fingers, degenerative joint changes, shortening of the digits, and skin redundancy.

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117

A 45-year-old woman sustains an avulsion injury of the volar distal phalanx of the right thumb. The flexor tendon and bone of the distal two thirds of the distal phalanx are exposed. Which of the following is the most appropriate management?

(A) Cross-finger flap
(B) Distant pedicle flap
(C) Moberg flap
(D) Shortening of the exposed bone with primary closure of the dorsal skin flap
(E) Thenar flap

The correct response is Option C.

Two important considerations for amputation of the tip of the thumb are preservation of both length and sensation. A Moberg flap is raised on its neurovascular pedicles and advanced distally; the resulting defect proximal to the flap can be closed in a V-Y fashion. This flap provides durable and sensate skin to the pulp of the thumb but is not recommended for other digits because the dorsal circulation of the digits is not reliable after both digital arteries are raised with the flap.

A cross-finger flap can be used for the thumb or other digits for coverage of bone, vessels, nerves, tendons, or joints. The sensory return is inferior to that of the Moberg flap, and it involves the division and inset of the flap at a second stage.

A distant pedicle flap, such as a groin flap or a chest flap, requires immobilization of the hand at the site of the distant flap and is also insensate.

Shortening of the thumb should be avoided when other options are available.

A thenar flap is appropriate for wounds of other fingertips but cannot be used for the thumb. A flap of skin is elevated at the thenar eminence and sutured to the open wound of the fingertip. Division and inset of the flap are then performed at a later time.

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118

The above photograph is of a 40-year-old press operator who sustained skin and pulp loss of the volar aspect of the dominant right ring and little fingers when he caught the fingers between two cylinders at work. On examination, there is full-thickness skin and pulp loss of the volar aspect of the fingers from the level of the distal interphalangeal joint flexion crease. There are exposed phalangeal tufts, flexor tendons, and digital nerve branches. Radiographs show no bony injury.

Which of the following is the most appropriate management?

(A) Full-thickness skin grafting
(B) Coverage with a groin flap
(C) Coverage with cross-finger flaps
(D) Coverage with palmar advancement flaps
(E) Revision amputation with shortening of the bones

The correct response is Option C.

This patient's volar defect is best covered with a cross-finger flap harvested from the dorsal aspect of the middle and ring fingers. This flap will provide durable skin and vascularized local tissue for coverage of the bones, tendons, and

nerves. Although a period of immobilization is required, other joints, such as the shoulder or elbow, will not be compromised. With this procedure, the proximal interphalangeal joints are immobilized in 30 to 40 degrees of flexion and become stiff; however, the flaps can be divided at 10 to 14 days. Any stiffness that is seen following immobilization of the digits can be relieved with a short course of hand therapy.

A full-thickness skin graft over exposed bone and tendon will not take. A groin flap is too bulky to be used for a finger defect, and would provide inadequate sensory coverage and require immobilization of the shoulder and hand. Palmar advancement flaps can be used to cover defects of the thumb, in which stiffness is less problematic. However, these flaps can only be mobilized 2.5 cm. Revision amputation would shorten both fingers to the level of the distal interphalangeal joint, resulting in impaired hand function.

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119

A right-hand dominant 35-year-old man sustains an avulsion injury of the soft tissue of the dorsal aspect of the right index finger when he catches his finger on the blade of an electric saw. The injury extends from the proximal interphalangeal (PIP) joint to the distal interphalangeal (DIP) joint. Examination shows exposure of the extensor tendon.

Which of the following is the best method for reconstruction of the dorsal defect of the index finger?

(A) Cross-finger flap
(B) Full-thickness skin graft
(C) Reverse cross-finger flap
(D) Thenar flap
(E) V-Y advancement flap

The correct response is Option C.

The most appropriate method for reconstruction of this patient's dorsal defect of the index finger is coverage with the reverse cross-finger flap, which is designed on the dorsal aspect of the middle phalanx of the adjacent, in this case middle, finger. Although it is technically demanding, it is best for coverage of primary defects of the dorsal aspect of the fingers. A full-thickness skin flap is raised on the donor site and the underlying subcutaneous tissue is raised in a manner similar to a cross-finger flap and transferred. The donor skin flap is then replaced in its bed. A full-thickness skin graft is used to cover the fat flap at the recipient site.

Primary dorsal defects cannot be covered by the standard dorsal cross-finger flap. A full-thickness skin graft alone is not appropriate in a patient with exposed tendons. Thenar and V-Y advancement flaps are used to cover volar defects involving the fingertips.

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120

In the normal human hand, the web space is typically located

(A) one-half of the distance from the carpus to the lunula
(B) one-half of the distance from the head of the metacarpal to the tip of the finger
(C) one-half of the distance from the metacarpal head to the proximal phalangeal joint
(D) three-fourths of the distance from the proximal interphalangeal joint to the midshaft of the metacarpal bone
(E) three-eighths of the length of the nail to the head of the metacarpal

The correct response is Option C.

In the normal human hand, the web space is typically located one-half of the distance from the metacarpal head to the proximal phalangeal joint. This information is critical to the plastic surgeon when planning surgical repair in a patient with syndactyly. During repair, the surgeon should extend the dorsal flap two-thirds of the distance from the proximal head to the proximal interphalangeal joint.

The web space between the middle and ring fingers is located in the most distal position, while the space between the index and middle fingers is slightly more proximal, and the space between the ring and little fingers is most proximal.

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121

A 27-year-old football player is unable to flex the distal interphalangeal (DIP) joint and has significantly impaired flexion of the proximal interphalangeal (PIP) joint of the left ring finger one week after feeling a pop in his left hand while making a tackle. On examination, there is pain and mild swelling of the finger. Radiographs show no abnormalities.

These findings are most consistent with

(A) attrition rupture of the profundus tendon at the level of the fibro-osseous tunnel
(B) rupture of the flexor digitorum superficialis tendon slip from the middle phalanx
(C) rupture of the profundus tendon at the musculotendinous junction
(D) rupture of the profundus tendon from its insertion
(E) traction injury of the anterior interosseous nerve

The correct response is Option D.

This patient has the classic findings of profundus tendon avulsion, or rupture of the tendon from its insertion. History and physical examination are most consistent with a type II avulsion injury; this is defined as retraction of the tendon to the level of the PIP joint with an intact vinculum. In a type II avulsion injury, there is a loss of active flexion of the DIP joint. On examination, the patient will have pain, swelling, tenderness, and some loss of active flexion of the PIP joint. Early reinsertion of the tendon into the distal phalanx is best for correction of the deformity. Although this procedure had been performed in the past using a pull-out wire technique, the repair is now more easily and successfully performed by using microsuturing anchors with decortication of the volar proximal lip of the distal phalanx.

Attrition ruptures are common in patients with rheumatoid arthritis but rarely occur in the fibro-osseous tunnel and could easily be distinguished on radiographs. In a patient with a rupture of the flexor digitorum superficialis tendon, also a rare occurrence, there would be normal active flexion of the DIP joint with minimal loss of active finger flexion. Rupture of the profundus tendon from its musculotendinous junction has not been seen clinically and is most likely not possible because of its long, broad muscular attachments to the tendon subunit. Because the profundus tendon of the ring finger is innervated by the ulnar nerve, the DIP joint would not be affected by a traction injury of the anterior interosseous nerve.

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122

A 48-year-old farmer is brought to the emergency department because his left hand was caught beneath a tractor for four hours. On examination, there is a crush injury of the left forearm and he is unable to move his left arm. There is significant edema and severe pain in the hand; he has pain with passive stretch of the forearm. Compartment pressures in the forearm are 68 mmHg. Radiographs show no evidence of fracture.

Which of the following is the most appropriate management?

(A) Elevation of the arm and application of warm compresses
(B) EMG and nerve conduction studies
(C) Carpal tunnel release
(D) Fasciotomy of the forearm
(E) Fasciotomy of the forearm and carpal tunnel release

The correct response is Option E.

In this patient who has compartment syndrome of the left forearm, the most appropriate management is fasciotomy of the forearm and release of the carpal tunnel. Compartment syndrome is a frequent sequela of crush injuries; other

precipitating factors include fractures, soft-tissue or arterial injuries, limb compression, and burn injuries. Pain with passive stretch of the involved muscles is the most reliable early clinical finding. In addition, affected patients will have pain, pallor, diminished sensation, paresthesias, absence of pulse, and ultimately paralysis in the involved extremity. Measurement of compartment pressures is critical when planning management. Normotensive patients who have compartment pressures greater than 30 mmHg or less than 30 mmHg below diastolic blood pressure should undergo decompressive fasciotomy.

In this patient, volar fasciotomy should be performed from the proximal forearm extending into the carpal tunnel. Following surgical decompression, compartment pressures should once again be measured; if pressures within the dorsal and/or mobile wad are elevated, these too should be decompressed. Fasciotomy of the hand and fingers can also be performed if indicated.

Elevation of the arm and application of warm compresses would increase the degree of ischemia in this patient. EMG and nerve conduction studies are not needed in a patient who has markedly increased compartment pressures and positive findings on clinical examination.

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123

A 39-year-old construction worker sustains a degloving injury of the weight-bearing heel of the left foot in a motorcycle accident. Examination shows a noncontaminated 5 × 4-cm wound with exposed fat and plantar fascia. Which of the following is most appropriate for coverage of the wound?

(A) Abductor hallucis flap
(B) Cross-foot skin flap
(C) Free muscle transfer
(D) Medial plantar fasciocutaneous flap
(E) Split-thickness skin graft

The correct response is Option D.

In this patient who has an exposed wound of the heel, the most appropriate management is coverage with a medial plantar fasciocutaneous flap. This injury to the weight-bearing portion of the heel requires reconstruction with durable, protective skin and stable, sensate tissue. The medial plantar region is close to the defect and will provide skin of similar strength. In addition, the medial plantar nerve does not provide weight-bearing sensation to the entire foot and thus can be neurolysed proximally to allow harvest with maintenance of distal sensation. The flap can be raised superficial to the plantar fascia, creating a sensate flap that is vascularized by the subcutaneous plexus and does not require sacrifice of the plantar arteries.

The abductor hallucis and flexor digitorum brevis muscles can be used if a fasciocutaneous flap is unavailable. However, these flaps provide less sensation and necessitate coverage with a skin graft.

The cross-foot flap will provide similar durable tissue but is seldom used because of the prolonged immobilization required. Joint stiffness is common with the use of this flap.

Free muscle transfer is appropriate for reconstruction in patients with osteomyelitis but is excessive for small defects of the heel.

Skin grafts are more appropriate for a patient who has a small skin defect with an intact subcutaneous heel pad. The sensibility of this type of graft is poor, and the risk for ulceration of the grafted skin is great.

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124

The above photograph is of a 60-year-old man with advanced rheumatoid arthritis who has a boutonnière (type I) deformity of the thumb. Which of the following is the most likely cause of this patient's findings?

(A) Rupture of the extensor pollicis longus tendon
(B) Rupture of the flexor pollicis longus tendon
(C) Tenosynovial proliferation at the carpometacarpal joint of the thumb
(D) Tenosynovial proliferation at the interphalangeal joint of the thumb
(E) Tenosynovial proliferation at the metacarpophalangeal joint of the thumb

The correct response is Option E.

This patient has developed a boutonnière (type I) deformity of the thumb caused by tenosynovial proliferation at the metacarpophalangeal (MP) joint of the thumb. With this deformity, there is stretching and attenuation at the insertion of the extensor pollicis brevis tendon, resulting in diminished thumb extension and a flexion deformity across the MP joint. In addition, the extensor pollicis longus tendon is displaced ulnarly and volarly, resulting in a more direct line of pull on the distal phalanx. Hyperextension of the interphalangeal (IP) joint results.

A patient who has a rupture of the extensor pollicis longus tendon will develop flexed posturing of the IP joint of the thumb, also known as a mallet deformity. Inability to lift the thumb off a tabletop with the hand held flat is a characteristic feature of this deformity.

Rupture of the flexor pollicis longus tendon is a common complication of rheumatoid arthritis and typically occurs as a result of attrition rupture at the level of the scaphoid. This is commonly known as a Mannerfelt lesion. This deformity is characterized by an inability to flex the IP joint of the thumb.

Manifestations of tenosynovial proliferation at the carpometacarpal joint include dorsoradial subluxation of the base of the metacarpal, adduction of the metacarpal, and secondary hyperextension of the MP joint. These abnormalities will ultimately result in the development of a swan-neck (type III) thumb deformity.

Tenosynovial proliferation at the interphalangeal joint of the thumb may also result in the development of a mallet deformity but not a boutonnière deformity.

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125

A patient is scheduled to undergo coverage of a defect of the distal phalanx of the thumb using a neurovascular island flap from the ulnar aspect of the middle finger. During preoperative evaluation, Doppler ultrasonography should be used to verify the patency of the radial and ulnar digital arteries of the middle finger and which other artery?

(A) Radial digital artery of the index finger
(B) Radial digital artery of the ring finger
(C) Radial digital artery of the little finger
(D) Ulnar digital artery of the index finger
(E) Ulnar digital artery of the ring finger

The correct response is Option E.

Because harvest of this lengthy neurovascular island flap from the middle finger will require division of the radial artery of the ring finger, perfusion of the ring finger will be solely dependent on its ulnar digital artery; therefore, Doppler ultrasonography is required to verify the patency of this artery. This flap will provide the adequate padding and sensate, vascularized coverage necessary for optimal reconstruction of the thumb defect. It is often harvested from the middle finger because of its long neurovascular pedicle. Division of the radial digital artery will provide additional length for the flap. In addition, the patency of both digital arteries of the middle finger should be demonstrated on Doppler ultrasonography.

The radial digital nerve of the ring finger is not divided but is instead separated from the ulnar digital nerve of the middle finger.

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126

A 25-year-old laborer has persistent loss of active flexion of the proximal interphalangeal (PIP) joint of the nondominant left index finger after sustaining a crush injury to the finger six months ago. At the time of injury, revision amputation was performed to the level of the midphalanx. On examination, passive range of motion of the PIP joint is from 0 to 90 degrees; when he attempts to actively flex the metacarpophalangeal joint, the PIP joint extends.

Which of the following is the most appropriate next step in management?

(A) Serial casting of the PIP joint in flexion
(B) Division of the lumbrical tendon
(C) Release of the flexor digitorum profundus tendon
(D) Dorsal capsulotomy of the PIP joint
(E) Revision amputation to a level proximal to the PIP joint

The correct response is Option B.

The most appropriate next step in management is division of the lumbrical tendon. After undergoing amputation of his crushed digit to the level of the midphalanx, this patient most likely has developed paradoxical extension resulting from a lumbrical plus deformity. Patients with this deformity have good passive range of motion but are unable to actively flex the PIP joint of the affected finger. At the time of amputation, the flexor digitorum profundus (FDP) tendon becomes detached from its insertion and migrates proximally, increasing the extension force of the intact lumbrical tendon at the PIP joint. This results in extension of the PIP joint with attempted active flexion of the metacarpophalangeal joint. Division of the lumbrical tendon will relieve this problem.

Other conditions that are likely to occur following digital amputation to the level of the middle phalanx include the development of either the quadriga effect or a painful neuroma. Patients who experience the quadriga effect have decreased grip strength and/or loss of flexion of the PIP and DIP joints of the adjacent digits, as well as cramping pain in the forearm that occurs with active flexion. These findings are caused by adherence of the stump of the FDP tendon to adjacent distal structures following digital amputation. Contraction of the common FDP muscle belly of the middle, ring, and little fingers is inhibited by the distal tendon adhesions, and the FDP tendons are no longer able to transfer force to the adjacent digits. Release of the adherent flexor tendon is appropriate treatment.

Resection of the digital nerves under tension will allow the nerve stump to retract away from the tip of the amputation stump and decrease the patient's likelihood of developing a painful neuroma. Neuromas are localized palpable masses that cause severe hypersensitivity in the area of the lesion. Although desensitization exercises are typically used to relieve pain, some patients with extremely painful neuromas will require surgical exploration and repositioning of the nerve stump to a site with adequate soft-tissue padding.

Serial casting of the PIP joint is never indicated in a patient who has good passive range of motion of the injured finger. Dorsal capsulotomy of the PIP joint can be used to correct static extension contractures if hand therapy has been unsuccessful. Revision amputation should only be performed after all other forms of treatment have been exhausted.

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127

The above radiograph is from an 18-year-old man who fell on his outstretched nondominant left hand while rollerblading. Which of the following is the most appropriate management?

(A) Short-arm thumb spica casting
(B) Long-arm thumb spica casting
(C) Closed reduction and percutaneous pin fixation, followed by cast immobilization
(D) Open reduction and internal fixation, followed by cast immobilization
(E) Open reduction and internal fixation with bone grafting

The correct response is Option D.

The most appropriate management in this 18-year-old man who sustained a wrist injury is open reduction and internal fixation. The patient's radiograph shows a fracture of the proximal third of the scaphoid with 1 mm to 2 mm of displacement. A fracture that is displaced more than 1 mm is considered unstable and increases the patient's risk for delayed union, nonunion, and avascular necrosis of the proximal pole. Therefore, the fracture should be reduced in the operating room and the bone should be fixated using Kirschner pins or Herbert or Acutrak screws. Although reduction can be performed arthroscopically, this a technically difficult procedure that should be attempted by experienced surgeons only in patients with undisplaced or minimally displaced fractures.

Use of cast immobilization only in the management of displaced fractures is associated with a higher incidence of fracture nonunion. One study of patients who were treated with cast immobilization showed a rate of union of 94% in nondisplaced fractures compared with a rate of union of only 54% in displaced fractures. A stable, undisplaced scaphoid fracture should be immobilized in an above-elbow cast that extends distally to the level of the interphalangeal joint. The cast should be molded carefully to provide proper compression over the dorsal capitate; this will prevent pronation and supination and result in a more rapid bone union.

Closed reduction and percutaneous pin fixation is inappropriate because the degree of fracture displacement seen in this patient indicates the need for open reduction.

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128

A 45-year-old electrician has pain and stiffness of the amputation stump one year after sustaining a crush amputation of the dominant right index finger at the level of the proximal interphalangeal joint. At the time of injury, primary closure was performed in the emergency department. Which of the following is the most appropriate management?

(A) Injection of formaldehyde into the amputation stump
(B) Desensitization of the stump with iontophoresis
(C) Repair of digital nerve neuromas
(D) Revision amputation to the level of the metacarpophalangeal joint
(E) Ray amputation of the injured digit

The correct response is Option E.

In this patient who has functional impairment of the dominant right index finger after trauma, the most appropriate management is ray amputation. Amputation is often the procedure of choice in patients who have functional

impairment or disability of one digit following trauma. This patient has stiffness and pain in the index finger remnant after sustaining a crush amputation at the level of the proximal interphalangeal joint. In addition, the stump is not functional and actually interferes with hand usage. Ray amputation will relieve this patient's symptoms and remove the amputation stump, resulting in unhindered hand function; the middle finger will perform the functions of the index finger during hand use.

Iontophoresis may relieve pain but will not improve finger mobility. Treatment of any neuromas using ablation or chemical techniques, such as injection of formaldehyde or alcohol, will also not restore finger function. Revision amputation to the level of the metacarpophalangeal joint is contraindicated in patients with amputations of the index finger because an amputation stump at this level may interfere with the thumb web or with overall hand function.

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129

Which of the following is the most definitive physical finding in the diagnosis of compartment syndrome?

(A) Delayed capillary refill
(B) Loss of active motion of the musculotendinous units within the involved compartment
(C) Paresthesias
(D) Severe pain with passive stretch of the involved muscles
(E) Tightness of the compartment on palpation

The correct response is Option D.

The most reliable physical finding in patients with suspected compartment syndrome is severe pain with passive stretch of the involved muscles. The diagnosis of compartment syndrome is primarily based on signs and symptoms of muscle and nerve ischemia. Because compartment ischemia always produces persistent unrelenting pain, any pain that is exacerbated on passive stretch of the involved muscles (also known as stretch testing) can be considered a confirmation of the diagnosis. Direct measurement of compartment pressures is also helpful.

Patients with confirmed compartment syndrome do not always experience delayed capillary refill or any other impairment in distal circulation. The ability to actively move the affected part depends more on the extent of ischemia then on its presence. Paresthesias are a clinically important but less consistent sign of nerve ischemia. Tightness of the compartment on palpation is a valuable finding; however, this may be difficult to assess in smaller compartments, such as in the hand.

References

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130

The above radiograph is of an 18-month-old infant who has bilateral polydactyly of the hands and feet. According to Wassel's classification, this infant has which of the following types of thumb deformity?

(A) Wassel III
(B) Wassel IV
(C) Wassel V
(D) Wassel VI
(E) Wassel VII

The correct response is Option E.

This patient with polydactyly has a Wassel type VII thumb deformity, also known as triphalangealism. Wassel's system is used to classify duplicate thumbs based on the extent of skeletal union. The table below explains this classification system.

Type I:	Skeletal union of all or a portion of the distal phalanges
Type II:	No skeletal union of the distal phalanges
Type III:	No skeletal union of the distal phalanges, but union (bifid) of the proximal phalanges
Type IV:	No skeletal union of the distal or proximal phalanges
Type V:	No skeletal union of the distal or proximal phalanges, but union of the metacarpals
Type VI:	No skeletal union of the distal or proximal phalanges or metacarpals
Type VII:	Thumb duplication involving triphalangeal digits

Triphalangeal thumbs are rare, occurring in 1 in 25,000 live births. This anomaly, which can be can be inherited as an autosomal dominant trait, results from abnormal persistence of the apical ridge and notching in the first ray during embryologic development. One type of triphalangeal thumb is characterized by a proximal metacarpal epiphysis, a normal carpometacarpal joint, an adequate web space, and near normal opposability; another type lacks these features.

Conditions associated with triphalangeal thumb include atrial or ventricular septal defects, transposition of the great vessels, patent ductus arteriosus, and hypoplastic anemia; associated syndromes may include Holt-Oram syndrome, Juberg-Haywood syndrome, Blackfan-Diamond anemia, and Fanconi pancytopenia.

Appropriate reconstruction includes excision of the less functional thumb, maintenance of the thumb web space, and creation of the interphalangeal joint, commonly using on-top plasty.

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131

A 52-year-old woman with obesity is scheduled to undergo open carpal tunnel release using regional anesthesia. She is 150 cm (5 ft) tall, weighs 103.5 kg (230 lb), and has short cone-shaped arms. Which of the following is the most appropriate anesthetic technique for this patient?

(A) Axillary block with 1% lidocaine
(B) Intravenous regional block (Bier block) with 0.5% bupivacaine
(C) Intravenous regional block (Bier block) with 0.5% bupivacaine plus 1:200,000 epinephrine
(D) Intravenous regional block (Bier block) with 0.5% lidocaine plus 1:200,000 epinephrine
(E) Musculocutaneous sensory nerve block with 1% lidocaine

The correct response is Option A.

In this patient with obesity who is scheduled to undergo carpal tunnel release, the most appropriate anesthetic technique is administering an axillary block with 1% lidocaine. The axillary block will provide adequate anesthesia for a short procedure, such as carpal tunnel release. In patients undergoing more prolonged procedures, a combination of anesthetics, such as lidocaine plus bupivacaine, can be used.

Intravenous regional block (Bier block) is frequently used in hand surgery. With this type of anesthesia, a double-cuffed tourniquet is placed on the upper arm and the proximal and distal cuffs are inflated sequentially. It is difficult to obtain a reliable tourniquet effect using a wide double cuff in a patient with obesity who has cone-shaped arms because of the inability to attain a proper fit. Thus, the risk for premature tourniquet loss and early systemic absorption of the anesthetic agent would be greatly increased. With lidocaine infused at a rate of 3 mg/kg, this patient would potentially be exposed to a dose of lidocaine of 300 mg if poor tourniquet function or early tourniquet loss were seen. Systemic absorption of such a large dose of lidocaine may produce signs and symptoms of lidocaine toxicity. In patients with cylindrically shaped forearms, the tourniquet can be placed more distally to establish a forearm Bier block.

Because the use of bupivacaine (even at concentrations as low as 0.25%) has been associated with several deaths during anesthesia, this anesthetic is now contraindicated in the Bier block technique. These deaths are believed to have resulted from the significant cardiac effects produced by bupivacaine when high concentrations of the anesthetic are used. Epinephrine should also not be used in a Bier block because it may produce adverse cardiovascular effects during systemic absorption.

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132

A 7-year-old boy is brought to the emergency department three hours after slamming his right middle finger in a car door. Examination shows a 5.0 × 8.0-mm defect with loss of skin and pulp from the volar distal fingertip. There is no exposed bone. The amputated skin and pulp cannot be recovered.

Which of the following is the most appropriate management?

(A) Healing by second intention
(B) Split-thickness skin grafting
(C) Shortening of the distal phalanx and primary closure
(D) Atasoy-Kleinert V-Y flap
(E) Neurovascular island flap

The correct response is Option A.

The most appropriate management in this 7-year-old boy who has a defect of the middle finger following trauma is to allow wound healing by second intention. This method is recommended in children who have fingertip amputations without exposed bone. The treatment regimen involves cleansing of the wound and application of a nonadherent dressing, with periodic dressing changes until healing is complete. Reattachment of the amputated fingertip as a graft might also be considered as long as the skin and soft tissues have been preserved and are not decimated.

Split-thickness or full-thickness skin grafting is typically recommended in the management of skin loss greater than 1 cm^2. Complications that may be encountered following split-thickness skin grafting include tenderness, decreased sensibility, induration, and fissuring of the grafted skin, as well as donor site scarring.

Shortening and primary closure would result in an undesirable aesthetic and functional deformity and should only be considered in certain adult patients with exposed bone.

The Atasoy-Kleinert V-Y advancement flap is used for reconstruction of the distal pad of the finger and is not recommended in a patient who has considerable palmar skin loss.

The neurovascular island flap provides adequate sensation and padding in patients with thumb defects.

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133

A 29-year-old man comes for evaluation because he has decreased function of his dominant right hand and cosmetic concerns six months after sustaining a traumatic amputation of the right middle finger at the level of the metacarpophalangeal (MP) joint. Examination shows ulnar deviation of the index finger at the level of the MP joint; the patient has scissoring of the index finger toward the ring finger when he attempts to make a fist.

Which of the following is the most appropriate management?

(A) Physical therapy and splinting of the index finger
(B) Arthroplasty of the MP joint of the index finger
(C) Transposition of the index finger
(D) Transposition of the ring finger
(E) Toe-to-hand transfer

The correct response is Option C.

In this patient with ulnar deviation of the index finger occurring during flexion, the most appropriate management is transposition of the index finger. This technique will correct the ulnar deviation as well as any "gapping" that may be seen secondary to the middle finger amputation.

Physical therapy and splinting are only temporary solutions for this patient's hand problem. Arthroplasty of the metacarpophalangeal joint will not resolve the force imbalance affecting the index finger. Transposition of the ring finger will result in a midhand gap. Toe-to-hand transfer is also not indicated.

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134

In a 45-year-old woman who has numbness and tingling in the ring and little fingers, which of the following tests is best used to distinguish ulnar tunnel syndrome at the level of Guyon's canal from cubital tunnel syndrome at the level of the elbow?

(A) Motor testing of the first dorsal interosseous muscle
(B) Motor testing of the second dorsal interosseous muscle
(C) Motor testing of the pronator quadratus muscle
(D) Sensation testing along the ulnar aspect of the dorsum of the hand
(E) Sensation testing along the ulnar volar aspect of the mid-distal forearm

The correct response is Option D.

Sensation testing along the ulnar aspect of the dorsum of the hand will best distinguish ulnar tunnel syndrome at the level of Guyon's canal from cubital tunnel syndrome at the level of the elbow. In the upper extremity, the dorsal sensory branch divides from the ulnar nerve within the distal third of the forearm; from this point, it travels distally and dorsally around the ulnar border and supplies sensation to the ulnar half of the dorsum of the hand. Because of its departure from the ulnar nerve and resultant path, the dorsal sensory branch is spared from entrapment within Guyon's canal. As a result, patients with ulnar tunnel syndrome at this level will have normal sensation along the dorsal ulnar aspect of the hand. In contrast, the dorsal sensory branch has not yet divided at the level of the elbow and is therefore included in the ulnar nerve within the cubital tunnel; therefore, patients with cubital tunnel syndrome will have decreased sensation in the dorsal ulnar half of the hand.

The interosseous muscles receive their innervation from the motor branch of the ulnar nerve, which branches off within the midportion of Guyon's canal. Therefore, patients with either cubital tunnel or ulnar tunnel syndrome will have weakness and atrophy of the dorsal interosseous muscles.

The pronator quadratus muscle is innervated by the anterior interosseous branch of the median nerve and is not affected in either cubital tunnel or ulnar tunnel syndrome.

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135

A 49-year-old woman with rheumatoid arthritis of the wrists and hands has had loss of active extension of the metacarpophalangeal (MP) joints of the right middle and ring fingers for the past six months. Examination shows full passive range of motion of the MP joints; radiographs show no joint subluxation. When the digits are passively extended, she is able to maintain extension against resistance.

Which of the following is the most appropriate next step in management?

(A) Observation
(B) Arthroplasty of the MP joints of the middle and ring fingers
(C) Repair of extensor tendon ruptures of the middle and ring fingers
(D) Centralization of the extensor tendons of the middle and ring fingers at the MP joints
(E) Arthrodesis of the MP joints of the middle and ring fingers

The correct response is Option D.

This patient who cannot actively extend the MP joints of his middle and ring fingers should undergo centralization of the extensor tendons. Ulnar displacement of the extensor tendons between the MP joint heads is most likely to result from attenuation or rupture of the radial sagittal band. When this occurs, the displaced tendon cannot correctly perform its action as an extensor because of its proximity to the center of rotation of the MP joint. However, passive

extension of the MP joint will move the tendon to its proper position over the MP joint, and as a result the patient will be able to actively maintain finger extension.

Arthroplasty alone will recentralize the tendons but will not correct the deformity; this procedure is more appropriate for a patient who has subluxation or destruction of the joints. Because a patient with a ruptured extensor digitorum communis tendon would not experience improvement with passive extension of the digits, extensor tendon repair is not indicated. MP joint arthrodesis is rarely performed in the middle and ring fingers.

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136

A 25-year-old construction worker has had numbness in the dominant left little finger and the dorsal ulnar hand and difficulty buttoning her shirt and turning a key in a lock since lifting heavy objects at work six months ago. Symptoms have not improved following conservative management. Which of the following is the most effective management?

(A) First rib resection
(B) Release of the band of Osborne
(C) Release of the mobile wad
(D) Release of the transverse carpal ligament
(E) Transection of Cleland's ligament

The correct response is Option B.

This patient has clinical signs consistent with cubital tunnel syndrome, which is characterized by sensory deficits along the ulnar aspect of the hand and in the ring and little fingers, as well as weakness of grip and loss of hand dexterity. These findings result from compression of the ulnar nerve at the level of the elbow, which may occur as a result of direct trauma to the elbow, fracture of the medial epicondyle, or congenital deformity. Potential sites of compression of the ulnar nerve include the arcade of Struthers, which is a group of fascial folds within the medial intermuscular septum, and the band of Osborne, which can constrict the nerve as it passes through the cubital tunnel. Release of the compressing structure effectively improves symptoms of cubital tunnel syndrome with minimal morbidity. Other types of surgery that may be considered in this patient include simple decompression or anterior transposition of the ulnar nerve.

First rib resection is appropriate for management of symptoms associated with thoracic outlet syndrome, and release of the mobile wad can be performed in patients with proximal radial nerve compression. Release of the transverse carpal ligament will effectively relieve the pain associated with carpal tunnel syndrome. Because Cleland's ligament is not associated with any type of nerve compression, transection of this ligament is not performed for management of a compression syndrome.

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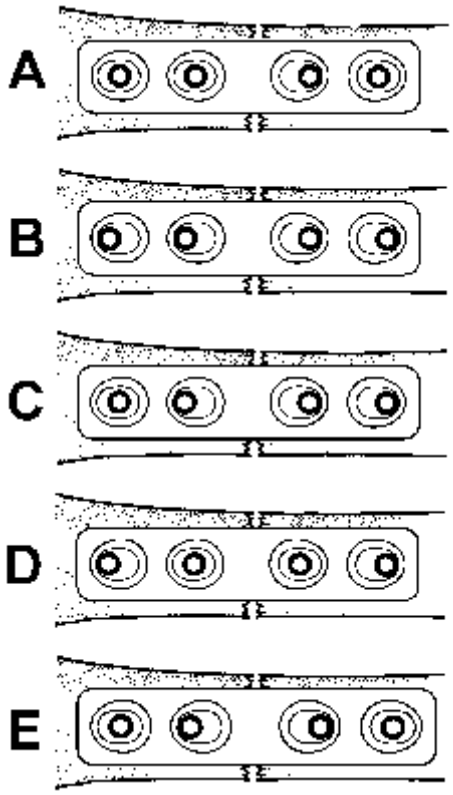
137

A patient with a transverse diaphyseal fracture of a metacarpal is scheduled to undergo open reduction and internal fixation using a four-hole dynamic compression plate. In order to provide adequate fracture reduction, stability, and compression, which of the following is the most appropriate application?



The correct response is Option A.

The illustration in Option A shows the most appropriate application of the dynamic compression plate. In order to adequately stabilize, compress, and reduce the fracture, the surgeon must first drill two neutral, or centered, holes on the left side of the fracture and insert two screws for fixation. Following careful reduction of the fracture, one hole is drilled into the right side of the plate. This hole must be adjacent to the fracture and lie asymmetric to the two holes on the left side. A single screw is inserted through the right-sided hole to adequately compress the fracture as the screw head engages the plate. Once the surgeon has obtained adequate compression, a neutral hole is drilled into the center of the plate on the right side (away from the fracture) and the final screw is inserted.

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138

A 29-year-old man sustains an open fracture of the left tibia 6 cm inferior to the tibial plateau in a motorcycle accident. On examination, there is a 3-cm segmental loss of bone at the fracture site; following debridement, he has a 5 × 7-cm skin defect. Which of the following is the most appropriate management?

(A) External fixation, implantation of a tobramycin-methacrylate bead spacer, and coverage with a gastrocnemius muscle flap and skin graft
(B) External fixation, implantation of a tobramycin-methacrylate bead spacer, and coverage with a latissimus dorsi myocutaneous flap
(C) Coverage with a free vascularized fibular osteocutaneous flap
(D) Open cancellous bone grafting (Papineau technique)
(E) Immediate bone grafting, internal fixation, and coverage with a gastrocnemius muscle flap and skin graft

The correct response is Option A.

The most appropriate management of this patient's injury is external fixation of the fracture, implantation of a tobramycin-methacrylate bead spacer, and coverage with a gastrocnemius muscle flap and skin graft. This procedure is the best option for a patient who has a fracture of the proximal third of the lower leg with limited soft-tissue and bone loss (less than 6 cm).

A latissimus dorsi flap can be used to cover a defect of the distal third of the lower leg when there is no local flap available for use. Transfer of a free vascularized fibular osteocutaneous flap generally involves a complex surgical procedure; this flap is typically reserved for bony defects larger than 8 cm. Open cancellous bone grafting (Papineau technique) requires multiple surgical procedures involving harvest of large amounts of bone followed by a prolonged period of immobilization. Because stable fixation is necessary, this procedure is not the first choice in a patient with a segmental bony defect. Performing immediate bone grafting and internal fixation without using an antibiotic-impregnated bead spacer would put this patient, who has a contaminated wound, at increased risk for development of infection.

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139

Which of the following areas of the nail is most resistant to development of infection?

(A) Eponychium
(B) Germinal matrix
(C) Hyponychium
(D) Lunula
(E) Nail fold

The correct response is Option C.

The hyponychium is a mass of keratin that separates the distal nail from the nailbed. Despite the frequency of bacterial contamination in this area, infection is rare because the hyponychium is particularly resistant to infection. Large amounts of lymphoid tissue are characteristic.

The eponychium is a thin membrane extending from the skin over the dorsal aspect of the nail fold to cover the nail. The germinal matrix, which is a portion of the proximal nailbed, contains the greatest amount of nail mass. The lunula is an opaque white portion of nailbed located just distal to the eponychium. The nail fold is the depression in which the proximal nail is contained. Infection is more likely to be seen in any of these areas than in the hyponychium.

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140

The above radiograph is from a 42-year-old welder who has progressively worsening pain in the right wrist five years after injuring the wrist while playing baseball. The pain is exacerbated with wrist motion. Which of the following is the most appropriate operative management?

(A) Capitohamate arthrodesis and excision of the scaphoid
(B) Capitohamatotriquetrolunate arthrodesis and excision of the scaphoid
(C) Radioscapholunate arthrodesis
(D) Scaphocapitate arthrodesis
(E) Scaphotrapeziotrapezoidal arthrodesis

The correct response is Option B.

In this patient who has developed posttraumatic degenerative arthritis following scaphoid nonunion, the most appropriate operative management is capitohamatotriquetrolunate (four-corner) arthrodesis combined with excision of the scaphoid. This pattern of arthritis is commonly known as scapholunate advanced collapse (SLAC) when it is associated with chronic rotary subluxation of the scaphoid, or as scaphoid nonunion advanced collapse (SNAC) when it is associated with nonunion of the scaphoid. Patients affected by either condition have proximal and dorsal migration of the capitate, along with flexion of the scaphoid and dorsal subluxation of its proximal pole, resulting in abnormal articular contact and shear. Narrowing and osteophyte formation occur first in the radioscaphoid joint and then in the capitolunate and scaphotrapeziotrapezoidal joints. However, because the radiolunate joint is typically spared in patients with SLAC/SNAC wrist, reconstruction is based on the radiolunate joint. Consequently, effective surgical management in this patient is excision of the scaphoid and limited wrist arthrodesis including the capitate, hamate, lunate, and triquetrum. The above radiograph shows the result following arthrodesis. In contrast, this type of surgical management is contraindicated in patients with SLAC/SNAC wrist who have involvement of the lunate or radiolunate joint combined with ulnar translocation of the carpus.

Because this patient has involvement of the radioscaphoid and capitolunate joints, any other type of arthrodesis that maintains these joints will ultimately be unsuccessful.

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141

A 2-year-old girl has congenital absence of the thumb at the level of the proximal metacarpal. Which of the following is the most appropriate reconstructive procedure?

(A) Distraction-lengthening of the first metacarpal
(B) Great toe-to-thumb free tissue transfer
(C) Pollicization of the index finger
(D) Second toe-to-thumb free tissue transfer
(E) Wraparound great toe-to-thumb free tissue transfer

The correct response is Option C.

Pollicization of the index finger will provide the best result in a 2-year-old child with congenital absence of the thumb. Most cases of congenital absence of the thumb are characterized by a complete lack of all neurovascular and tendinous thumb structures. Children who are born without any thumb structures will experience involuntary pronation of the index finger as it attempts to take the place of the missing thumb. As a result, the web space between the index and middle finger will naturally increase. If pollicization is performed in this child prior to age 3 years, the new thumb will be more easily integrated into hand function and the child will adapt to this new hand posture more rapidly. In contrast, adults have a more difficult time adjusting to this change in hand structure. It should be noted that children who have congenital absence of the thumb associated with amniotic band syndrome may experience better results with toe-to-thumb transfer. In these patients, the neurovascular and tendinous structures are most often preserved prior to the level of amniotic banding; therefore, creation of a viable thumb from a transferred toe is more easily facilitated.

Distraction-lengthening procedures are rarely used now because of the resultant absence of thumb joint motion. Although a lengthened first metacarpal will provide opposability for the other digits, its lack of joint motion makes it clearly inferior to other procedures such as the toe-to-thumb transfer. As stated above, toe-to-thumb transfers require intact recipient nerves, vessels, and tendons, which are clearly absent in this patient. The great toe is 20% larger than the normal human thumb but provides a better aesthetic match than the second toe. However, the second toe is more appropriate for transfer in patients with thumb amputations through the base of the metacarpal. In these patients, transfer of the great toe would require sacrifice of the metatarsophalangeal joint, resulting in impaired ambulation. Wraparound procedures are best used in patients with degloving injuries to preserve bony thumb length.

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An 18-year-old woman has severe cold intolerance nine months after undergoing zone II replantation of the middle and ring fingers. Function of the replanted fingers is good. Which of the following is the most appropriate management?

(A) Observation
(B) Injection of cortisone
(C) Digital sympathectomy
(D) Stellate ganglion blocks
(E) Amputation of the replanted digits

The correct response is Option A.

In this patient who has cold intolerance following zone II replantation of the middle and ring fingers, the most appropriate next step is observation. Cold intolerance is a common sequela of replantation. In fact, several long-term studies have shown that some patients with this condition may experience some improvement as late as two years following surgery. Nevertheless, some patients do not have complete resolution.

Cortisone injections, digital sympathectomy, and stellate ganglion blocks have not been shown to improve cold intolerance in patients with replanted digits. Because improvement may occur as late as two years after replantation, amputation is not indicated as soon as nine months after surgery.

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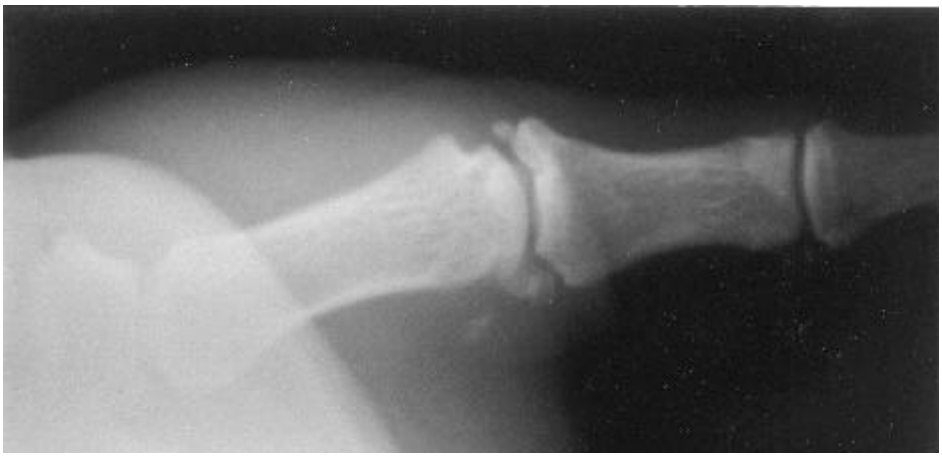

The above radiograph is from a 45-year-old man who has had pain, swelling, and ecchymoses over the ulnar aspect of the thumb metacarpophalangeal joint since falling on his outstretched hand three days ago. On examination, a tender mass can be palpated. Which of the following is the most appropriate management?

(A) Application of a thumb spica splint
(B) Application of a thumb spica cast
(C) Closed reduction
(D) Open reduction

The correct response is Option D.

Open reduction is the most appropriate management of this patient's deformity. These findings are consistent with a classic Stener lesion, in which the ulnar collateral ligament (UCL) avulses and retracts proximally. The interposed adductor aponeurosis precludes primary healing; the UCL will not heal properly without contact at the site of avulsion. Avulsion of the UCL can occur with or without a bony fragment. A mass can be palpated. Laxity of the ulnar capsule will occur and will not improve with immobilization of the fracture, resulting in chronic pain and instability. Open reduction and internal fixation should be performed to effectively restore contact between the fracture fragments and allow the fracture to heal.

In patients who have partial tears of the UCL, operative repair is indicated if collateral ligament instability is greater than 30 degrees during stress in both full extension and semi-flexion. Conservative management is recommended instead for incomplete ligament tears not associated with instability.

Appropriate surgical repair of this injury includes debridement of the fracture fragment, division of the adductor aponeurosis, and anchoring of the residual UCL to the small area of decorticated proximal phalanx using sutures. The adductor aponeurosis is repaired after the UCL is attached. The repaired ligament can be protected with a transarticular Kirschner wire and a cast for four weeks. After the cast is removed, a thumb spica splint should be worn for four weeks.

As mentioned above, splint immobilization or closed reduction would be ineffective in restoring contact between the fracture fragments in this patient.

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144

A 42-year-old woman with severe rheumatoid arthritis has advanced joint degeneration, pain, and decreased use of the right elbow, wrist, and hand. On examination, the elbow is stiff and tender and the wrist and metacarpophalangeal joints are tender and subluxed. Radiographs confirm these findings.

Which of the following staged sequences is most appropriate?

(A) Elbow arthroplasty, wrist arthrodesis, MP joint arthroplasties
(B) Elbow arthroplasty, MP joint arthroplasties, wrist arthrodesis
(C) MP joint arthroplasties, elbow arthroplasty, wrist arthrodesis
(D) MP joint arthroplasties, wrist arthrodesis, elbow arthroplasty

The correct response is Option A.

This patient with severe rheumatoid arthritis should first undergo total elbow arthroplasty followed by wrist arthrodesis and then by MP joint arthroplasties. This proximal-to-distal sequence of procedures is advocated for most patients who have diffuse rheumatoid arthritis of the upper extremity. Performing the elbow arthroplasty first will facilitate the subsequent surgical procedures and postoperative recovery and rehabilitation by stabilizing the arm, increasing elbow mobility, and decreasing pain. Postoperative self-care following subsequent surgeries will be easier for the patient. In addition, patients with rheumatoid arthritis have joint and tendon imbalance and resultant "zig-zag" deformities; the ulnar deviation and volar subluxation of the MP joints is further aggravated by the radial deviation and supination of the wrist. Therefore, wrist arthrodesis should precede MP joint arthroplasties.

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145

An otherwise healthy 50-year-old surgeon has the sudden, rapid onset of severe swelling in the fingers as well as pain, stiffness, and swelling of the distal interphalangeal joints. On examination, the fingernails are pitted and cracked. These findings are most consistent with

(A) gout
(B) HIV infection
(C) rheumatoid arthritis
(D) systemic lupus erythematosus

The correct response is Option B.

A diagnosis of HIV infection should be considered in patients who have the rapid or explosive onset of psoriatic arthritis or Reiter's syndrome. Arthritic HLA B27-associated conditions are frequently seen in conjunction with HIV infection and are often more aggressive and resistant to treatment. Psoriasis either develops or worsens with the onset of HIV infection; in contrast, Reiter's syndrome, which in most patients is a triad of arthritis, conjunctivitis, and uveitis, is more likely to have only polyarthritic involvement. However, awareness of the coexistence of HIV infection in this patient is important because immunosuppressive therapy, which is often prescribed for management of arthritis, can have devastating effects in patients with HIV infection. The findings in this patient can also be mistaken for onychomycosis or herpetic whitlow.

Gout is a crystalline arthropathy, while rheumatoid arthritis and systemic lupus erythematosus are inflammatory systemic autoimmune diseases. None of these conditions would present with the above findings, although some symptoms of HIV infection can mimic systemic lupus erythematosus.

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146

A 40-year-old butcher has had progressive episodes of popping and clicking of the dominant right thumb during flexion and extension over the past two months. On examination, a node can be palpated within the flexor pollicis longus tendon.

The most appropriate management is division of which of the following pulleys?

(A) A1 pulley
(B) A1 and oblique pulleys
(C) A2 pulley
(D) A2 and oblique pulleys

The correct response is Option A.

This patient has acquired triggering of the flexor pollicis longus tendon of the thumb, which most often occurs just proximal to the proximal lip of the A1 pulley. The area of involvement can be found by identifying the flexion crease of the metacarpophalangeal joint of the thumb as its anatomic landmark. The most appropriate management of acquired triggering of the thumb is division of the A1 pulley, which provides complete relief of triggering in most cases. In addition, the surgeon should verify during the procedure that full digital excursion is not inhibited mechanically.

Splinting of the thumb, injection of a corticosteroid into the flexor tendon sheath, and release of the A1 pulley are treatment options for adult patients with acquired triggering. However, splinting and/or injection are less successful when the patient experiences locking of the digit, or when a nodule is present.

Division of the oblique pulley alone or the A1 and oblique pulleys together will result in bowstringing and will significantly impair digital function. Tenoplasty should be considered if the oblique pulley is indeed obstructing the palpable node.

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In a patient with undiagnosed compartment syndrome of the forearm, which of the following muscles are at greatest risk for ischemic injury?

(A) Extensor carpi ulnaris and flexor digitorum superficialis
(B) Flexor digitorum profundus and flexor carpi ulnaris
(C) Flexor digitorum superficialis and palmaris longus
(D) Flexor pollicis longus and flexor digitorum profundus
(E) Pronator teres and brachioradialis

The correct response is Option D.

An undiagnosed compartment syndrome poses the greatest risk to the flexor digitorum profundus and flexor pollicis longus muscles in the forearm. These muscles lie within the deepest compartments adjacent to bone and thus typically experience the greatest increases in interstitial pressure, leading first to ischemia and then to muscle necrosis.

In patients who develop severe contractures (involving all four fingers) resulting from undiagnosed compartment syndrome, the deep flexor muscles are most often involved as previously mentioned. The superficial flexors (flexor

digitorum superficialis, flexor carpi radialis, flexor carpi ulnaris, and pronator teres) are the next to be involved, followed by the deep extensors (extensor pollicis longus, extensor pollicis brevis, abductor pollicis longus, extensor indicis proprius), and finally the superficial extensors (brachioradialis, extensor carpi radialis longus, extensor carpi radialis brevis, extensor digitorum communis, extensor carpi ulnaris). The characteristic deformity in these patients does not develop until weeks or months later and manifests as flexion of the elbow and wrist, pronation of the forearm, adduction and flexion of the thumb, and extension at the level of the metacarpophalangeal joint and flexion at the level of the interphalangeal joint with a claw-type deformity. These patients may also have a loss of sensation in the hand resulting from ischemic injury to the median and ulnar nerves.

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148

A 35-year-old woman has pain in the medial elbow and numbness and tingling of the ring and little fingers. Her symptoms are exacerbated by flexing the elbow with the forearm in supination. The most likely cause of this patient's findings is nerve entrapment within which of the following structures?

(A) Arcade of Frohse
(B) Arcade of Struthers
(C) Lacertus fibrosis
(D) Leash of Henry
(E) Ligament of Struthers

The correct response is Option B.

This patient has cubital tunnel syndrome, or compression of the ulnar nerve at the level of the elbow. Characteristic findings include numbness in the dorsoulnar aspect of the hand, in the little finger, and in the ulnar aspect of the ring finger, as well as weakness of the ulnar extrinsic and intrinsic muscles. Although there are several potential sites of nerve entrapment, it is most likely to occur within the arcade of Struthers. This is a group of fascial bands from the medial intermuscular septum that can entrap the nerve, such as following anterior transposition. Another potential site of entrapment is the band of Osborne, which constricts the ulnar nerve as it passes through the cubital tunnel. Release of this band is critical during neuroplasty.

Entrapment of the deep branch of the radial nerve, or posterior interosseous nerve, can occur at the arcade of Frohse, which is a fascial band located along the supinator muscle in the forearm, or at the vascular leash of Henry, which is a sling of radial recurrent vessels that crosses the radial nerve.

The lacertus fibrosus, a dense sheet of aponeurotic fascia that extends from the biceps tendon to the flexor muscle mass, is a potential site of entrapment of the median nerve at the level of the elbow. This nerve can also become entrapped more proximally by the ligament of Struthers, which forms between the supracondylar humeral process and the medial epicondyle.

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The above photograph is of a 75-year-old woman who has a discolored 4-mm lesion of the nail bed of the nondominant left thumb after undergoing removal of the nail plate for management of chronic paronychia. A biopsy specimen of the lesion shows subungual melanoma with a thickness of 3 mm. The above MRI shows possible tumor tracking along the ulnar neurovascular bundle. Lymphoscintigraphy shows two positive nodes in the axilla.

Which of the following is the most appropriate level of amputation?

(A) Carpometacarpal joint
(B) Metacarpal diaphysis
(C) Metacarpophalangeal joint
(D) Proximal phalanx diaphysis
(E) Interphalangeal joint

The correct response is Option D.

This patient has a subungual melanoma, an uncommon, aggressive tumor most often seen in the thumb. Excisional biopsy should be performed immediately to distinguish this type of tumor from squamous cell carcinoma, basal cell carcinoma, pyogenic granuloma, glomus tumor, or giant cell tumor. Amelanotic tumors, which are often diagnosed late, comprise approximately 30% of all subungual melanomas. A Clark's level cannot be determined in patients with subungual melanoma because of the absence of subcutaneous tissue within the nail matrix. Although in situ melanomas are associated with a relatively good prognosis, all other forms of subungual melanoma are associated with poor prognoses. The outcome is particularly poor in patients with ulcerated lesions.

Patients with melanoma must be evaluated for the presence of local, regional, and distant metastases. Consultation with a medical oncologist is needed; MRI is helpful in determining the extent of local disease. However, the MRI findings may be confused with inflammatory changes. Melanomas can extend along the neurovascular bundles.

In patients with localized subungual melanomas, amputation just proximal to the most distal joint is recommended to clear disease while maintaining length and function of the digit. Sentinel node biopsy will determine tumor staging and the need for lymphadenectomy. In order to maintain thumb function following amputation, Z-plasty, detachment of the first dorsal interosseous tendon, and a more proximal reattachment of the adductor pollicis tendon can be performed to deepen the first web space and effectively lengthen the thumb.

More distal amputation will not clear local disease and will instead increase the risk for local recurrence. A more proximal amputation will not improve the poor prognosis and will also result in a significantly less functional digit, especially when the thumb is involved.

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150

A 17-year-old girl sustains an open pilon fracture of the middle finger of the dominant right hand during a basketball game. Open reduction and internal fixation with autologous bone grafting are performed; on examination three months later, there is a flexion contracture of the proximal interphalangeal (PIP) joint. Active range of motion is 90 degrees to 95 degrees. Radiographs show a stable, healed fracture with a smooth surface and congruency of the PIP joint. Hand therapy has not resulted in any improvement in hand function.

Which of the following is the most appropriate operative management?

(A) Bone grafting
(B) Capsulectomy
(C) Arthroplasty
(D) Arthrodesis
(E) Amputation

The correct response is Option B.

This 17-year-old girl sustained an open pilon fracture of the middle finger; fractures such as this one involving the proximal interphalangeal (PIP) joint are often extremely difficult to manage. The articular surfaces should be re-established surgically; autologous bone grafts can be applied to maintain reduction. Ligamentotaxis will aid in realignment of the joint. Early controlled motion is associated with the best functional outcome.

In patients who develop flexion contractures following PIP joint injury, early management will result in optimal return of function. Serial casting is recommended for patients who have PIP joint contractures of greater than 30 degrees; dynamic splinting is used subsequently. Controlled application of 100 g to 250 g of torque will stretch the soft tissues without causing inflammation. A dynamic external distraction device can be applied to help realign the joint and obtain further tissue stretch.

Because treatment of this patient's severe posttraumatic flexion contracture has been delayed, the most appropriate management at this time involves release of the scarred soft tissues. The collateral ligaments, volar plate, capsule, and check rein ligaments of the PIP joint should be evaluated and then released sequentially. Capsulectomy is recommended to improve active motion of the finger.

Bone grafting is best when performed at the time of initial repair to maintain reduction following re-establishment of the articular surfaces; grafting at this time is not warranted. Arthroplasty is appropriate for posttraumatic degeneration of the PIP joint in a radial digit, while arthrodesis is recommended for the same condition in an ulnar digit. Amputation should only be performed if the patient has severe, uncontrolled neuropathic pain and loss of function of the digit.

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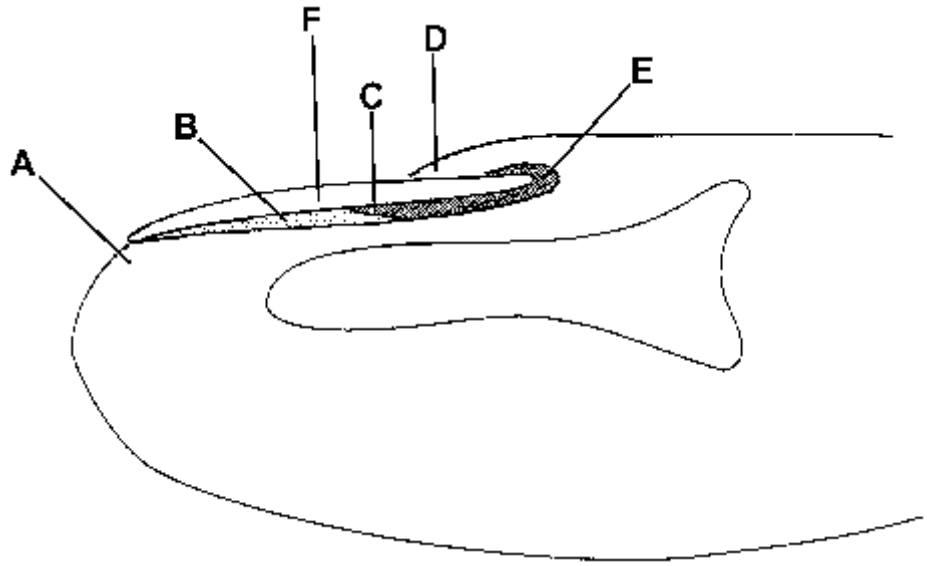

In the above diagram, the sterile matrix of the nail is best represented by

(A) A
(B) B
(C) C
(D) D
(E) E

The correct response is Option B.

Anatomically, A represents the hyponychium, B is the sterile matrix, C is the lunula, D is the eponychial fold, E is the germinal matrix, and F is the nail plate. The sterile matrix begins at the lunula and facilitates the adherence of the nail to the finger.

The germinal matrix lies proximal to the sterile matrix and has a component within the nail fold. It contributes to growth and development of the nail plate and the smooth, shiny surface of the nail.

The hyponychium is specialized tissue with a dense collection of keratin molecules. It is located under the distal aspect of the nail and helps to prevent infection.

The lunula denotes the endpoint of the germinal matrix and the starting point of the sterile matrix.

The eponychium is the edge of skin at the end of the nail; the nail plate is found beneath it.

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152

The percentage of persons who have absence of the plantaris muscle in one lower extremity is

(A) less than 5%
(B) 10% to 15%
(C) 25% to 30%
(D) 45% to 50%
(E) 75% to 80%

The correct response is Option B.

According to the results of several studies, the plantaris muscle has been shown to be absent in at least one lower extremity in approximately 10% to 15% of persons. This tendon can be used for grafting procedures. It provides a longer donor graft than the palmaris longus in the forearm; however, it is hidden on physical examination, making it more difficult to locate prior to surgery. Because the muscle may be absent in one or both lower extremities, ultrasonography can be helpful in determining its presence and location. Approximately 33% of patients have a plantaris muscle in only one lower extremity.

Other studies have shown that absence of the plantaris muscle occurs with slightly greater frequency in women, and the plantaris muscle is more likely to be absent in the left lower extremity. Differences based on race and/or ethnicity have not been studied. In addition, absence of the plantaris muscle is unrelated to absence of the palmaris longus muscle; in other words, a person who is missing one or both plantaris muscles may in fact have one or both palmaris longus muscles.

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153

A 27-year-old woman has had localized pain and tenderness at the tip of the right index finger for four months. She has a history of severe sensitivity to cold but no history of trauma. Examination shows a normal-appearing index finger; no mass is noted. There is a slight bluish discoloration under the nail and a localized area of exquisite pinpoint tenderness in this area over the nail. Radiographs show a cortical indentation of the dorsal aspect of the middle of the distal phalanx.

Which of the following is the most likely diagnosis?

(A) Enchondroma
(B) Epidermal inclusion cyst
(C) Giant cell tumor of the tendon sheath
(D) Glomus tumor
(E) Mucous cyst

The correct response is Option D.

The findings in this patient are most consistent with a glomus tumor, a benign lesion of the neuromyoarterial apparatus whose presence is characterized by exquisite pain, pinpoint tenderness, and extreme sensitivity to cold. Other occasional findings include a faint blue spot as well as erosion of the distal phalanx. MRI is best for delineation of occult glomus tumors.

Excision and primary closure are recommended for management. In patients who have subungual lesions, the nail plate is removed and the tumor is excised via a longitudinal incision in the nail matrix.

Enchondromas, which are the most common primary solid tumors of the hand, are typically asymptomatic and are often only discovered in conjunction with a pathologic fracture. Radiographs will show a stippled, radiolucent lesion with distinct margins in the metaphysis or diaphysis. Appropriate management is curettage with fixation and bone grafting as needed.

Epidermal inclusion cysts are painless, slow growing benign masses that are thought to develop following a traumatic episode in which epithelial cells are implanted into the subcutaneous tissues. Tumor growth can impair hand function. Excision is appropriate management.

Giant cell tumors of the tendon sheath are lobulated, firm, nontender, slowly enlarging masses firmly fixed to the deep soft tissue. They are typically found on the palmar surfaces of the wrist, hand, and fingers. Excision is recommended although recurrence is common.

Mucous cysts are ganglions of the distal interphalangeal joint that initially appear in patients age 50 to 70 years. Heberden's nodes are frequently associated; longitudinal nail grooving may develop from pressure on the nail matrix. Radiographs will show evidence of osteoarthritic changes within the joint. Appropriate management is excision with removal of the arthritic spur.

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154

The photograph shown on the previous page is of a 45-year-old man with insulin-dependent diabetes mellitus who develops a gangrenous toe. Culture of the wound shows mixed aerobic and anaerobic organisms, including *Bacteroides*, *Enterococcus*, and *Staphylococcus*. Noninvasive vascular studies show an ankle-brachial index of 0.76. The patient wishes to undergo a single-stage surgical procedure.

Which of the following is the most appropriate type of amputation for this patient?

(A) Amputation at the level of the metatarsophalangeal joint
(B) Transmetatarsal amputation
(C) Lisfranc amputation
(D) Syme's amputation
(E) Below-knee amputation

The correct response is Option B.

Amputation is indicated in this patient who has obvious necrosis of the toe. Indeed, ischemic changes and wound problems are often seen in patients with diabetes mellitus. Because these patients are typically predisposed to further, more proximal amputations in the future, a conservative approach to amputation should be used in this instance. Several factors, including ankle-brachial index, help to predict the success rate in patients who undergo partial amputations of the foot; an ankle-brachial index of less than 0.7 indicates a markedly increased risk for wound healing problems following surgery. However, this patient has an ankle-brachial index of 0.76, which is an acceptable risk for complications following amputation. Therefore, an evaluation for the likelihood of revascularization should be undertaken prior to any amputation procedure. The surgeon should attempt to save as much of the foot as possible to allow for primary closure of the defect. As a result, the amputation should be performed at the metatarsal level in this patient. The surgeon should also be aware of the vascular supply to the adjacent toes during the amputation procedure in order to prevent any associated complications.

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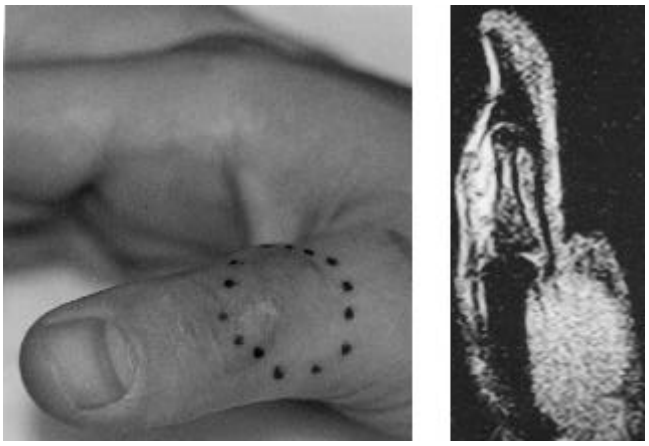

A 25-year-old man sustains a complete transverse laceration of the extensor pollicis longus tendon of the dominant right thumb. The tendon is surgically repaired and the hand is splinted; occupational therapy is started three weeks later. Two months after surgery, the patient has pain, slight swelling, and discoloration at the level of the interphalangeal joint; a photograph and MRI are shown on the previous page.

Which of the following is the most appropriate next step in management?

(A) Decortication
(B) Neurectomy
(C) Neuroplasty
(D) Tendon repair
(E) Tenolysis

The correct response is Option A.

Patients who have pain disproportionate to the level of injury should be evaluated to exclude a potential diagnosis of osteomyelitis, which in those without open fractures can result from local infection or hematogenous spread. In this patient, the MRI shows an abnormal signal in the proximal phalanx, which is consistent with osteomyelitis. Indium-111-labeled leukocyte scanning can also be used to confirm the diagnosis. Although *Staphylococcus aureus* is the most likely causal organism, *Mycobacterium marinum* and anaerobic organisms can also be associated. In cases such as this one, appropriate management includes surgical exploration, decortication to decompress the infected bone, and removal of all involved bone. Antibiotics should be administered intravenously following this procedure, and bone grafting should be performed at a later date. Photographs of the decortication procedure are shown above.

Neurectomy is used for repair of neuromas, which manifest as a localized positive Tinel's sign, while neuroplasty would be the procedure of choice in a patient who has an entrapped nerve. Tendon repair is not required because the previous repair is still intact, as shown in the photograph and MRI. Tenolysis will improve the limited tendon excursion seen in patients who have tendon adhesions or scarring.

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156

A 3-year-old girl has congenital amniotic band syndrome affecting the nondominant left hand. On examination of the hand, the thumb is intact and functional, but there is adactyly of the other digits at the level of the metacarpophalangeal joint. The right hand is unaffected.

In order to improve function of this patient's left hand, which of the following is the most appropriate management?

(A) Use of digital prostheses
(B) Toe phalangeal grafting
(C) Metacarpal lengthening
(D) Second toe-to-hand transfer
(E) Thumb amputation

The correct response is Option D.

Although there are many options for reconstruction of this patient's fingers, the second-toe-to-hand transfer will provide the greatest restoration of function. Congenital band syndrome is one of few conditions (along with variations of hypoplasia and aplasia) that can affect the fingers but leave a functional thumb. In fact, children with congenital band syndrome often have better hand function following reconstruction because the structures proximal to the level of the deformity are unaffected (ie, bones, muscles, tendons, and vessels).

Because these recipient structures are normal, a second toe-to-hand transfer will provide the best sensory, motor, and overall hand function. The transferred second toe can be positioned to provide either pincer or grasp functions. The transfer is successful in most cases, and growth of the transferred toe is approximately 90% of the normal toe. Donor site morbidity is rare. The incidence of premature physeal closure is 10%.

Digital prostheses will improve the aesthetic quality of the child's hand but will not restore function. Toe phalangeal grafting is more appropriate for treatment of aphalangia or hypophalangia. These grafts can be used to improve motion at the metacarpophalangeal joints but have a poorer functional outcome when compared with the second toe transfer. Although metacarpal lengthening can be performed to produce a "post" for the thumb to work against, the resultant digit is also less useful than a transferred second toe. A functioning thumb should never be amputated.

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157

The above radiograph is from a 30-year-old construction worker who injured his dominant right hand in a motor vehicle accident two months ago. These findings are most consistent with

(A) Kienböck's disease
(B) midcarpal instability
(C) perilunate dislocation
(D) scapholunate dissociation
(E) scapholunate syndrome

The correct response is Option D.

This patient has findings consistent with scapholunate dissociation and longitudinal carpal instability. Scapholunate dissociation involves mechanical disruption of the ligament between the scaphoid and lunate bones. Anteroposterior radiographs will show an increased scapholunate gap; the scaphoid bone will appear foreshortened. Comparison radiographs with the opposite, unaffected wrist and anteroposterior radiographs with the fist clenched are also helpful in diagnosis. Early recognition and treatment are important to prevent the development of radiocarpal arthritis following injury, which can ultimately progress to scapholunate advanced collapse (SLAC wrist).

Interestingly, this patient's radiograph also shows diastasis of the capitatohamate joint and the third and fourth metacarpals. This is a rare finding that is only seen following high-energy injuries and should be treated as soon as possible.

Kienböck's disease, or avascular necrosis of the lunate, is a progressive condition associated with an ulnar negative variance. Radiographs will show sclerosis or fragmentation of the lunate or loss of lunate height, depending on the stage of the disorder.

In patients with midcarpal instability, the proximal row is shifted into either dorsiflexed or volar-flexed intercalated segment instability. There is destabilization between the distal and proximal carpal rows on radial or ulnar deviation of the wrist. However, separation of the scaphoid and lunate bones would not be evident on radiographs.

Perilunate dislocations can be classified as either greater arc or lesser arc injuries depending the site of trauma and the extent of carpal bone injury. Anteroposterior radiographs will show overlap of the distal carpal row onto the proximal carpal row and a triangular-shaped lunate.

Scapholunate syndrome develops following fracture of both the scaphoid and capitate. The proximal pole of the capitate will typically be rotated either 90 degrees or 180 degrees.

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158

A 50-year-old woman has joint stiffness and shiny edema of both hands. She has had difficulty swallowing for the past several months. Examination shows ulcers on the distal tips of several fingers. These findings are most consistent with

(A) Raynaud's disease
(B) Raynaud's phenomenon
(C) reflex sympathetic dystrophy
(D) scleroderma
(E) systemic lupus erythematosus

The correct response is Option D.

The most likely diagnosis in this 50-year-old woman is scleroderma, or primary systemic sclerosis. Characteristic findings in patients with scleroderma include shiny edema of the skin and stiffness of the joints. Vasospasm of the digits may lead to ischemia and ultimately to the ulceration typically associated with Raynaud's phenomenon. These conditions may occur concomitantly as part of the CREST syndrome (calcinosis, Raynaud's phenomenon, esophageal dysfunction, sclerodactyly, and telangiectasias).

Raynaud's disease is a vasospastic disorder characterized by triphasic color changes of the skin. This disorder has no gender predilection and typically has its onset in patients age 30 to 50 years. Hand symptoms are bilateral and dysesthesias of the extremities are associated. Symptoms must be present for two years before a definitive diagnosis can be made.

In patients with Raynaud's phenomenon, there are episodic triphasic color changes of the digits following stress or cold exposure. Digital gangrene may result. This condition often occurs in patients with connective tissue disorders such as scleroderma.

Patients with reflex sympathetic dystrophy have the sudden onset of diffuse pain and hypersensitivity of one extremity following surgery or trauma to the extremity. Signs and symptoms of reflex sympathetic dystrophy include diminished hand function, joint stiffness, color changes, and vasomotor instability.

Systemic lupus erythematosus is an autoimmune disorder characterized by arthralgias of the hands, wrists, and feet and swelling of the joints. This condition typically affects women of child-bearing age. Neurologic involvement is common; a malar rash can also be seen.

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159

A 30-year-old man is undergoing evaluation one week after sustaining a sharp laceration over the dorsal metacarpophalangeal (MP) joint of the thumb from a razor knife. At the time of injury, the wound was cleansed in the emergency department and primary closure was performed. On current physical examination, he cannot extend the interphalangeal joint of the thumb.

Which of the following is the most appropriate management?

(A) Control of edema
(B) Removal of the sutures
(C) Sensory re-education of the thumb
(D) Repair of the extensor pollicis longus tendon
(E) Arthrodesis of the MP joint

The correct response is Option D.

In this patient who has a functional deficit involving the interphalangeal (IP) joint of the thumb after sustaining a zone V laceration of the extensor pollicis longus (EPL) tendon, repair of the tendon will provide the best functional outcome. The EPL tendon facilitates hyperextension of the IP joint of the thumb, which is no longer possible in this patient. In contrast, the mechanism of action of the intrinsic muscles, via their contributions to the extensor tendon mechanism, allows the patient to extend the IP joint of the thumb only to a neutral position.

Control of edema is appropriate for patients who have joint stiffness or loss of motion due to swelling of the soft tissues. Removal of sutures is indicated following wound healing but will not address the functional EPL deficit. Sensory re-education is used to optimize functional outcome in patients with sensory nerve injuries. Arthrodesis of the MP joint can be performed to relieve severe posttraumatic arthritis, not acute tendon lacerations.

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160

The above radiograph is from a 53-year-old woman who sustained a closed, rotatory volar dislocation of the proximal interphalangeal joint of the nondominant left ring finger when it accidently became caught in a spin dryer. Closed reduction cannot be maintained. Which of the following is the most appropriate management?

(A) Extension block splinting
(B) Extension block pin fixation
(C) Dynamic skeletal traction
(D) Repair of the lateral band
(E) Volar plate arthroplasty

The correct response is Option D.

This patient has a volar rotary dislocation of the proximal interphalangeal (PIP) joint, an injury that is often described as irreducible. This type of dislocation occurs following partial rupture of the volar plate, collateral ligament, and accessory collateral ligament; the flared ipsilateral condyle of the proximal phalanx often becomes entrapped between the central slip and lateral band in a "buttonhole" manner. The fragmented fibers of the lateral band become trapped beneath the flare of the condyle and redirected through the PIP joint. The usual maneuver for obtaining closed reduction, which involves traction and extension of the middle phalanx, actually tightens the encirclement around the condyle and ultimately leads to loss of the reduction. In some patients, closed reduction may be maintained by flexing the metacarpophalangeal and PIP joints, which relaxes the volarly displaced lateral band; a rotary motion can be used to re-establish congruity between the proximal and middle phalanges. However, in the majority of patients who have this type of injury, open repair should be considered. During this procedure, the fragmented lateral band should be repaired and properly aligned, and the central slip should also be repaired. An intraoperative photograph of this technique is shown on the previous page.

Extension block splinting and pin fixation can be used for treatment of dorsal fracture-dislocations. Skeletal traction is also an option for patients who have dorsal fracture-dislocations, especially pilon fractures. Volar plate arthroplasty is the preferred management of unstable dorsal dislocations of the PIP joint.

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161

A 34-year-old secretary has difficulty extending the middle and ring fingers of the right hand. On examination, there is weakness with extension of the wrist, fingers, and thumb. There is no sensory deficit. This patient's findings are most consistent with

(A) C7 nerve root lesion
(B) lateral epicondylitis
(C) posterior interosseous nerve syndrome
(D) radial tunnel syndrome
(E) Wartenberg's syndrome

The correct response is Option C.

This patient has findings consistent with posterior interosseous nerve syndrome, which is initially characterized by weakness and pain in the forearm in the absence of sensory loss. Other findings include weakness of extension of

the metacarpophalangeal joints of the fingers and interphalangeal joint of the thumb, as well as weakness of thumb abduction and wrist extension. Because the innervation of the extensor carpi radialis longus tendon lies above the elbow and is thus not affected, the wrist often deviates radially.

A patient with a C7 nerve root lesion would have weakness in the radially innervated muscles (including the triceps), as well as weakness in the muscles with median nerve innervation, such as the pronator teres, flexor carpi radialis, flexor digitorum superficialis, and flexor pollicis longus.

Lateral epicondylitis is characterized by sharp pain at the epicondyle that is exacerbated with passive flexion of the wrist and fingers with the elbow in extension. Injection of a corticosteroid may produce relief. Although patients with lateral epicondylitis may have positive findings on middle finger testing, severe pain with passive stretch is more typical.

Radial tunnel syndrome involves compression of the radial nerve and results in chronic, aching pain in the area of the lateral humerus, elbow, extensor mass, and dorsal wrist. In addition, patients have tenderness over the mobile wad. Severe pain is elicited on middle finger testing. Weakness is not characteristic.

Wartenberg's syndrome, or radial sensory nerve entrapment, is characterized by pain and/or paresthesias over the dorsoradial aspect of the hand and wrist. Tinel's sign will be positive along the course of the nerve, and the patient will have paresthesias with the forearm in hyperpronation and the wrist in neutral. Because the motor branch of the radial nerve divides more proximally, weakness is not seen.

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A 22-year-old man has had a progressively worsening fixed flexion contracture of the proximal interphalangeal (PIP) joint of the left little finger since birth. There is no history of trauma or illness. The patient has stiffness of the PIP joint but no pain in the finger. These findings are most consistent with

(A) camptodactyly
(B) clinodactyly
(C) scleroderma
(D) symbrachydactyly
(E) systemic lupus erythematosus

The correct response is Option A.

This 22-year-old man has findings consistent with camptodactyly ("bent finger"), a nontraumatic flexion deformity of the proximal interphalangeal (PIP) joint. This condition can be either sporadic or autosomal dominant and occurs in less than 1% of the population. The little finger is most frequently affected, and nearly two thirds of patients with camptodactyly have bilateral findings. The underlying etiology of this deformity involves volar PIP joint structures

and is thought to result from abnormal insertion of either the lumbrical or superficialis tendons. Static or dynamic splinting has been shown to be beneficial in some patients. Surgical repair often yields only partial correction.

Clinodactyly involves either a radial or ulnar curvature of the fingers. This condition is believed to be autosomal dominant, is often bilateral, and is typically associated with some forms of mental retardation, including Down syndrome. Severe clinodactyly is often seen in association with a delta phalanx. Excision and wedge osteotomy are recommended for correction.

Symbrachydactyly is a sporadic, inherited central hand defect characterized by shortened, syndactylous digits. This condition is unilateral. The index, middle, and ring fingers are typically affected.

Systemic conditions such as scleroderma (primary systemic sclerosis) and systemic lupus erythematosus can involve the interphalangeal joints; however, dorsal wounds and flexion contractures are typically associated.

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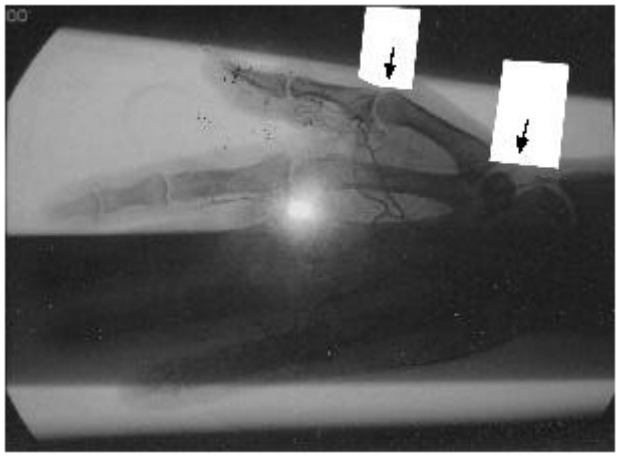
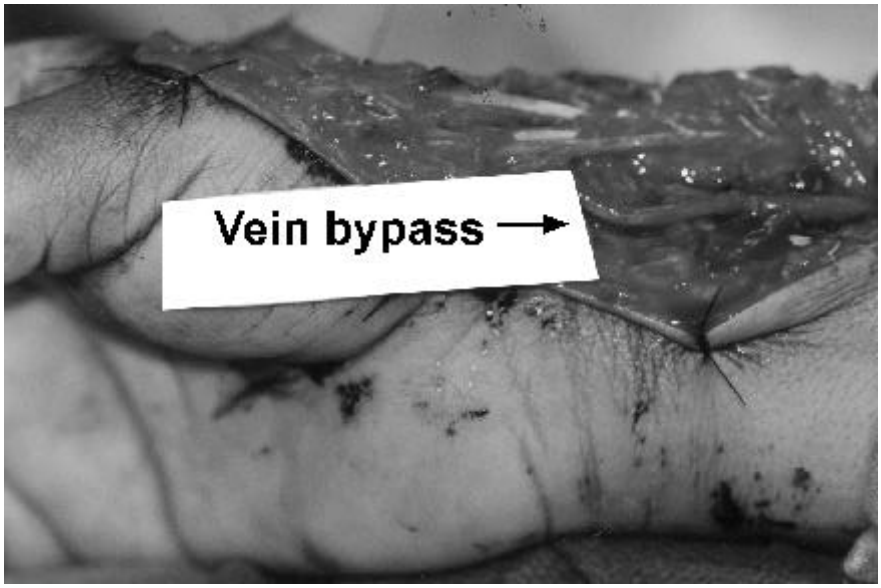


A 31-year-old man who has had severe advanced peripheral vasculitis for the past two years is referred for evaluation of gangrene involving the tip of the dominant index finger. He also has uveitis affecting the left eye and dermatitis of the lower extremities. The patient is currently taking high-dose cyclophosphamide and corticosteroids. A photograph and arteriogram are shown on the previous page.

Which of the following is the most appropriate next step in management?

(A) Anticoagulant therapy
(B) Infusion of tissue plasminogen activator
(C) Amputation of the tip of the index finger
(D) Thrombectomy
(E) Venous bypass grafting



The correct response is Option E.

This patient has advanced ischemia and radial artery thrombosis as demonstrated by the photograph and angiogram. These findings indicate a diagnosis of advanced peripheral vasculitis, a severely incapacitating disease that results in thrombosis of the involved vasculature leading to end-stage gangrene. Each of the various types of advanced peripheral vasculitis (eg, Wegener's granulomatosis, Churg-Strauss syndrome, Takayasu's vasculitis, giant cell arteritis) has similar findings as well as unique histologic characteristics; diagnosis of one specific type can be difficult. The cause of radial artery thrombosis is frequently unknown; however, local inflammation and systemic disease may be predisposing factors.

The most appropriate management of this patient's condition is venous bypass grafting from the radial artery to the dorsal radial artery near its trifurcation, using a lesser saphenous vein. This procedure will relieve pain and inhibit the progressive spread of gangrene. An intraoperative photograph is shown above.

Because patients with long-standing peripheral vasculitis are more likely to have organized peripheral thromboses, as opposed to new clots developing secondary to cumulative trauma, anticoagulant therapy or infusion of tissue plasminogen activator via an intra-arterial catheter will not resolve this condition. Amputation of the fingertip should be only performed as palliative treatment. Thrombectomy will not improve arterial inflow.

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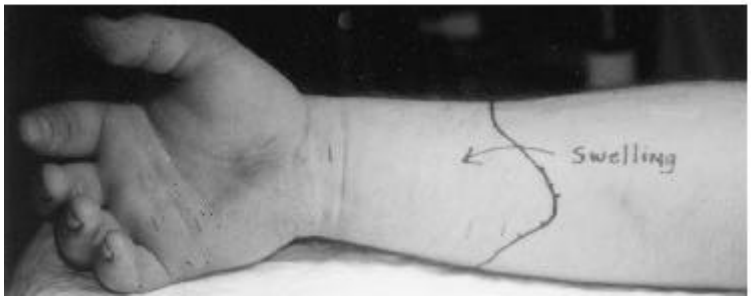

A 34-year-old man is brought to the emergency department after sustaining a snake bite to the dominant right thumb. A photograph is shown above. The patient has severe pain, nausea, and vomiting. On examination, the distal forearm is tense. Prothrombin time and partial thromboplastin time are increased. The snake has been captured and was brought to the emergency department by the patient; a photograph is shown above.

Which of the following is the most appropriate management?

(A) Elevation of the extremity, application of ice, and intravenous administration of antibiotics
(B) Elevation of the extremity, application of ice, intravenous administration of antibiotics, and administration of antivenin
(C) Incision and suction drainage of the bite wound, elevation of the extremity, application of ice, and intravenous administration of antibiotics
(D) Fasciotomy and intravenous administration of antibiotics
(E) Fasciotomy, intravenous administration of antibiotics, and administration of antivenin

The correct response is Option E.

This patient who has sustained a pit viper bite to the dominant right thumb requires immediate treatment involving fasciotomy, intravenous administration of antibiotics, and administration of pit viper antivenin. Approximately 98% of venomous snake bites are from pit vipers, and more than 70% of these bites involve the upper extremity. Pit vipers can be distinguished from other snakes by the presence of two retractable maxillae, each of which contains a fang for envenomation. In patients who sustain pit viper bites, immediate first aid should consist of patient reassurance, immobilization of the affected limb and placement of the limb on a level plane, and transportation to a hospital as soon as possible. Envenomation should be assumed with the presence of fang marks and rapid swelling of the extremity; broad-spectrum antibiotics should be administered immediately in the emergency department. Patients who have tense edema of the affected extremity and compartment pressures of greater than 30 mmHg should be diagnosed with compartment syndrome. Urgent fasciotomy should be performed.

Because snake venom can greatly worsen myonecrosis and systemic findings, antivenin should be administered to any patient who has systemic symptoms of envenomation associated with increased laboratory values. Following administration of a test dose, five to 10 vials of snake antivenin are typically administered in patients who do not exhibit allergic sensitivity. A central line should be placed and emergency resuscitation should be available. The administration of as many as 20 vials of antivenin may be required in patients who have extreme abnormalities on laboratory evaluation.

Application of ice will result in vasoconstriction, ischemia, and tissue necrosis. Incision and suction drainage of the bite wound should be performed within 15 minutes of the bite.

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165

A 2-year-old girl with VATER syndrome (involving vertebral, anal, tracheoesophageal, radial, and renal defects) has total absence of the left radius (type IV radial club hand). Which of the following is the most appropriate management for stabilization of the wrist?

(A) Ablation of the ulna
(B) Centralization of the ulna
(C) Lengthening of the ulna
(D) Shortening of the ulna
(E) Straightening of the ulna

The correct response is Option B.

This 2-year-old girl has complete absence of the left radius (type IV radial club hand) involving an absence of the thumb associated with type IV radial dysplasia. The most appropriate management is centralization of the ulna into the carpus followed by pollicization of the index finger. Total absence is the most common radial deficiency. Radial dysplasia is seen in as many as one in 55,000 births; boys and girls are affected equally. This deformity is frequently bilateral; preaxial hypoplasia or aplasia is common, and the radial artery is usually absent. The thumb may be hypoplastic and is in fact absent in nearly half of all affected persons. A common radial muscle mass is noted. The wrist is angulated radially from 30 degrees to 90 degrees, the carpus articulates with the radial border of the distal ulna, and the scaphoid and trapezium are usually absent. In addition to VATER syndrome, conditions associated with radial dysplasia include Holt-Oram syndrome and TAR (thrombocytopenia-absent radius) syndrome.

Although centralization of the carpus is a technically difficult procedure, it has been shown to be successful in many patients with radial dysplasia. This technique aligns the hand over the distal ulna, resulting in improved hand function. Following centralization, pollicization of the index finger will help with grasping of large objects.

Corrective closing wedge ulnar osteotomy is often necessary for patients who have ulnar bowing of greater than 35 degrees. Other techniques such as ulnar lengthening, shortening, or ablation will not correct the alignment of the hand and wrist in relation to the forearm.

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A 25-year-old construction worker sustains a crush amputation involving the distal third of the dominant right thumb. Examination shows exposed bone at the distal phalanx. Which of the following is most appropriate for coverage of the wound?

(A) Split-thickness skin graft from the hypothenar region
(B) Full-thickness skin graft from the medial upper arm
(C) Cross-finger flap from the index finger
(D) Thenar flap
(E) Volar advancement flap

The correct response is Option E.

In this patient who has sustained a crush amputation of the distal third of the dominant thumb, the most appropriate management is coverage of the wound using a volar advancement, or Moberg, flap. This flap is most effective for coverage of thumb amputations that occur distal to the interphalangeal joint. It is comprised entirely of palmar thumb skin, providing an excellent color and tissue match. In addition, both neurovascular bundles are included for stable, sensate wound coverage.

Split-thickness skin grafting alone over exposed bone will result in a painful thumb due to inadequate padding. A full-thickness skin graft provides a poor skin match. Sensory recovery is diminished with the use of this type of graft. The cross-finger flap should not be used in construction workers or other patients who require good hand function following repair. In addition, a large donor site defect would result. A thenar flap, which is based on the thenar eminence, is used to cover adjacent defects and cannot be used for the thumb.

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Which of the following tendons comprise the compartment that forms the volar border of the anatomic snuff box?

(A) Abductor pollicis brevis and extensor pollicis longus
(B) Abductor pollicis longus and extensor pollicis brevis
(C) Extensor digitorum communis and extensor indicis proprius
(D) Extensor pollicis longus and abductor pollicis longus
(E) Flexor carpi radialis and flexor pollicis longus

The correct response is Option B.

The volar border of the anatomic snuff box is comprised of the abductor pollicis longus (APL) and extensor pollicis brevis (EPB) tendons (first dorsal compartment). The dorsal border is comprised of the extensor pollicis longus (EPL) tendon (third dorsal compartment).

The abductor pollicis brevis tendon is the most radial component of the thenar musculature; the extensor digitorum communis (EDC) and extensor indicis proprius (EIP) tendons are found in the fourth dorsal compartment. The flexor carpi radialis (FCR) tendon can be found radial to the other tendons within the superficial compartment of the volar forearm at the level of the wrist. The flexor pollicis longus (FPL) tendon lies within the deepest compartment of the volar forearm.

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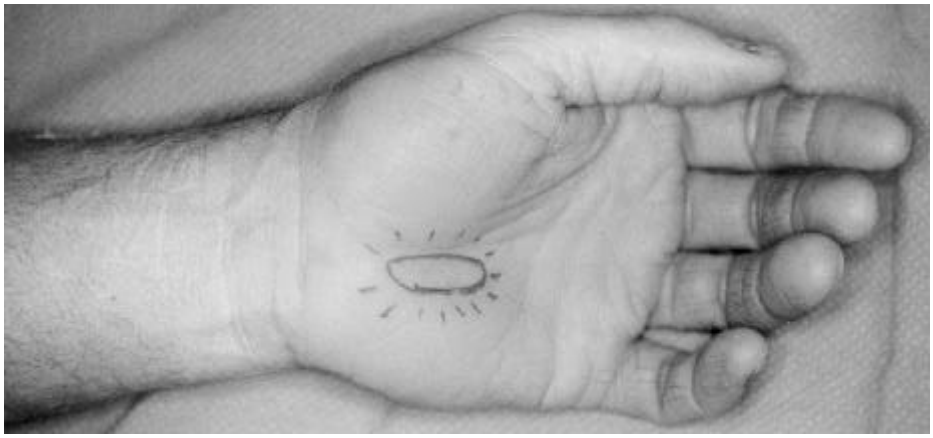

A 54-year-old carpenter has the sudden onset of numbness, tingling, and a cold sensation in the ring and little fingers of his dominant left hand. On examination, he has an area of tenderness in the palm; a photograph is shown above. Two-point discrimination is 12 mm in the ring and little fingers. Temperature in the small finger is 26.7 EC (80EF).

Which of the following is the most appropriate next step in diagnosis?

(A) Radiograph of the carpal tunnel
(B) CT scan of the hand
(C) EMG and nerve conduction velocity studies
(D) Impedance plethysmography with cold temperature challenge
(E) Angiography of the upper extremity

The correct response is Option E.

In this patient who has findings consistent with hypothenar hammer syndrome, or thrombosis of the ulnar artery in Guyon's canal, the most appropriate next step in diagnosis is angiography of the upper extremity. Hypothenar hammer syndrome is characterized by pain in the region of the hook of the hamate bone as well as paresthesias and a decrease in digital temperature in the ring and little fingers. Because this condition is caused by repetitive trauma, it is often seen in carpenters who use the hypothenar eminence as a hammer-type device during their work.

The diagnosis of hypothenar hammer syndrome can be confirmed with Doppler ultrasonography or angiography of the upper extremity. If findings on either test are positive, management should include surgical exploration of the ulnar artery and resection of the thrombosed segment. The inflammation characteristically seen around the thrombus in patients with hypothenar hammer syndrome has been theorized to result in sympathetic hyperstimulation and irritation of the ulnar nerve; as a result, some surgeons have advocated the use of thrombolytic therapy. Although reconstruction of the ulnar artery with a vein graft is controversial, most surgeons agree that grafting can be used to prevent cold intolerance in certain patients. If the distal ulnar artery pressure is less than 0.7 times the proximal ulnar artery pressure, vein grafting can be beneficial.

Radiographs of the carpal tunnel can be performed to diagnose a fracture of the hook of the hamate bone, which is characterized by symptoms similar to hypothenar hammer syndrome but would not be associated with temperature changes in the finger. CT scan is also effective for more detailed fracture delineation. Impedance plethysmography is used to diagnose vascular instability in patients with Raynaud's phenomenon.

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A 33-year-old machinist has high median and ulnar nerve paralysis after sustaining a gunshot wound to the nondominant right elbow. Which of the following tendon transfers is most appropriate for opponensplasty in this patient?

(A) Abductor digiti quinti
(B) Extensor indicis proprius
(C) Flexor digitorum superficialis of the ring finger
(D) Flexor pollicis longus
(E) Palmaris longus

The correct response is Option B.

In order for a tendon transfer to be successful, the muscle-tendon unit must be available, of appropriate strength, and able to be spared at the donor site (ie, function of the muscle cannot be critical to the site). The strength of the antagonist muscle must also be opposed, intercalary joints should have appropriate mobility, and the excursion and direction of the muscle should be well matched. In addition, the proposed tendon transfer should demonstrate integrity and synergy.

In this 33-year-old man who has developed high median and ulnar nerve paralysis, the extensor indicis proprius is the only tendon of those listed that still has motor innervation. The patient's injuries preclude the use of all muscle-tendon units powered by the paralyzed nerves. However, because the index finger has two independent extensor tendons, the extensor indicis proprius tendon can be used in tendon transfer.

A viable abductor digiti quinti muscle-tendon unit can be used for reconstruction in patients with thumb hypoplasia; this is known as the Huber opponensplasty. The flexor digitorum superficialis tendon of the ring finger can be used for opponensplasty when motor innervation is adequate; likewise, the function of the flexor pollicis longus tendon will most likely be restored with a transfer of the brachioradialis tendon. Transfer of the palmaris longus tendon to the abductor pollicis brevis tendon (Camitz transfer) is an abductorplasty, not an opponensplasty.

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A 56-year-old man has a 30-degree flexion contracture of the proximal interphalangeal (PIP) joint of the right ring finger. He has had thickening in the palm at the base of the finger for the past five years. Which of the following structures are most likely involved in the PIP joint contracture?

(A) Central and spiral cords
(B) Lateral cord and knuckle pad
(C) Natatory and retrovascular cords
(D) Retrovascular and lateral cords
(E) Spiral cord and Cleland's ligament

The correct response is Option A.

The central, lateral, and spiral cords each contribute to recurrent contracture of the PIP joint; the little finger is affected most frequently. The central cord develops from fascia between the neurovascular bundles and is continuous proximally with the pretendinous cord. It attaches distally to the tendon sheath over the middle phalanx. The lateral cord is adherent to the skin, while the spiral cord can occur as a continuation of the pretendinous cord or can arise at the musculotendinous junction of the intrinsic muscle. This cord straightens and courses less obliquely over time.

The natatory cord passes across the palm at the level of the web spaces and attaches to each individual flexor tendon sheath. Contracture of this cord can contribute to contracture of the PIP joint. Cleland's ligaments are fascial structures located dorsal to the neurovascular bundle that help to hold the skin in position during flexion and extension of the finger. These structures are only an occasional cause of PIP joint contracture. The retrovascular cord most frequently causes contractures of the distal interphalangeal joint. This longitudinally oriented fascial cord lies dorsal to the neurovascular bundle and palmar to Cleland's ligament.

Knuckle pads are a manifestation of joint contracture and not a cause themselves.

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171

A 25-year-old man sustains an extravasation injury of the dorsal aspect of the wrist. Following debridement, the extensor tendons are exposed; a photograph is shown above. Findings on Allen's test demonstrate radial dominance. Which of the following is the most appropriate next step in management?

(A) Dressing changes and healing by second intention
(B) Split-thickness skin grafting
(C) Coverage with a free lateral arm flap
(D) Coverage with a free rectus abdominis muscle flap and split-thickness skin graft
(E) Coverage with a reverse radial forearm flap

The correct response is Option C.

In this patient who has exposure of the tendons and loss of paratenon after sustaining a wrist injury, the most appropriate management is coverage of the defect using a free lateral arm flap. This is a pliable fasciocutaneous flap that will provide durable coverage of this patient's defect with optimal cosmetic results and minimal donor site morbidity. Its good gliding surface will permit tendon gliding without tethering. If tethering were to occur subsequently, a secondary tenolysis could be easily performed underneath this thin flap.

Dressing changes and healing by second intention are not appropriate in a patient with exposed tendons because tendon adhesions and/or dessication will result. In the same way, the defect should not be covered with a split-thickness skin graft, which will not take when placed directly on top of exposed tendon. Coverage with a free rectus abdominis flap will be bulky and can result in tethering. Secondary tenolysis will be difficult under this flap. The reverse radial forearm flap has been linked to the development of hand ischemia in patients who demonstrate radial dominance on Allen's testing.

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172

A 43-year-old man has moderate Dupuytren's contractures of the middle, ring, and little fingers. There is limited abduction of the ring and little fingers at the level of the metacarpophalangeal joints. This finding most likely results from Dupuytren's contracture of which of the following structures?

(A) Cleland's ligaments
(B) Grayson's ligaments
(C) Natatory ligaments
(D) Pretendinous bands
(E) Spiral band

The correct response is Option C.

This 43-year-old man has limited abduction of the ring and little fingers at the level of the metacarpophalangeal joints caused by Dupuytren's contracture of the natatory ligaments. These ligaments, which are found within the digital web spaces, primarily pass in a transverse manner but may run distally along the sides of the fingers to join with the lateral digitalsheet. Patients with Dupuytren's contracture of the natatory ligaments have limited finger abduction and flexion contractures of the proximal interphalangeal joints. Although transverse fibers of the palmar aponeurosis are seen more proximally at the level of the metacarpal necks, they play no role in the Dupuytren's contractures.

Cleland's ligaments, which originate from the phalanges and pass dorsal to the digital neurovascular bundle into the lateral digital sheet, do not contribute to Dupuytren's contractures. Grayson's ligaments are thin structures that arise from the flexor tendon sheath and travel volar to the digital neurovascular bundle into the lateral digital sheet. These

ligaments are frequently involved in Dupuytren's contractures. The mechanism of action of both Cleland's and Grayson's ligaments is stabilization of the skin during finger motion.

Most patients with Dupuytren's contractures have involvement of the pretendinous bands of the palmar aponeurosis. Progressive fibrosis and shortening of these bands results in the development of a pretendinous cord, which causes flexion contractures of the metacarpophalangeal joints in the disease state. This band continues distally into the fingers, where it divides into the radial and ulnar spiral bands. Although these bands ultimately contribute to the lateral digital sheet, they are not a cause of Dupuytren's contractures.

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173

A 50-year-old woman has paresthesias of the right thumb six hours after undergoing anatomic open reduction and rigid internal fixation of a fracture of the right distal radius. The pain, numbness, and weakness are worsening. Which of the following is the most appropriate next step in management?

(A) Application of ice and elevation of the extremity
(B) Semmes-Weinstein monofilament testing
(C) Open carpal tunnel release
(D) Release of Guyon's canal
(E) Surgical exploration of the fracture site

The correct response is Option C.

In this patient who has acute carpal tunnel syndrome, the most appropriate management is open release of the carpal tunnel. Acute carpal tunnel syndrome can occur following injury, infection, or hemorrhage. Although appropriate reduction and stabilization of the fracture should typically be followed by rehabilitation of the soft tissues and wrist joint, open decompression of the median nerve in the carpal canal is the only logical next step in a patient who has developed acute carpal tunnel syndrome. Limited exposure techniques are contraindicated in patients with fractures.

Although application of ice and elevation of the extremity are part of normal fracture management, this course would be inadequate in a patient who has acute compression of the median nerve. Semmes-Weinstein monofilament testing will provide objective evidence of median nerve pathology but will not relieve the pain, numbness, and weakness. Release of Guyon's canal is appropriate for those patients who require decompression of the ulnar nerve at the wrist. Surgical exploration is recommended for definitive management of fractures not associated with carpal tunnel syndrome or other complications, and may not even be necessary in patients with simple fractures.

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174

A 65-year-old attorney has severe ischemia of the right leg. On examination, the leg is gangrenous and ulcerated; he has pain with motion and at rest. Noninvasive vascular studies show an ankle-brachial index of 0.16. He refuses to undergo amputation. Which of the following is the most appropriate technique for limb salvage?

(A) Distal arterial bypass
(B) Distal venous arterialization bypass
(C) Endovascular stent placement
(D) Free muscle transfer
(E) Lumbar sympathectomy

The correct response is Option B.

The symptoms and findings of severe pain at rest, ulceration, and gangrene seen in this patient are indicative of limb ischemia, a critically urgent condition that results from occlusion of the pedal and crural arteries. Although amputation had been performed in the past for patients with this condition, distal venous arterialization bypass is now a recommended alternative method for limb salvage. According to one small study of 18 patients, limb salvage was successfully accomplished in 83% of patients at surgery and 75% of patients at follow-up examination one year later. In these patients, the distal bypass was performed to the venous vessels of the foot using a conduit of either vein, synthetic graft, or a combination of both. The valves of the venous system were destroyed, and arterial inflow was then provided by the most distal patent artery.

Because both the pedal and crural arteries are occluded in this patient, neither direct arterial bypass nor placement of an endovascular stent will address the problem. Both free muscle transfer and lumbar sympathectomy are associated with lower rates of limb salvage in patients with severe ischemia.

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A 36-year-old woman has a boutonnière deformity of the right middle finger after sustaining a closed central slip injury while playing volleyball two months ago. She is able to extend the proximal interphalangeal (PIP) joint passively to 0 degrees. Which of the following is the most appropriate management?

(A) Buddy taping of the PIP joint
(B) Splinting the distal interphalangeal joint at 0 degrees
(C) Splinting the PIP joint at 0 degrees
(D) Primary repair of the PIP joint
(E) Open repair of the PIP joint

The correct response is Option C.

This patient has a boutonnière deformity, in which the extensor mechanism (comprised of the central slip, transverse and oblique retinacular ligaments, and lateral bands) becomes imbalanced. In patients with this deformity, the central slip is damaged and the transverse retinacular ligament is stretched. The lateral bands begin to drift volarly, eventually moving anterior to the center of rotation of the proximal interphalangeal (PIP) joint. As a result, the lateral bands flex the PIP joint, and passive extension of the PIP joint becomes impossible.

There are three stages of boutonnière deformity. Patients with stage 1 deformities can passively extend the PIP joint. With stage 2, the joint becomes contracted and cannot be extended fully, but the joint itself is not yet involved. Degeneration of the joint is seen in a patient with a stage 3 boutonnière deformity.

Because this patient has only a stage 1 boutonnière deformity, the most appropriate management is splinting the PIP joint in extension (ie, at 0 degrees) for a minimum of six to eight months. The distal interphalangeal (DIP) joint should be unencumbered and allowed to flex actively, and an exercise program should be initiated for joint rehabilitation.

Buddy taping is only useful for certain types of injuries involving the collateral ligament and volar plate. Splinting of the DIP joint in extension is appropriate for treatment of a mallet finger deformity. Primary repair and open repair are difficult procedures and are not advocated as management options for patients with stage 1 deformities.

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176

A 57-year-old woman with rheumatoid arthritis who has taken anti-inflammatory medication for the past six months has pain and catching of the ring finger; she has occasional locking when she attempts to flex the finger. On examination, the finger locks as she attempts to make a fist; a nodule is palpable in the palm.

Which of the following is the most appropriate operative procedure?

(A) Release of the A1 pulley only
(B) Release of the A1 pulley and excision of the flexor tendon nodule
(C) Release of the A1 pulley and tenosynovectomy
(D) Tenosynovectomy only
(E) Tenosynovectomy and excision of the flexor tendon nodule

The correct response is Option E.

The most appropriate management of this patient's condition is flexor tenosynovectomy and excision of the flexor tendon nodule. This patient has developed trigger finger secondary to rheumatoid arthritis. The table on the following page describes the four clinical types of trigger finger that may develop in patients with this condition.

Type I	There is a small localized area of disease with catching of the tendon with flexion
Type II	There is digital tenosynovitis; flexor tendon nodules in the palm cause the finger to lock during flexion
Type III	There is a nodule in the flexor digitorum profundus tendon in the region of the A2 pulley that causes the finger to lock in extension
Type IV	There is generalized tenosynovitis and limited motion

Flexor tenosynovectomy and excision of the flexor tendon nodules are indicated in the treatment of all types of tenosynovitis and triggering seen in patients with rheumatoid arthritis. The annular pulleys should be preserved to prevent the development of bowstringing. In addition, excision of the nodule at this time will prevent disease progression and potential tendon rupture.

In a patient with rheumatoid arthritis, release of the A1 pulley may further exacerbate ulnar drift.

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177

Over the past nine months, a 58-year-old woman has had four episodes of paronychia of the right middle finger characterized by pain, swelling, and inflammation. She has taken oral antibiotics intermittently during that time; there is no purulent drainage. Which of the following is the most likely causal organism?

(A) *Candida albicans*
(B) Herpes simplex virus
(C) *Mycobacterium marinum*
(D) *Pseudomonas aeruginosa*
(E) *Staphylococcus aureus*

The correct response is Option A.

In this patient who has a history of recurrent inflammation consistent with chronic paronychial infection, the most likely causal organism is *Candida albicans*, which has been shown to be responsible for as many as 97% of cases of chronic paronychia. In patients with this condition, the affected area should be kept dry and a topical antifungal agent such as clotrimazole should be applied. Eponychial marsupialization, which involves the removal of a crescent-shaped piece of skin from the eponychium, may be considered to clear the scarred, infected tissues.

Herpes simplex virus results in herpetic whitlow, an extremely painful condition characterized by visible vesicles. It is self-limiting and typically resolves in three to four weeks, but may recur. Incision and drainage are not indicated.

Mycobacterium marinum, an atypical mycobacterium, can result in superficial or deep granulomatous infections. The recommended treatment includes multidrug antituberculous therapy and surgical debulking.

Although *Pseudomonas aeruginosa* is part of the normal flora of the hyponychial space, this organism can result in acute infection in patients with diabetes mellitus or can be a secondary cause of chronic paronychia. Discoloration of the nail is a frequent finding.

Staphylococcus aureus is the predominant pathogen associated with acute paronychial infection, which manifests as an abscess requiring incision and drainage.

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A 19-year-old woman has pain especially at night in the middle phalanx of the left little finger that is relieved with administration of aspirin. Examination shows swelling in this area. A radiograph of the hand is shown above. Which of the following is the most likely diagnosis?

(A) Chondroma
(B) Giant cell tumor of bone
(C) Multiple enchondromatoses
(D) Osteochondroma
(E) Osteoid osteoma

The correct response is Option E.

This 19-year-old woman has findings consistent with osteoid osteoma, a painful tumor usually seen in patients younger than age 40 years. Pain frequently occurs at night and is typically relieved with oral administration of nonsteroidal anti-inflammatory drugs. Radiographs of the tumor will show a radiolucent zone with a dense nidus surrounded by a distinctive area of cortical sclerosis. Complete excision is usually curative and recurrence is rare.

Chondromas (extraosseous tumors) and enchondromas (endosteal tumors) are common bone tumors typically found in the metacarpals and phalanges in young persons. Most enchondromas are incidentally discovered on radiographs and/or in conjunction with pathologic fractures. Radiographs will show a radiolucent neoplasm; there is thinning and expansion of the bony cortex with widespread speckled calcification. Appropriate management includes curettage of the lesion with autogenous bone grafting as necessary and internal fixation of any associated fractures.

Giant cell tumor of bone is a common multifocal hand tumor. Radiographs show an irregular, expansile radiolucent lesion typically in the epiphyseal region of a tubular bone. Ray resection or en bloc removal combined with bone grafting is recommended because recurrence is common.

Multiple enchondromatoses (Ollier's disease) are larger than solitary enchondromas and are associated with axial skeletal deformities. Because patients with multiple enchondromatoses are at increased risk for malignant degeneration to chondrosarcoma, incisional biopsy should be performed if pain or swelling develops in the area of the lesion. Any patient with chondrosarcoma confirmed by histologic examination of a biopsy specimen should undergo intraosseous en bloc excision or ray resection.

Osteochondroma can be either a solitary lesion or an autosomal dominant condition consisting of multiple tumors. Deformity and impaired motion are typically associated. In patients with multiple osteochondromas, endochondral ossification may lead to the formation of secondary bone mass. Appropriate management includes resection of all tumors with reconstructive surgery to repair any bone or joint malalignment.

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179

During embryologic development, inhibition of physiologic cell death in the interdigital area will most likely result in the development of which of the following congenital hand deformities?

(A) Cleft hand
(B) Constriction band syndrome
(C) Phocomelia
(D) Polydactyly
(E) Syndactyly

The correct response is Option E.

During embryologic development of the upper limb, the lateral body wall elevates at approximately four weeks after conception and develops into a mass of undifferentiated mesenchyme covered by ectoderm known as the limb bud. The limb bud elongates beneath the apical ectodermal ridge, and its distal end expands into the hand plate at five weeks of gestation. During the next two weeks, physiologic cell death occurs between the digital rays, leading to separation of the digits and the formation of a normal human hand. In contrast, syndactyly, or fusion of the digits, results from inhibition of this cell death in the interdigital area.

Other abnormalities in development that occur during this time period can manifest as specific limb malformations. Cleft hand results from hypoplasia of the ectodermal ridge, while polydactyly is caused by hyperplasia of the ectodermal ridge. Constriction band syndrome occurs when amniotic bands constrict a digit or extremity, resulting in tissue loss and scarring.

Phocomelia is a congenital anomaly that involves gross defects of the bones of the upper extremity. Severe intercalary and/or longitudinal deficiencies are associated. In patients with this deformity, the hand may attach directly to the humerus or even to the trunk. The forearm may also attach directly to the trunk. Administration of thalidomide during pregnancy has been linked to the development of phocomelia in the fetus.

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180

A 24-year-old man has a 2.5-cm gap in the distal digital nerve of the dominant right index finger after cutting the finger while using a saw. Which of the following donor nerves is most appropriate for autografting?

(A) Dorsal branch of the ulnar nerve
(B) Medial antebrachial cutaneous nerve
(C) Superficial radial nerve
(D) Sural nerve
(E) Terminal branch of the posterior interosseus nerve

The correct response is Option E.

Selection of an appropriate nerve graft depends on the length, diameter, and function required from the graft. In addition, sensory loss at the donor site should not present a functional problem.

In this patient, the terminal branch of the posterior interosseous nerve will best match the required specifications for replacement of the severed digital nerve. The posterior interosseous nerve can be found deep to the extensor tendons at the level of the wrist. It lies in the floor of the fourth extensor compartment on the radial side, ulnar and deep to the extensor pollicis longus tendon and muscle. The terminal branch is frequently harvested for digital nerve defects

because one fascicular strand can be transferred to replace a single digital fascicle. Because it is an articular branch of the nerve, there is no associated sensory deficit.

All of the other sources can be used for grafting but are inferior to the terminal branch of the posterior interosseous nerve for the replacement of a digital nerve. Although the dorsal branch of the ulnar nerve can provide approximately 15 cm of nerve for grafting, harvest of this branch is associated with numbness on the dorsoulnar aspect of the hand. Harvest of the lateral and medial antebrachial cutaneous nerves can be associated with significant donor site morbidity. This is a less favored site for grafting due to the large amount of interfascicular tissue surrounding the nerves. The superficial radial nerve provides an excellent source for graft material, with minimal epineural tissue and tightly packed fascicles, and is best used for nerve reconstruction in a patient with a pre-existing lesion of the high radial nerve with degeneration. Harvest of this nerve is associated with numbness of the forearm and hand. Use of the sural nerve for grafting involves harvest from the lower leg and ankle with an associated donor site defect. This nerve is found distal and posterior to the lateral malleolus in the ankle and can provide as much as 40 cm of nerve for grafting.

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181

A 42-year-old man has the acute onset of ischemia in the dominant right upper extremity after sustaining a myocardial infarction. The patient undergoes embolectomy followed by infusion of heparin; 24 hours later, he has pain, tenseness, and tingling of the affected extremity. On examination, he has severe pain with passive range of motion of the elbow, forearm, wrist, and hand. Pulses are weak.

Which of the following is the most appropriate next step in management?

(A) Application of a wrist extensor fixator
(B) Incision and drainage
(C) Median nerve decompression
(D) Fasciotomy
(E) Brachial palmar arch bypass

The correct response is Option D.

This patient has developed acute ischemia in the upper extremity, a finding most likely caused by the development of cardiac mural thrombi. Cardiac mural thrombi can result from myocardial infarction or atrial fibrillation and can subsequently embolize. Emboli may also develop from the superficial palmar arch or subclavian artery. Embolectomy and anticoagulant therapy are usually recommended. However, because he has had ischemia for more than 24 hours

prior to reperfusion, his condition has most likely progressed to compartment syndrome; the findings of pain, tenseness, and tingling are consistent with this diagnosis. Delayed reperfusion can lead to the onset of compartment syndrome. Therefore, the most appropriate next step is to perform fasciotomy, or compartment release, to relieve the progressively worsening muscle necrosis.

Because there are no signs of fracture or infection in this patient, use of a wrist fixator or incision and drainage of the wound are not indicated. Median nerve decompression is indicated in the presence of carpal tunnel syndrome, while bypass is indicated for hand ischemia resulting from obstruction of the palmar arch.

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182

A 45-year-old computer programmer sustains a transverse guillotine amputation of the dominant thumb midway through the nail bed. The distal phalanx is exposed. Which of the following is the most appropriate management?

(A) Dressing changes
(B) Full-thickness skin grafting
(C) Coverage with a Moberg advancement flap
(D) Coverage with a neurovascular island flap
(E) Coverage with a thenar flap

The correct response is Option C.

This patient's wound is best covered with a Moberg advancement flap. This flap can be used to effectively preserve length in many patients who have palmar oblique amputations of the thumb. Harvest of the Moberg flap is possible because the thumb has a dual arterial supply. It is raised on its neurovascular pedicles and thus provides durable, sensate coverage of the pulp of the thumb. However, advancement greater than 1.5 cm is difficult; contractures of the interphalangeal joints can occur with the use of a Moberg flap. In addition, this flap should not be used in other digits because the digital arteries must be included with the flap. Vascular compromise is likely, resulting in dorsal skin necrosis. The V-Y flap is a useful variation of the Moberg flap.

Dressing changes are most appropriate for small wounds (less than 10 × 10 mm) without exposure of bone or tendon. Full-thickness skin grafts are appropriate for large avulsion injuries; these grafts will regain at least protective sensibility when employed. The neurovascular island flap is a sensate flap harvested from the ulnar side of the middle or ring finger and transferred to the thumb. Venous congestion and absence of cortical reorientation may be noted following flap transfer. Thenar flaps are used for amputations of the index and middle fingertips with exposed bone to preserve finger length; they cannot be used in the thumb. Postoperative stiffness of the proximal interphalangeal joint and painful donor site scarring may be associated.

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183

In a 1-month-old infant with a suspected congenital abnormality of the hand, which of the following carpal bones is most likely to be visualized on radiographs?

(A) Capitate
(B) Lunate
(C) Pisiform
(D) Scaphoid
(E) Trapezium

The correct response is Option A.

Of the carpal bones listed above, the capitate will be visualized earliest on radiographs. Skeletal growth results from endochondral ossification or appositional growth. While endochondral ossification occurs at the physis, appositional growth occurs within primary or secondary ossification centers, such as the carpal bones.

In general, of the secondary ossification centers, the capitate and hamate are first seen from birth to age 6 months, the triquetrum from age 6 months to 4 years, the lunate from age 6 months to 9½ years, the trapezium from age 1½ years to 10 years, the trapezoid from age 2½ years to 5 years, the scaphoid from age 2½ years to 9 years, and the pisiform from age 6½ years to 16½ years. The pisiform is the last of all of the ossification centers to be visualized. The presence of congenital anomalies can alter the time of appearance and fusion of these centers.

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184

A 35-year-old man with insulin-dependent diabetes mellitus develops a 14 × 8-cm ulcer of the left posterior calf overlying the Achilles tendon. He underwent kidney transplantation two years ago and has been taking immunosuppressive agents since that time. Which of the following is the most appropriate management?

(A) Growth factor therapy
(B) Skin grafting
(C) Free tissue transfer
(D) Syme's amputation
(E) Below-knee amputation

The correct response is Option C.

This 35-year-old man with diabetes mellitus who previously underwent kidney transplantation has a large ulcer overlying the left Achilles tendon. Because of his immunosuppressive state and concomitant diabetes mellitus, he is most likely to experience cardiovascular problems, neuropathy, and poor wound healing following any type of reconstructive surgery. However, despite these potential adverse sequelae, free tissue transfer is most appropriate for management of the ulcer. Appropriate work-up should be obtained before attempting any reconstructive procedure.

Growth factor therapy will not adequately heal this large ulcer. A skin graft alone is inappropriate for coverage of exposed tendons. Because amputations often increase cardiovascular demand in patients with diabetes mellitus, they should only be used as a last resort. An amputation is also inappropriate in a young patient because it will significantly alter his ability to perform activities of daily living. In addition, the Syme's amputation is used in wound management of the forefoot and not the distal calf.

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185

A 30-year-old carpenter sustains an avulsion injury of the palmar skin of the dominant thumb from the tip to the interphalangeal joint. The palmar aspect of the distal phalanx is exposed; both digital nerves are absent. Which of the following is the most appropriate management?

(A) Dressing changes
(B) Split-thickness skin grafting
(C) Coverage with a kite flap
(D) Coverage with a Moberg advancement flap
(E) Coverage with a thenar flap

The correct response is Option C.

In this patient who has sustained an avulsion injury of the skin of the dominant thumb, the most appropriate management is coverage of the defect using a kite flap, a neurovascular flap harvested from the dorsal soft tissue of the proximal phalanx of the index finger. The vascular pedicle of this flap is the second dorsal metacarpal artery; two nerve branches, the superficial radial sensory nerve branch and dorsal proximal interphalangeal joint branch, can be used for digital nerve reconstruction (microneurorrhaphy). The kite flap can only be used if the paratenon has been preserved; in addition, skin grafting of the donor site must be performed following flap transfer.

Dressing changes are best for defects smaller than 10 × 10 mm without exposed vital structures (eg, bone, tendons, nerves). A 1-cm wound may require as long as six weeks to heal.

Split-thickness skin grafts to the distal phalanx of the thumb cortex would not result in stable, durable, or sensate thumb padding.

The Moberg advancement flap is appropriate for palmar oblique thumb amputations in order to preserve as much length as possible. However, because the flap cannot be advanced more than 1.5 cm, its use would not be practical in this patient. In addition, contractures of the interphalangeal joints are associated, and sensibility would be poor in a patient with absence of both digital nerves.

The thenar flap is typically used for coverage of defects involving the index and middle fingers in which there is exposed bone in order to preserve much length as possible. Postoperative stiffness of the proximal interphalangeal joint and painful scarring are associated. The thenar flap cannot be used to cover thumb amputations.

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A 42-year-old woman has a pigmented matrix lesion on the index finger. Biopsy of the lesion shows a subungual melanoma. Which of the following is the most appropriate management?

(A) Ablation of the nailbed and matrix resurfacing with skin grafting
(B) Amputation at the distal interphalangeal joint
(C) Amputation at the proximal interphalangeal joint
(D) Ray amputation

The correct response is Option B.

This patient who has a subungual melanoma of the index finger should undergo amputation at the level of the distal interphalangeal joint. In patients with histologically confirmed subungual melanoma, the recommended level of amputation is somewhat controversial; however, conservative management (ie, amputation at the level of the joint located just proximal to the lesion) is recommended to preserve function. Ray amputation, a more aggressive alternative, is still advocated by some surgeons. Studies have reported a five-year survival rate of 66% in patients diagnosed with subungual melanoma.

This patient should undergo a complete physical examination, radiographs of the hand, and CT scans of the chest, head, abdomen, and pelvis. Although the role of elective lymph node dissection in the management of subungual melanoma is controversial, sentinel lymph node dissection may be helpful in patients who have tumors of intermediate thickness (1.0 to 4.0 mm).

Ablation of the nailbed and matrix resurfacing with skin grafting is appropriate management of melanoma in situ of the matrix, also known as melanocytic dysplasia.

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187

An 8-year-old boy sustains a near complete amputation through the midportion of the nondominant left arm. Examination shows a significantly comminuted fracture of the humerus. On intraoperative exploration, the median and radial nerves are transected and retracted. The proximal and distal ends of each nerve are visualized; however, following debridement of the affected nerve areas and mobilization of the nerves, there is a 5-cm gap between the nerve ends.

Following reestablishment of arterial and venous flow, which of the following is the most appropriate management of the nerve injuries?

(A) Delayed reconstruction following healing and stabilization of the humerus fracture
(B) Use of absorbable polyglycolic acid conduits to bridge the gap between nerve endings
(C) Sural nerve cable grafting to bridge the gap between nerve endings
(D) Transfer of the ipsilateral intercostal nerves to the distal ends of the radial and median nerves
(E) Humeral shortening with primary repair of the proximal and distal nerve ends

The correct response is Option E.

Following reestablishment of arterial and venous flow, the most appropriate next step is humeral shortening with primary repair of the proximal and distal nerve ends. Nerve repair should ideally be performed as a primary end-to-end repair without tension; in patients with bone comminution, the bone can be shortened within limits to alleviate tension. Shoulder abduction will increase median nerve length by 2.5 cm and ulnar nerve length by 2 cm; elbow flexion will increase the length of both the median and ulnar nerves by an additional 4 cm.

Delayed reconstruction will ultimately be more difficult because the injured nerves will have become retracted and scarred, and mobilization will be limited.

Absorbable polyglycolic acid conduits have been used successfully in bridging digital nerve gaps of 4 mm or less. However, success has not been reported with the use of this material for repair of major peripheral nerves.

Non-interfascicular nerve cable grafts do not optimize fascicle-to-fascicle opposition and thus provide poor results; interfascicular nerve grafts are now used instead. Results seen with nerve grafting are typically less satisfactory than primary repair, especially in older patients. Interfascicular sural nerve grafts can be used in patients in whom humeral shortening is not an option.

Nerve transfer is inappropriate in this patient because the proximal, median, and radial nerves can be repaired instead. Likewise, a neurotization procedure, which involves embedding of the distal end of a nerve in continuity with the spinal cord directly into a recipient muscle, is also not indicated because the distal nerve ends are available for use.

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188

A 25-year-old steelworker has significant posttraumatic trapeziometacarpal arthritis of the dominant thumb that interferes with job-related activities. Conservative management including joint protection and administration of anti-inflammatory drugs does not alleviate the pain. Which of the following is the most appropriate operative management?

(A) Excision of the distal pole of the scaphoid
(B) Excision of the distal trapezium
(C) Excision of the proximal trapezium
(D) Scaphotrapezial arthrodesis
(E) Trapeziometacarpal arthrodesis

The correct response is Option E.

Patients with basilar joint arthritis of the thumb typically have involvement of the trapeziometacarpal joint; the scaphotrapeziotrapezoidaljoint is involved less frequently. Conservative management including splinting, administration of anti-inflammatory agents, and joint protection should be attempted first. Recent studies have shown that administration of glucosamine and chondroitin sulfate may aid in alleviation of pain.

Both arthroplasty and arthrodesis are recommended in patients in whom conservative management has been unsuccessful. Either procedure will alleviate pain in the diseased trapeziometacarpal joint. Because arthroplasty has limited use in manual laborers who require durability, arthrodesis is more appropriate. Although trapeziometacarpal arthrodesis permits pain-free powerful grip and pinch, this procedure places greater motion demands on the metacarpophalangeal and scaphotrapezial joints. Another disadvantage of trapeziometacarpal arthrodesis is that the procedure results in a decrease in thumb metacarpal motion; as a result, hand span will be decreased, and the patient will be unable to flatten the palm completely.

The other procedures do not address the trapeziometacarpal joint of the thumb and thus are not indicated.

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189

In children with juvenile rheumatoid arthritis, which of the following hand deformities is most common?

(A) Loss of flexion of the interphalangeal joint
(B) Radial deviation of the carpus
(C) Rupture of the extensor tendons
(D) Supination of the carpus
(E) Ulnar deviation of the metacarpophalangeal joints

The correct response is Option A.

Hand deformities associated with juvenile rheumatoid arthritis typically differ from those seen in adult patients with rheumatoid arthritis. Affected pediatric patients have wrist flexion with loss of wrist extension. The carpus and metacarpals are deviated ulnarly, and loss of flexion and radial deviation of the metacarpophalangeal joints is characteristic. In addition, there is a loss of flexion of the interphalangeal joints. Swan-neck and boutonnière deformities and spontaneous tendon ruptures are rare.

In contrast, adults with rheumatoid arthritis exhibit radial deviation and supination of the carpus. The metacarpophalangeal joints are subluxed palmarly and deviated ulnarly. Swan-neck deformities, boutonnière deformities, and spontaneous tendon ruptures occur in significant numbers.

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190

A 40-year-old surgeon sustains a laceration of the flexor digitorum profundus tendon of the small finger in zone II. Operative repair includes use of a six-strand core with epitendinous sutures. Which of the following is the most effective program to achieve maximum active motion of the finger?

(A) Immediate free activity
(B) Immediate early active flexion
(C) Immediate passive flexion-active extension
(D) Late passive flexion-active extension
(E) Late active flexion

The correct response is Option B.

In patients with zone II flexor tendon injuries, outcome is most dependent on the repair technique and rehabilitation protocol used. Suture techniques that employ locking loops or multiple strands have been shown to be stronger and to provide a better, longer lasting repair than the standard, two-strand modified Kessler technique. Compliance is critical to successful rehabilitation. In general, an immediate, graded early active flexion program has been shown to result in greater total active motion than early passive flexion and/or late motion programs. Repair techniques that use increased strength, combined with a more detailed early, graded active flexion program, have been shown to optimize active flexion while minimizing tendon rupture. In addition, a history of smoking has been shown to correlate with poorer outcomes regardless of the method of rehabilitation.

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191

A 15-year-old boy has a 1-cm defect of the ulnar nerve after sustaining a laceration of the nerve at the distal wrist crease, just proximal to Guyon's canal. During dissection of the ulnar nerve at the wrist in preparation for nerve repair, the motor fascicular group can be identified at which of the following sites?

(A) Interwoven with the sensory group
(B) Radial and dorsal to the sensory group
(C) Radial and palmar to the sensory group
(D) Ulnar and dorsal to the sensory group
(E) Ulnar and palmar to the sensory group

The correct response is Option D.

During dissection of the ulnar nerve at the wrist in preparation for nerve repair, the motor fascicular group can be identified ulnar and dorsal to the sensory group at the wrist. The motor fascicles in the arm are consistently found between the sensory fascicles to the dorsal sensory nerve branch and the ulnar sensory fascicles to the ring and small fingers. Beyond the dorsal cutaneous nerve branch, the fascicles lie ulnar and slightly dorsal to the sensory fascicular group and then pass dorsal and radial to the cutaneous fascicular group in Guyon's canal.

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192

A 3-year-old boy sustained a complete, clean amputation of the volar tip of the dominant small finger when he crushed the finger in a car door. On examination, there is a 1.0 × 0.9-cm defect of the volar fingertip; the distal phalanx is exposed. The amputated piece was recovered and brought to the emergency department.

Which of the following is the most appropriate management?

(A) Healing by secondary intention
(B) Split-thickness skin grafting
(C) Full-thickness skin grafting
(D) Composite grafting of the fingertip
(E) Reconstruction with a thenar flap

The correct response is Option D.

The most appropriate management in this 3-year-old child who has a minimal fingertip defect is replacement using the amputated tip as a composite graft. The results are often good in children who undergo composite grafting of modest fingertip defects because the amputated part typically survives completely.

Healing by secondary intention is appropriate for small defects without exposed bone, which may dessicate during the prolonged recovery period. Moist dressings can be used to cover the wound, but this becomes less optimal if the amputated tip is available for grafting. Split-thickness and full-thickness grafts should not be placed directly over exposed bone. A thenar flap is more appropriate for defects of the index and long fingers. In order to use this flap, the small finger must reach the thenar crease, which is difficult.

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193

In patients who sustain crush injuries to the fingers, significant nail bed lacerations are most closely associated with which of the following physical findings?

(A) Closed division of the extensor tendon (mallet finger)
(B) Dislocation of the distal interphalangeal joint
(C) Fracture of the distal phalanx
(D) Neurapraxia of the digital nerve
(E) Subungual hematoma involving 25% of the nail

The correct response is Option C.

Studies have shown that approximately 80% to 95% of patients with fractures of the distal phalanx have an associated nail bed laceration, making this the most commonly associated physical finding. In contrast, 60% of persons who have a subungual hematoma involving more than 50% of the nail have an associated nail bed laceration. These lacerations are seen more frequently in children and adolescents and are typically caused by crush injuries, in which the affected digit is caught in a door or window. The long finger is most often affected. In a patient who has either a fracture of the distal phalanx or a large subungual hematoma, the nail plate should be removed and the nail bed inspected under direct visualization. Nail bed lacerations can be repaired using small (6.0 or 7.0) absorbable sutures, which will prevent long-term nail ridging. The nail plate should then be replaced beneath the eponychial fold, where it will prevent the development of adhesions between the eponychial fold and nail matrix (termed “synechia”).

Nail bed lacerations are not commonly associated with closed division of the extensor tendon or dislocation of the distal interphalangeal joint. Digital nerve neurapraxia is common in patients who sustain significant crush injuries to the fingertip but is not a predictor of nail bed lacerations.

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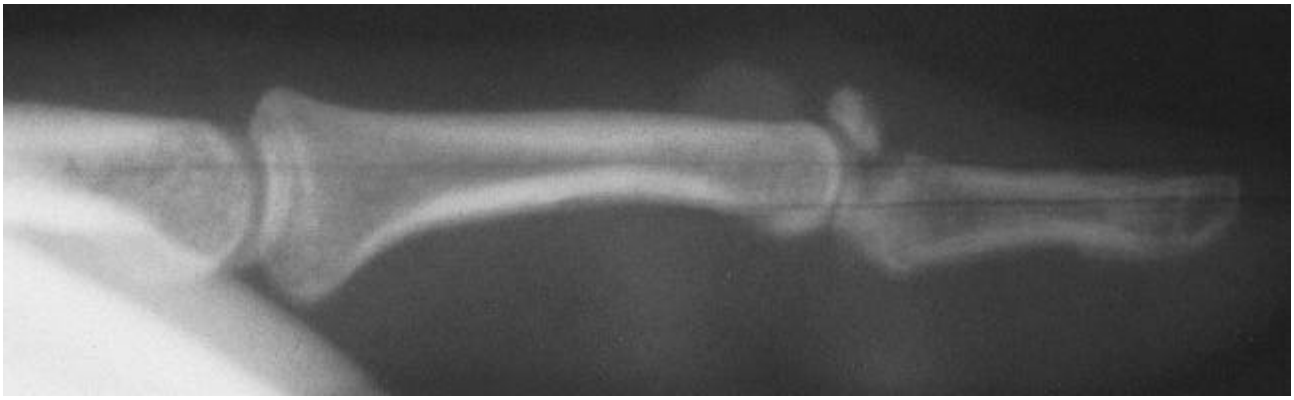

Which of the following is the most appropriate management of the fracture shown in the radiograph above?

(A) Buddy taping
(B) Extension block splinting
(C) Stack splinting
(D) Closed reduction and longitudinal pin fixation
(E) Open reduction and internal fixation

The correct response is Option D.

This patient has a type IV mallet injury in which greater than 30% of the articular surface of the distal phalanx has been avulsed. The most appropriate management of this patient's fracture is closed reduction and longitudinal pin fixation. Because most of the collateral ligament remains attached to the avulsed fragment, the distal phalanx is subluxed on the middle phalanx. In order to correct this deformity, closed reduction and longitudinal Kirschner wire immobilization or open reduction with a pull-out wire technique should be performed. This will restore articular congruity and reduce the subluxed joint, preventing the development of osteoarthritis. Most type IV mallet injuries can be reduced with a closed technique alone; open reduction should be considered only if closed reduction cannot be achieved.

Buddy taping is more appropriate for dislocations of the metacarpophalangeal and proximal interphalangeal joints but will not immobilize the distal interphalangeal joint in extension. Extension block splinting, which again does not immobilize the distal interphalangeal joint, is a useful rehabilitation technique in patients with dorsal dislocations of the proximal interphalangeal joint.

Stack splinting is more appropriate for correction of a type I mallet injury in which the tendon is avulsed from the proximal dorsal base of the distal phalanx. The stack splint immobilizes the distal interphalangeal joint in extension, allowing healing of the avulsed tendon to the distal phalanx. Stack splinting should also be used following suture repair in a patient with a type II mallet injury, which manifests as an open laceration of the terminal extensor tendon.

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195

An otherwise healthy 31-year-old woman has had worsening pain in the long finger of the nondominant left hand for the past four hours. She reports no history of trauma. On examination, there is mild swelling, and the finger is held in slight flexion. There is tenderness over the volar surface of the proximal phalanx, proximal interphalangeal (PIP) joint, and middle phalanx. Passive extension of the finger exacerbates pain.

Which of the following is the most appropriate next step in management?

(A) Administration of analgesics and splinting
(B) Injection of a corticosteroid and splinting
(C) Intravenous administration of antibiotics and splinting
(D) Incision and drainage of the flexor tendon sheath
(E) Incision and drainage of the PIP joint

The correct response is Option C.

This patient has all four of the Kanavel's signs associated with pyogenic flexor tenosynovitis. These include flexed positioning of the finger, fusiform swelling, tenderness over the flexor tendon sheath, and pain with passive extension of the finger. Early pyogenic flexor tenosynovitis can be treated conservatively within the first 24 to 48 hours after the onset of symptoms if the infection has not progressed. Therefore, in this patient who has had symptoms for four hours, antibiotics should be administered intravenously, and the hand should be splinted and elevated. The patient should then be reevaluated frequently within the first 12 hours. Incision and drainage of the flexor tendon sheath is only indicated if there is clinical progression of the infection and/or no resolution of symptoms within 48 hours.

Administration of anti-inflammatory agents such as corticosteroids is contraindicated in patients with suppurative flexor tenosynovitis. Incision and drainage would not be required because the patient does not have sepsis of the PIP joint.

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196

A 30-year-old man has a flexion deformity of the left long finger eight weeks after sustaining a router injury to the finger. The flexor digitorum profundus tendon was repaired at the time of injury. On current examination, the patient has weakness of all fingers of the left hand and limited flexion of the ring and small fingers.

Which of the following is the most likely cause of the current findings?

(A) Adhesions of the flexor digitorum profundus tendon
(B) Lumbrical plus deformity
(C) Quadriga effect
(D) Rupture of the flexor digitorum profundus tendon
(E) Triggering of the flexor digitorum profundus tendon

The correct response is Option C.

This patient's deformity is most likely caused by the quadriga effect, which occurs as a result of excess distal pull on one profundus tendon. Because the flexor profundus tendons share a common muscle belly, any excess pull on one tendon will decrease the force and amplitude of all of the tendons. Quadriga can occur secondary to amputations in which the flexor digitorum profundus (FDP) tendon is attached to the extensor tendon or following grafting of excessively short tendons or advancement of the FDP tendon in patients with zone I injuries.

Flexor tendon adhesions can occur following injury or prolonged immobilization. Decreased flexion of the affected digit only is a characteristic finding.

Lumbrical plus deformity most frequently affects the index finger, which has an independent FDP tendon. Division of the distal tendon results in proximal migration of the tendon and lumbrical muscle, exacerbating tension on the lateral bands. This tension results in paradoxical extension of the proximal interphalangeal joint with attempted finger flexion.

A patient with a tendon rupture would be unable to flex the long finger; the other fingers would not be affected.

Triggering of the FDP tendon may be seen following tendon repair because of the excess bulk created as a result of the repair; this appears to interfere with the pulley system. Affected patients would have decreased motion of the long finger without any effect on the other fingers.

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197

A 34-year-old man is brought to the emergency department with marked pain and swelling on the radial side of the right hand after falling on his outstretched hand. Radiographs are shown above. Which of the following is the most appropriate next step in management?

(A) Closed reduction of a complex dislocation of the metacarpophalangeal joint of the thumb
(B) Closed reduction of a dislocation of the carpometacarpal joint of the thumb
(C) Closed reduction of a displaced scaphoid fracture
(D) Closed reduction of a transradial styloid perilunate fracture-dislocation
(E) Closed reduction of a trapezoid fracture-dislocation

The correct response is Option B.

Based on the above radiographs, this patient has a dislocation of the carpometacarpal (CMC) joint of the thumb, a rare injury. The metacarpophalangeal joint is not involved. Dislocations of the CMC joint at the base of the small finger are more common. Closed reduction of the dislocated joint should be performed as soon as possible; this can be accomplished by applying axial traction and pronation combined with manual pressure over the metacarpal base. Because CMC joint dislocations in the thumb are frequently accompanied by complete tears of the palmar oblique ligament (volar beak ligament), further management should include Kirschner wire stabilization and casting if the dislocation is unstable. Patients with stable dislocations may require casting only. Immobilization and stabilization of the ligament tear will protect the ligament during healing. There is no associated fracture in this patient.

Open reduction and internal fixation are recommended for management of displaced scaphoid fractures. Perilunate dislocation would be demonstrated by incongruity of Gilula's arcs on posteroanterior radiographs and by subluxation of the capitate from its articulation with the lunate. Trapezoid fractures can be subtle on standard radiographs of the wrist; fluoroscopic imaging or CT scans may be beneficial. Because trapezoid fractures are typically stable and nondisplaced, cast immobilization alone is indicated.

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198

A 35-year-old man has a 10-degree extensor lag at the proximal interphalangeal joint of the right index finger three months after undergoing flexor tendon repair in zone II. On examination, active motion of the finger is as follows:

Metacarpophalangeal joint	80 degrees
Proximal interphalangeal joint	60 degrees
Distal interphalangeal joint	20 degrees

What is the total active range of motion of the index finger in this patient?

(A) 130 Degrees
(B) 140 Degrees
(C) 150 Degrees
(D) 160 Degrees
(E) 170 Degrees

The correct response is Option C.

The total active range of motion of the index finger in this patient is 150 degrees. Total active motion (TAM), which is used to measure range of motion of the fingers, is the sum total of active motion of the metacarpophalangeal (MP), proximal interphalangeal (PIP), and distal interphalangeal (DIP) joints, subtracting any extension deficit of the joints. The range of motion of the MP joint (80 degrees), PIP joint (60 degrees), and DIP joint (20 degrees) is 160 degrees; the 10-degree extensor lag is then subtracted for a TAM of 150 degrees.

A person with normal TAM would have 90 degrees of motion in the MP joint, 110 degrees in the PIP joint, and 70 degrees in the DIP joint for a total of 270 degrees.

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199

A 68-year-old woman has a mass at the distal interphalangeal joint of the dorsal aspect of the right index finger. Examination of the finger shows a cyst filled with clear fluid, and there is associated nail grooving. Radiographs show joint space narrowing and the presence of an osteophyte.

Which of the following is the most appropriate management?

(A) Aspiration of the cyst
(B) Injection of a corticosteroid
(C) Laser ablation
(D) Excision of the cyst
(E) Excision of the cyst and osteophyte

The correct response is Option E.

In this patient who has a mucous cyst or ganglion of the distal interphalangeal joint, the most appropriate management is excision of both the cyst and osteophyte. Mucous cysts typically occur in middle-aged or elderly patients and are characterized by swelling and nail deformities; pain is not always present. Radiographs of the affected area typically show osteoarthritis with osteophytes. The lesion exerts pressure on the nail matrix and skin, often resulting in nail grooving or thinning of the skin, and may ultimately lead to skin breakdown and infection. Spontaneous fusion of the joint can occur in the later stages, and arthrodesis may be required in some patients.

Aspiration is not appropriate management of a mucous cyst, and excision of the cyst alone is inadequate. Injection of a corticosteroid or laser ablation has been attempted in some patients with mucous cysts but was not associated with good results.

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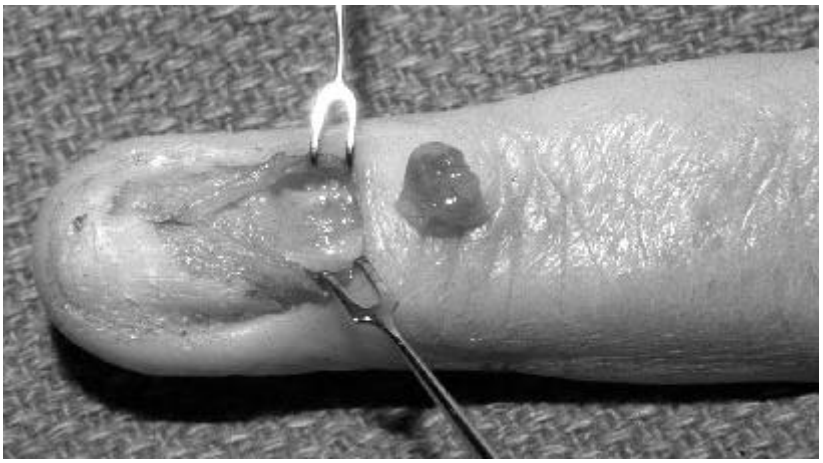
200

A 62-year-old woman has a 2-mm subungual area of blue discoloration of the nondominant small finger located approximately 4 mm distal to the germinal matrix. She reports intermittent episodes of pain in the finger that are exacerbated with exposure to cold. On examination, there is exquisite pinpoint tenderness in the affected area.

Which of the following is the most appropriate management?

(A) Nifedipine therapy
(B) Carbon dioxide laser ablation
(C) Radiation therapy
(D) Simple surgical excision
(E) Nail ablation



The correct response is Option D.

Management of subungual glomus tumors should include removal of the nail plate and simple surgical excision of the lesion. Glomus tumors are uncommon, benign vascular lesions typically located on the fingertips. Affected patients have episodic pain, cold intolerance, and exquisite point tenderness in the area of the tumor. MRI may be used in the diagnosis of those patients who have characteristic symptoms without visible evidence of tumor. Although surgical excision is curative, as many as 20% of patients can develop recurrent lesions. Multiple glomus tumors are present in approximately 25% of patients.

Nifedipine is a calcium channel blocker administered for treatment of vasospastic disorders such as Raynaud's disease. It would not alleviate this patient's symptoms. Use of a carbon dioxide laser has been recommended for ablation of glomus tumors of the reticular dermis. Radiation therapy is not recommended for glomus tumors. Nail ablation is an excessive procedure.

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201

A 3-year-old girl with constriction band syndrome has absence of functional fingers on the dominant right hand. The dominant thumb is completely spared. Which of the following is most appropriate for correction of this deformity?

(A) Intensive occupational therapy
(B) Use of digital prostheses
(C) Metacarpal lengthening
(D) Reconstruction with a radial forearm osteocutaneous flap
(E) Toe-to-hand autotransplantation

The correct response is Option E.

Reconstruction should be considered in a child who has partial or complete absence of function of the thumb or one or more fingers. Absence of functional fingers is an uncommon condition caused by either congenital amniotic band syndrome or a variant of hypoplasia or aplasia. This 3-year-old child who has congenital amniotic band syndrome is an excellent candidate for reconstruction because, in patients with this syndrome, the structures that exist proximal to the level of deformity (eg, bone, nerves, muscles, tendons, and vessels) are unaffected. Therefore, toe-to-hand transfer would be most appropriate because it would provide the best sensorimotor function and aesthetic outcome. Toes can be transferred independently or as a group and positioned for either fine motor or grasp functions. Complications in the donor foot are typically minor. The growth of the transferred toe has been estimated as 90% of a normal toe; there is a 10% risk for premature physeal closure.

Occupational therapy would yield only limited functional improvement in a patient who has no functional fingers. Digital prostheses would provide aesthetic but not functional improvement. Metacarpal lengthening is performed to provide a post for the thumb to work against; reconstruction with a radial forearm flap could also create a thumb post. Both techniques are inferior to an appropriately placed, rehabilitated toe transfer.

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202

A 54-year-old violinist has severe posttraumatic osteoarthritis of the metacarpophalangeal (MP) joint of the nondominant left long finger. She has severe pain and limited finger use despite administration of nonsteroidal anti-inflammatory drugs and protection of the joint. Radiographs show fracture union, adequate metacarpal and phalangeal bone stock, and severe degenerative arthritis of the MP joint.

Which of the following is the most appropriate management of the MP joint?

(A) Perichondrial autograft arthroplasty
(B) Silicone implant arthroplasty
(C) MP joint arthrodesis
(D) Nonvascularized toe joint arthroplasty
(E) Free vascularized toe joint arthroplasty

The correct response is Option B.

This 54-year-old violinist with posttraumatic arthritis of the MP joint of the long finger requires motion. Therefore, the most appropriate management is silicone implant arthroplasty of the MP joint. This procedure will alleviate pain and yield good range of motion of the joint.

Arthroplasty and arthrodesis are typically performed for operative management of posttraumatic joint arthritis. Although both procedures generally alleviate pain, only the arthroplasty procedure permits joint motion. Joint arthrodesis diminishes pain but results in a stable, rigid joint, which would not be appropriate in a violinist who requires motion. Perichondrial autografts are unpredictable, especially when used in complete joint resurfacing. Nonvascularized toe joint transfers provide only a limited range of joint motion, and degeneration of donor cartilage occurs. Free vascularized toe joint transfers allow growth in young patients, and offer composite tissue (joint, extensor mechanism, and bone stock). However, range of motion following any type of toe joint transfer is less than with silicone implant arthroplasty.

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203

A 65-year-old man with tetraplegia to the level of C5-6 has the forearm supination deformity shown in the photograph above. On examination, the supination deformity can be passively corrected. In order to relieve the deformity and improve arm function, which of the following is the most appropriate management?

(A) Release of the biceps tendon
(B) Redirecting the brachioradialis tendon into the flexor carpi ulnaris tendon
(C) Redirecting the biceps tendon through the interosseous membrane
(D) Transfer of the triceps tendon to the biceps tendon
(E) Transfer of the biceps tendon to the brachialis tendon

The correct response is Option C.

In order to permanently correct this patient's supination deformity and improve arm function, the biceps tendon should be redirected through the interosseous membrane. The supination deformity shown in the photograph is common to patients who have C5-6 tetraplegia, but the resting hand position results in loss of function and a displeasing aesthetic appearance. Functional improvement can be achieved by performing a tendon transfer to place the hand in a pronated position (eg, a palm-down position on a table top). This will improve the current aesthetic appearance and allow further tendon transfers to potentially establish key pinch. Because the biceps tendon is the strongest supinator in the forearm, it can be redirected through the interosseous membrane, then reattached to itself to establish forearm pronation. Redirecting the tendon insertion will convert a supinator tendon into a pronator tendon.

Release of the biceps tendon will impair elbow flexion and further weaken upper extremity strength. The brachioradialis tendon, which is the strongest elbow flexor, inserts into the ulna and does not influence supination and pronation in the forearm. Transferring the triceps to the biceps or the biceps to the brachioradialis will not correct the supination deformity.

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204

A 29-year-old computer programmer sustains an avulsion injury of the volar soft tissue of the dominant thumb to the level of the proximal nail. Examination shows exposed bone. When harvesting a Moberg advancement flap for coverage of the defect, which of the following should be included with the flap?

(A) One digital artery and one digital nerve
(B) One digital artery and two digital nerves
(C) Two digital arteries and one digital nerve
(D) Two digital arteries and two digital nerves
(E) Two digital nerves only

The correct response is Option D.

The thumb has a dual blood supply, which allows for harvest of volarly based flaps (such as the Moberg flap) without compromising digital perfusion. With the Moberg flap, volar tissue based on both neurovascular bundles is advanced. The edge of the defect comprises the distal limit of the flap. Lateral incisions are made between the dorsal and volar skin; the flap is dissected distally to proximally and raised from the remaining periosteum and flexor tendon sheath to include both digital arteries and digital nerves to the level of the metacarpophalangeal joint crease. Following harvest, the thumb joints are splinted in flexion for two to three weeks. Although pulp sensibility is near normal with the use of this flap, thumb stiffness may be seen. The typical Moberg flap can be advanced 1 to 1.5 cm. The skin at the base of the flap can be divided, and the subcutaneous tissue can be covered with a skin graft.

Larger defects can be reconstructed using either a neurovascular island flap from the index, long, or ring fingers or a free tissue transfer from the great toe.

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205

A 32-year-old carpenter is scheduled to undergo a revision amputation procedure after sustaining an amputation of the left index finger at the level of the distal interphalangeal joint. She says that she often catches the finger on objects and has extension of the proximal interphalangeal (PIP) joint of the index finger when she attempts to make a fist.

Which of the following is the most likely cause of these findings?

(A) Adherence of the extensor tendon of the index finger
(B) Excessive power of the central slip over the flexor digitorum sublimis tendon
(C) Lumbrical plus deformity
(D) Quadriga effect
(E) Posttraumatic stiffness of the PIP joint

The correct response is Option C.

The findings in this patient are most likely caused by the development of a lumbrical plus deformity. Patients with this deformity have paradoxical extension of the proximal interphalangeal (PIP) joint during attempted flexion; the finger often catches on objects. Common causes of the lumbrical plus deformity include distal amputations, excessively long flexor digitorum profundus (FDP) tendon interposition grafts, and excessive FDP tendon lengthening procedures.

A patient with extrinsic extensor tendon adherence or scarring will have limited flexion across the metacarpophalangeal and PIP joints without paradoxical extension of the finger. The flexor digitorum sublimis tendon is still intact at the level of the distal interphalangeal joint. The quadriga effect results from adherence of the FDP tendon to the amputation stump. In patients with this condition, tethering of the FDP tendon in the injured finger leads to decreased motion and strength in the uninjured fingers. Posttraumatic stiffness would inhibit both passive and active range of motion of all joints in the hand.

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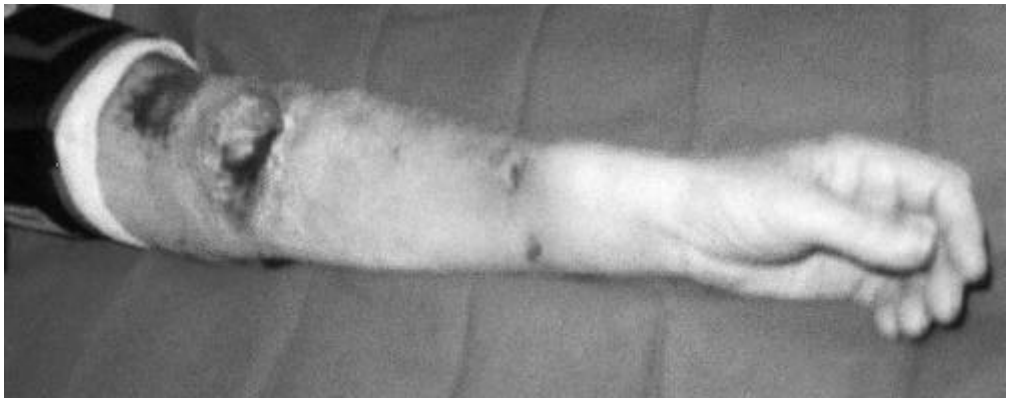

A 60-year-old man has a patent but widely exposed Gore-Tex dialysis access graft in the antecubital fossa. A photograph is shown above. Appropriate coverage of this defect is best accomplished using a flap that is vascularized by which of the following structures?

(A) Deep inferior epigastric artery
(B) Radial recurrent artery
(C) Septal branches of the profunda brachii artery
(D) Superficial circumflex iliac artery
(E) Ulnar artery

The correct response is Option B.

This defect is best reconstructed using a brachioradialis flap, which derives its vascularity from the radial recurrent artery pedicle. The brachioradialis muscle lies in a superficial position on the forearm and, therefore, is best suited for reconstruction of defects involving the anterior elbow; it is less reliable for coverage of posterior elbow defects. Because it is an accessory flexor, the patient will not experience weakness or loss of motion following flap transfer. Transposition of the muscle alone followed by skin grafting of the recipient site will prevent skin deficits at the donor site.

The deep inferior epigastric artery provides the primary blood supply for both the free rectus abdominis flap and the free transverse rectus abdominis (TRAM) flap. Free flap reconstruction could be performed in this patient but is unnecessary when a local flap is available. In addition, venous hypertension resulting from the arteriovenous fistula would increase this patient's risk for free flap failure.

The septal perforating branches of the profunda brachii artery provide the primary vascularity for the lateral arm flap, which is especially reliable when transferred as a free flap. The distally based lateral arm flap is dependent on the tenuous anastomoses between the recurrent radial vessels and the profunda brachii artery and, thus, would not be directly vascularized by the profunda brachii artery.

The superficial circumflex iliac artery supples blood to the groin flap, which is used to cover defects of the hand, wrist, and distal forearm but often lacks adequate length to reliably cover elbow defects.

Although the ulnar forearm flap, supplied by the ulnar artery, can be used for reconstruction of forearm, elbow, and arm defects, its harvest would involve sacrifice of the dominant blood supply to the hand and fingers. In addition,

transfer of this flap would intensify steal phenomenon, which is typically seen in patients who have large arteriovenous fistulas created for dialysis access.

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207

A 32-year-old man sustains a frostbite injury to the dominant right hand. On examination of the hand five days later, the skin is necrotic to the level of the metacarpals. A triple-phase bone scan shows bone pool to the level of the proximal interphalangeal (PIP) joint.

Which of the following is the most appropriate next step in management?

(A) Observation and allowance for autoamputation
(B) Magnetic resonance angiography (MRA) of the hand
(C) Operative debridement to the level of bleeding tissue followed by skin grafting
(D) Amputation at the level of the PIP joint followed by debridement and coverage with vascularized soft tissue
(E) Amputation at the level of the metacarpophalangeal joint followed by coverage with vascularized soft tissue

The correct response is Option D.

In this patient who has a deep frostbite injury, the most appropriate management is amputation of the digits to the level of the PIP joint followed by debridement of the remaining skin and subcutaneous tissue. The remaining nerves, tendons, and bones should then be covered with vascularized tissue. Triple-phase bone scanning is performed initially for evaluation of the patient's injuries. In patients with normal bone and blood pool, observation is indicated. Debridement may be required in patients with no blood pool but visible bone pool. However, this patient has no blood or bone pool distal to the PIP joint; therefore, amputation should be performed at this level. Because the remaining structures appear to be unaffected, a well-vascularized flap, such as a rectus muscle free flap, will potentially provide the best functional outcome.

In this patient, amputation, operative debridement to bleeding tissue, or observation until demarcation is complete will result in greater loss of the involved digits. Hand function will subsequently be poor. Magnetic resonance angiography (MRA) has been used to evaluate the extent of frostbite injury but is not superior to triple-phase scanning in determining tissue perfusion. Amputation at the level of the metacarpophalangeal joint would also result in poor hand function, as the uninjured areas of the proximal phalanges would be removed unnecessarily.

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208

An otherwise healthy 64-year-old man is unable to extend the left wrist and fingers 24 hours after undergoing release of Dupuytren's contractures of the ring and small fingers. Anesthesia for the procedure was provided using a brachial plexus block with 1% lidocaine and inflation of the pneumatic tourniquet to 300 mmHg for 70 minutes. On current examination, active flexion of the wrist and fingers is possible. Capillary refill is less than 3 sec in all digits.

These findings are most consistent with which of the following?

(A) Compartment syndrome
(B) Extensor mass ischemia
(C) Persistent brachial plexus block
(D) Post-tourniquet syndrome
(E) Radial nerve palsy

The correct response is Option E.

This patient has findings consistent with radial nerve palsy. Complications associated with pneumatic tourniquets have been reported in one of every 5000 to 8000 patients following tourniquet use. Post-tourniquet nerve palsies are more frequently associated with the use of rubber bandages. The most common complication following tourniquet use is nerve injury; the radial nerve is affected most frequently. Such nerve palsies result from pressure beneath the cuff rather than prolonged ischemia; most cases reportedly result from use of faulty pressure gauges. Permanent nerve deficits are rare; most patients have resolution of symptoms within six months. Tourniquet times of two hours at a pressure of 250 mmHg are commonly used in adults.

Although compartment syndrome has been reported as a complication of pneumatic tourniquet use, it typically occurs secondary to prolonged ischemia.

Muscle weakness resulting from intraoperative ischemia is unlikely in this patient because the pneumatic tourniquet was inflated for only 70 minutes.

In a patient who receives a brachial plexus block with 1% lidocaine, numbness should resolve within six hours.

Findings of post-tourniquet syndrome include edema, stiffness, pallor, weakness without paralysis, and subjective numbness without anesthesia. This condition results from prolonged ischemia, not direct tourniquet pressure, and may even be a mild form of compartment syndrome or ischemic reperfusion.

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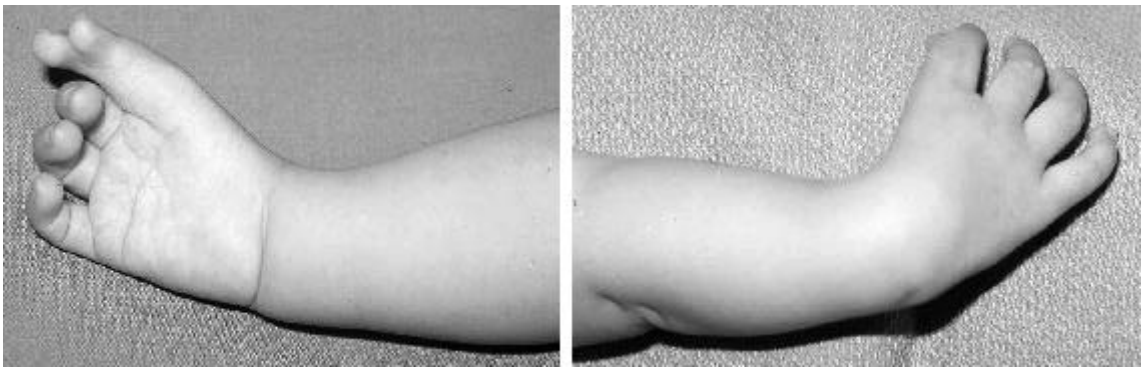

A 1-year-old infant has the deformity shown in the photographs above. These findings are most consistent with which of the following?

(A) Arthrogryposis
(B) Complete thumb-index syndactyly
(C) Madelung's deformity
(D) Poland's syndrome
(E) Radial club hand

The correct response is Option E.

This infant has a radial club hand or radially deficient hand, involving partial or total absence of the radial or preaxial border of the upper extremity. Although radial club hand deformities can range from thumb hypoplasia to varying degrees of absence of the radius, resulting in radial deviation of the hand, most patients have total absence of the radius with absence of the radial carpal bones and thumb. It occurs in one in every 55,000 to 100,000 neonates and can be unilateral or bilateral. Abnormalities associated with radial dysplasia include cardiac septal defects (Holt-Oram syndrome), hematopoietic disorders (Fanconi anemia and TAR (thrombocytopenia-absent radius) syndrome), and gastrointestinal disorders (imperforate anus). Radial dysplasia may also occur as part of VATER syndrome (involving vertebral, anal, tracheoesophageal, and renal defects).

Fanconi aplastic anemia is the most serious condition associated with radial club hand. Affected patients also have pancytopenia, a progressive condition that may not be detected initially. Mitomycin testing should be performed in neonates with radial club hand to detect Fanconi anemia and prevent the development of life-threatening complications.

Arthrogryposis is a congenital disorder characterized by nonprogressive joint contractures present at birth. It is thought to occur secondary to neurogenic or myopathic weakness in utero. Multiple joints are typically affected; the extremities are atrophic and have limited active and passive motion. The wrist has a clublike appearance but is usually flexed and deviated ulnarly. Neurogenic and myopathic disorders are often associated with arthrogryposis.

Although this infant's deformity may appear similar to thumb-index syndactyly, this is a rare finding and would not be characterized by radial deviation of the carpus and hypoplasia of the thenar eminence, which are seen in this patient.

Madelung's deformity is a congenital disorder of the wrist that first becomes apparent in late childhood or adolescence. Affected patients have shortening of the radius, apparent palmar subluxation of the carpus, and prominence of the ulnar head. Finger abnormalities are not associated.

Patients with Poland's syndrome have unilateral findings including absence of the pectoralis major and minor muscles, hypoplasia of the breast, and preaxial deformities.

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210

A 29-year-old woman is brought to the emergency department one hour after sustaining a traumatic avulsion amputation at the level of the proximal third of the lower leg. On examination, the tibia is exposed, and there is not adequate soft tissue for coverage of the bone. The amputated part has been appropriately preserved; examination shows extensive injury in the middle third of the leg but no evidence of injury in the distal third or the foot.

In order to provide the best functional outcome in this patient, which of the following is the most appropriate management?

(A) Above-knee amputation
(B) Immediate coverage of the exposed tibia with a reverse rectus femoris flap
(C) Immediate coverage of the exposed tibia with a filet-of-foot free flap
(D) Immediate coverage of the exposed tibia with a latissimus dorsi muscle flap and split-thickness skin graft
(E) Microvascular replantation of the amputated leg with 12 cm of bone shortening to allow for complete soft-tissue coverage

The correct response is Option C.

The most appropriate management is immediate coverage of the exposed tibia using a filet-of-foot free flap. Free tissue from the amputated foot can be transferred to provide appropriate soft-tissue coverage without additional donor site morbidity. The dorsalis pedis artery and/or posterior tibial artery supply vascularity to the flap, and the tibial nerve provides sensory innervation.

Above-knee amputation should be considered only as the last possible option. The energy required for ambulation in a patient with an above-knee amputation is much greater than in a patient with below-knee amputation.

The reverse rectus femoris flap is not based on a distal pedicle; thus, it should not be used in a patient in whom knee extension must be preserved.

A latissimus dorsi flap and split-thickness skin graft could be used for coverage if the amputated part were injured and unavailable as a donor site; however, in this patient there is no evidence of trauma distal to the lower third of the leg.

Microvascular replantation cannot be performed in a patient who has sustained an avulsion amputation. In addition, bone shortening of greater than 10 cm would ultimately result in an abnormal gait.

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211

A 27-year-old woman is scheduled to undergo coverage of a 3.0 × 1.5-cm full-thickness defect of the dominant right thumb using a neurovascular island flap from the ulnar aspect of the long finger. When harvesting this flap, which of the following structures is routinely divided?

(A) Radial digital artery of the long finger
(B) Radial digital artery of the ring finger
(C) Ulnar digital artery of the long finger
(D) Ulnar digital artery of the ring finger
(E) Ulnar digital nerve of the long finger

The correct response is Option B.

Because the radial digital artery of the ring finger is typically less important to finger perfusion, it is routinely ligated during mobilization of a neurovascular island flap from the ulnar aspect of the long finger. This flap, which is used in thumb reconstruction, derives its sensory innervation from the ulnar digital nerve. Although the flap can be harvested from the nontactile aspect of any digit, the ulnar aspect of the long finger is often used. Adequate blood flow in the ulnar digital artery of the ring finger and radial digital artery of the long finger must be ensured prior to flap harvest using either Doppler ultrasonography or an Allen's test. The ulnar digital artery and nerve of the long finger are included with the skin flap along with a cuff of fibrofatty tissue for venous drainage.

During dissection, the common digital arteries in the palm, which are branches of the superficial palmar arch, are identified first. The patency of the radial digital artery of the long finger and ulnar digital artery of the ring finger are confirmed, and the flap is harvested with the included structures identified above. The radial digital artery of the ring finger is divided. The proper ulnar digital nerve of the long finger may be dissected proximally from the common digital nerve to allow for tension-free transposition.

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212

The radiograph shown above is from a 12-year-old boy who sustained a thumb fracture. According to the Salter-Harris fracture classification, which of the following is the most appropriate classification of this fracture?

(A) Type I
(B) Type II
(C) Type III
(D) Type IV
(E) Type V

The correct response is Option B.

Findings on this child's radiograph are consistent with a Salter-Harris type II fracture in which the fracture has proceeded through the diaphysis of the proximal phalanx of the thumb and the epiphyseal plate.

The Salter-Harris classification describes fractures involving the epiphyseal plate in children. The degree of growth disturbance correlates directly with the level of fracture classification. In type I fractures, the epiphysis is separated from the metaphysis; the diaphysis and articular surface are unaffected. Type II fractures involve a small fracture of the metaphysis and separation of the epiphysis from the metaphysis. In type III fractures, the epiphysis is fractured and the articular surface is involved. Patients with type IV fractures have involvement of the diaphysis, epiphyseal plate, and articular surface. In type V fractures, the epiphyseal plate is compressed; the metaphysis is unaffected.

In children with Salter-Harris type I or type II fractures, appropriate management is closed reduction, followed by casting or pin fixation. Management of type III, type IV, and type V fractures is similar but should also include restoration of the articular surface.

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213

A 17-year-old boy is brought to the emergency department five hours after sustaining a complete amputation of the arm above the level of the elbow. Which of the following is the most appropriate initial management?

(A) Arterial shunting
(B) Bone fixation
(C) Fasciotomy
(D) Vein repair
(E) Revision amputation

The correct response is Option A.

The most appropriate first step in major limb replantation is establishment of blood flow. In any patient who sustains an amputation proximal to the level of the wrist, the blood supply must be reestablished within six hours of warm ischemia time (or 12 hours of cold ischemia time) to minimize the extent of myonecrosis. In a patient who seeks treatment immediately after sustaining an amputation, fasciotomies should be performed first, followed by bone fixation, arterial repair, vein repair, and then nerve repair. However, if the ischemia time is approaching the six-hour limit, temporary arterial shunting should be established with a Silastic endarterectomy shunt, small Foley catheter, or feeding tube. In patients who have prolonged ischemia, arterial flow should always be established before venous outflow. The arterial anastomosis should be opened to allow venous egress and to prevent the systemic return of lactic acid, which can result in detrimental complications.

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214

A 52-year-old man has a painless, nontender 2-cm mass in the left palm that has been stable for the past three years. He has a history of plantar fibromatosis but no history of trauma. His father and brothers have similar nodules. Which of the following is the most appropriate management?

(A) Observation
(B) Punch biopsy of the lesion
(C) Incisional biopsy of the lesion
(D) Excisional biopsy of the lesion
(E) Wide radical resection of the lesion

The correct response is Option A.

This 52-year-old man most likely has a Dupuytren's nodule; therefore, the most appropriate management is observation alone. Dupuytren's nodules are common in patients who have a history of plantar fibromatosis. Solitary nodules often remain unchanged for years, and only occasional follow-up examinations are required. Painful lesions can be treated with injection of a corticosteroid.

Because Dupuytren's nodules contain abundant myofibroblasts that produce abnormal collagen, purified collagenase has been used with some success in management. Other conservative treatments including application of dimethyl sulfoxide (DMSO), interferon therapy, splinting, and ultrasonography have not been proven to be widely effective.

Biopsy is not recommended for this nonmalignant lesion. Excision of a Dupuytren's nodule is rarely indicated.

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215

A 5-year-old child has an angular deformity of the ring finger; a photograph and radiograph are shown above. This finding is most consistent with which of the following?

(A) Complex incomplete syndactyly
(B) Fracture malunion
(C) Longitudinally bracketed epiphysis
(D) Madelung's deformity
(E) Osteoma of the proximal phalanx

The correct response is Option C.

These findings are most consistent with a longitudinally bracketed epiphysis. In this child's ring finger, there is a bracketed longitudinal growth plate with a reverse C-shaped configuration, rather than a normal transverse growth plate configuration. Longitudinal growth on the radial aspect of the phalanx is arrested but proceeds more normally on the ulnar aspect of the proximal phalanx, where the epiphysis is not bracketed. This finger deformity is most frequently associated with a delta phalanx, which is indeed present in this patient. However, a delta phalanx is more commonly evident in triphalangeal thumbs.

This child underwent release of simple, incomplete syndactyly of the third postaxial web space at age 8 months but subsequently developed a progressive angular deformity of the ring finger and severe scissoring beneath the long finger, as shown in the photograph. Angulation of greater than 5 degrees in any of the digits should be corrected surgically. Closing wedge osteotomy and epiphyseolysis with fat interposition were performed in this patient.

Complex incomplete syndactyly is characterized by webbing of the bone and soft tissues between adjacent digits that does not extend the length of the digits. Fracture malunion can be easily recognized on radiographs but is not seen in this patient. Patients with Madelung's deformity have arrested growth of the ulnar aspect of the distal radius resulting in a patterned wrist deformity. Osteoma of the proximal phalanx appears as a smooth, oval radiolucency of bone on radiographs.

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216

A 37-year-old man has severe pain, swelling, and discoloration of the right hand one month after sustaining a crush injury to the dorsal aspect of the hand. A 4-cm laceration was repaired at the time of injury; there were no fractures or tendon injuries. On examination, the hand is swollen and stiff.

These findings are most consistent with which of the following conditions?

(A) Osteomyelitis
(B) Posttraumatic arthritis
(C) Reflex sympathetic dystrophy
(D) Secretan's disorder
(E) Suppurative tenosynovitis

The correct response is Option C.

This patient's findings are most consistent with reflex sympathetic dystrophy (RSD) or complex regional pain syndrome (CRPS), which manifests as a progressive or complex pain syndrome. Severe pain, swelling, stiffness, and

discoloration of the affected part are characteristic. These changes are thought to result from vasomotor instability of the sympathetic nervous system. Hyperhidrosis, osteoporosis, and trophic changes may also occur. The stages of reflex sympathetic dystrophy are acute, subacute, and chronic.

Osteomyelitis is a bone infection that develops secondary to an adjacent wound, joint, or tenosynovial infection. Osteomyelitis can also arise from blood-borne pathogens.

Patients with posttraumatic arthritis have joint pain, stiffness, and swelling that develop following intra-articular injury; however, the pain is typically less severe than in patients with RSD.

Secretan's disorder or peritendinous fibrosis is often associated with minor work-related trauma. It is characterized by edema of the dorsal aspect of the hand and factitious lymphedema of the hand. This condition is typically not associated with the severe pain of RSD.

Suppurative tenosynovitis is characterized by fusiform swelling, tenderness along the flexor tendon sheath, and increased pain with passive extension or semiflexed positioning of the finger.

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217

Which of the following structures provides the vascular supply to the osteocutaneous radial forearm flap?

(A) Fascioperiosteal perforators between the flexor carpi radialis and palmaris longus muscles
(B) Fascioperiosteal perforators between the brachioradialis and flexor carpi radialis muscles
(C) Musculoperiosteal perforators from the recurrent radial artery
(D) Musculoperiosteal perforators through the flexor digitorum profundus muscle
(E) Musculoperiosteal perforators through the pronator teres muscle

The correct response is Option B.

During harvest of the osteocutaneous radial forearm flap, a segment of radius as long as 10 cm with as much as 40% of the cross-section of the radius can be harvested. This flap can be found between the insertion of the pronator teres and brachioradialis muscles and is raised from the radial and ulnar sides. Vascularity is primarily supplied by fascioperiosteal perforators that lie within the intermuscular septum between the brachioradialis and flexor carpi radialis muscles. Musculoperiosteal branches of the flexor pollicis longus and perforators in the pronator quadratus muscle arising from the radial artery also supply blood to the flap. Dissection is performed laterally to the anterolateral

intermuscular septum between the flexor carpi radialis and brachioradialis muscles and medially to the medial side of the intermuscular septum between the brachioradialis and flexor carpi radialis muscles. The brachioradialis is retracted radially and the flexor carpi radialis is retracted medially. The bellies of the flexor pollicis longus and pronator quadratus muscles are divided longitudinally to the radial periosteum, and the periosteum is incised beyond the attachments of the septum to the radius. Bone instruments are used to remove a segment of radius attached to the intermuscular septum and to the remnants of the pronator quadratus and flexor pollicis longus.

The recurrent radial artery is part of the anastomotic vasculature that surrounds the elbow. The fascioperiosteal perforators lie within the intermuscular septum between the brachioradialis and flexor carpi radialis muscles, not the flexor carpi radialis and palmaris longus muscles. There are no functional perforators arising from the flexor digitorum profundus or pronator teres muscles to supply blood to the radius.

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218

A 25-year-old man has painful swelling of the proximal phalanx of the right small finger after hitting it lightly against a closet door. A pathologic fracture is noted at the site of a markedly radiolucent lesion with speckled calcification. A radiograph is shown above. Which of the following is the most likely diagnosis?

(A) Enchondroma
(B) Giant cell tumor of bone
(C) Multiple enchondromatoses
(D) Osteochondroma
(E) Osteoid osteoma

The correct response is Option A.

The 25-year-old man has an enchondroma, a common bone tumor typically found in the metacarpals and phalanges in young adults. Most enchondromas are incidentally discovered on radiographs and/or in conjunction with pathologic fractures. Radiographs will show a radiolucent neoplasm; there is thinning and expansion of the bony cortex with widespread speckled calcification. Appropriate management includes curettage of the lesion.

Giant cell tumor of bone is a common multifocal hand tumor. Radiographs show an irregular, expansile radiolucent lesion typically in the epiphyseal region of a tubular bone. Ray resection or en bloc removal combined with bone grafting is recommended because recurrence is common.

Multiple enchondromatoses are larger than solitary enchondromas and are associated with axial skeletal deformities. Because patients with multiple enchondromatoses are at increased risk for malignant degeneration to chondrosarcoma, incisional biopsy should be performed if pain or swelling develops in the area of the lesion. Any patient with chondrosarcoma confirmed by histologic examination of the biopsy specimen should undergo intraosseous en bloc excision or ray resection.

Osteochondroma is a widespread lesion of bone that may be hereditary. In patients with osteochondromas, endochondral ossification may lead to the formation of secondary bone mass. Appropriate management includes resection of all tumors with reconstructive surgery to repair any bone or joint malalignment.

Osteoid osteoma is a painful tumor usually seen in patients younger than 40 years. Pain is often relieved with administration of nonsteroidal anti-inflammatory drugs. Radiographs of the tumor will show a radiolucent zone with a dense nidus surrounded by a distinctive area of cortical sclerosis. Complete excision is usually curative and recurrence is rare.

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219

A 35-year-old assembly-line worker has pain in the right upper extremity. On examination, there is pain and tenderness over the mobile wad; long finger extension and resisted supination tests are positive. These findings are most consistent with which of the following syndromes?

(A) Carpal tunnel syndrome
(B) Cubital tunnel syndrome
(C) Intersection syndrome
(D) Radial tunnel syndrome
(E) Wartenberg's syndrome

The correct response is Option D.

This patient has symptoms consistent with radial tunnel syndrome, which is characterized by pain and tenderness over the mobile wad (radial tunnel) that occurs with extension, supination against resistance, or passive flexion and

pronation of the wrist. Pain is localized just below the elbow in the extensor mass and along the course of the radial nerve. Radial tunnel syndrome has no sensory or motor loss. The compressing structures are the vascular leash, the arcade of Frohse, and the extensor carpi radialis brevis tendon.

Patients with carpal tunnel syndrome have pain at night, numbness, and tingling in the thumb, index, and long fingers and the radial side of the ring finger. Thenar weakness can develop. Associated findings include a positive Tinel's sign over the carpal tunnel and positive findings on both the Phalen's and reverse Phalen's tests.

Cubital tunnel syndrome, or compression of the ulnar nerve at the elbow, is characterized by numbness and tingling in the ring and small fingers, pain over the medial aspect of the elbow, and sensory deficits along the ulnar side of the palm and in the ring and small fingers. Weakness develops in both the ulnar extrinsic and intrinsic motors. In patients with entrapment of the ulnar nerve at the wrist, numbness and tingling in the ring and small fingers are also presenting signs. These patients can also develop ulnar intrinsic weakness.

Intersection syndrome is a pain syndrome localized to the distal forearm at the intersection of the first extensor compartment (which contains the abductor pollicis longus and extensor pollicis brevis muscle bellies) and the second extensor compartment (which contains the extensor carpi radialis longus and brevis tendons). Patients with intersection syndrome have pain, swelling, and crepitus in the distal forearm proximal to the Lister tubercle. Symptoms are caused by tightness of the retinaculum over the first and second dorsal compartments associated with tenosynovitis of the tendons. Corticosteroid injections or tenosynovectomy are recommended for treatment.

In Wartenberg's syndrome (ie, cheiralgia paresthetica), the radial nerve is compressed beneath the edge of the brachioradialis muscle at the level of the wrist. Affected patients have persistent pain on the dorsoradial surface of the hand and distal aspect of the forearm. Examination is most likely to show sensitivity to percussion over this area; Tinel's sign is most likely to be positive over the course of the superficial radial sensory nerve along the dorsal edge of the brachioradialis muscle. The patient should first be instructed to avoid wearing tight jewelry or bracelets in the area. Operative exploration may be indicated in patients with persistent symptoms; however, decompression procedures are only associated with moderate success rates.

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220

A 33-year-old snake handler has diffuse swelling of the left hand and forearm after being bitten by a pit viper. The venom was directly injected into the skin and subcutaneous tissue of the forearm. When establishing a diagnosis of compartment syndrome in this patient, which of the following is the earliest clinical finding?

(A) Accentuation of pain by passive muscle stretching
(B) Diminished sensation in the affected compartment
(C) Obliteration of distal pulses by compartment swelling
(D) Persistent, worsening pain
(E) Tenseness on palpation of the compartments of the forearm

The correct response is Option A.

This patient has compartment syndrome due to a snake bite. Pain is the hallmark of compartment syndrome and is accentuated by passive stretching of the involved muscle compartment, which is the most consistent early sign. Patients with injuries of the upper and lower extremities should be closely monitored for the presence of muscle, nerve, and tissue ischemia. However, compartment syndrome occurring in conjunction with a pit viper or other snake bite is often worse than other types of compartment syndrome. Because the venom is injected directly into the tissues, tissue destruction occurs rapidly, leading to the immediate onset of edema, ecchymosis, and swelling.

Measurement of compartment pressures is an important step in the diagnosis of compartment syndrome, especially in patients who have sustained head trauma or spinal cord injuries. Decompressive fasciotomy should be performed in normotensive patients when compartment pressures are greater than 30 mmHg and the duration of symptoms is longer than eight hours or is unknown or the patient is unconscious or uncooperative. Patients with hypotension and compartment pressures greater than 20 mmHg should also undergo surgery within six hours.

In some patients with compartment syndrome, central or peripheral sensory deficits or late nerve ischemia may preclude the presence of pain as a diagnostic finding.

In compartment syndrome, distal pulses may still be present. The affected extremity may appear cyanotic, pale, or normal. Sensation may be normal or diminished.

Tenseness and tenderness of the closed compartments are nonspecific findings that are not necessarily associated with ischemic tissue damage.

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221

In a patient undergoing medicinal leech therapy for management of venous congestion following thumb replantation, the most appropriate adjunctive treatment is antibiotic prophylaxis against which of the following organisms?

(A) *Aeromonas hydrophila*
(B) *Eikenella corrodens*
(C) *Histoplasma capsulatum*
(D) *Pasteurella multocida*
(E) *Staphylococcus aureus*

The correct response is Option A.

Adjunctive treatment in this patient should include antibiotic prophylaxis against *Aeromonas hydrophila* organisms. This is a symbiotic bacteria found in the intestines of medicinal-grade leeches of the *Hirudo medicinalis* species, which can be applied to flaps or replanted limbs in order to alleviate venous congestion. The *Aeromonas* bacteria produces digestive enzymes that act to break down hemoglobin within the intestines of the leech. However, patients with devitalized vascular tissue are particularly susceptible to infection with this gram-negative organism. Affected patients will develop a rapidly progressive infection with gas in the soft tissues that can resemble clostridial myonecrosis. Appropriate management consists of debridement of the affected area and administration of aminoglycoside, trimethoprim-sulfamethoxazole, or a third-generation cephalosporin.

Eikenella corrodens is a facultative anaerobic gram-negative rod typically associated with human bite wounds. Penicillin or ampicillin is recommended for treatment. *Histoplasma capsulatum* is a fungus that results in arthralgia and arthritis in affected patients. Administration of amphotericin B is indicated. *Pasteurella multocida* is an anaerobic gram-negative bacillus, typically associated with cat bites and best treated with penicillin or amoxicillin with clavulanate. *Staphylococcus aureus* is an anaerobic gram-positive coccus present on the skin that is a frequent cause of skin and soft-tissue infections.

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222

A 64-year-old man has had a 10-mm lesion on the radial matrix of the thumb for the past two years. Plain radiographs suggest bony involvement. MRI shows involvement of the distal phalanx only. A punch biopsy specimen of the affected area indicates squamous cell carcinoma. There are no palpable lymph nodes.

Which of the following is the most appropriate management?

(A) Laser ablation
(B) Excision with 5-mm margins and coverage with a skin graft
(C) Mohs' excision and coverage with a skin graft
(D) Amputation of the thumb at the level of the interphalangeal joint
(E) Ray amputation of the thumb

The correct response is Option D.

The most appropriate management of this patient with squamous cell carcinoma of the thumb with involvement of the distal phalanx is amputation of the thumb at the level of the interphalangeal joint. This level of amputation allows for clear histopathologic margins while maintaining optimal thumb function. An adequate level of amputation in this patient is likely to be curative. Selective lymph node sampling may be beneficial in establishing the extent of disease and in determining the appropriate management.

Squamous cell carcinoma is the most common paronychial malignancy. Subungual squamous cell carcinoma usually involves the thumb or index finger and is more common in men. It is often mistaken for chronic paronychia.

Laser ablation is more appropriate for superficial cutaneous lesions without bony involvement. Likewise, excision of the lesion with clear margins and coverage with a skin graft is appropriate for patients with more limited disease. The bony involvement associated with this tumor precludes any type of excision with soft-tissue margins, including Mohs' excision. In addition, Mohs' excision of digital tumors has been shown to have an unacceptable five-year cure rate of 75%. Ray amputation is a functionally disabling procedure.

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Which of the following is the most likely site of entrapment of the posterior interosseous nerve in the forearm?

(A) Arcade of Frohse
(B) Arcade of Struthers
(C) Band of Osborne
(D) Lacertus fibrosis
(E) Ligament of Struthers

The correct response is Option A.

Nerves of the upper extremity are prone to entrapment in areas of tight passage or at sharp inflection points. The site or level of compression defines the sensory and motor findings. The median nerve can become entrapped proximally in the arm by the ligament of Struthers, which is a dense band that can form between the supracondylar humeral process and the medial epicondyle. More distally, the median nerve can become entrapped beneath the lacertus fibrosis, which is a dense fascial sheet that extends proximally to the biceps tendon from the antebrachial fascia.

The ulnar nerve exits the arm in the medial intermuscular septum. Fascial folds in this area are known as the arcade of Struthers and can pinch the nerve, especially following anterior transposition. As the ulnar nerve passes through the cubital tunnel, a constricting band can form. This band, known as the band of Osborne, must be released during neuroplasty.

The radial nerve exits the arm after passing posterior to the humerus. It divides into the superficial and deep branches; the deep branch of the radial nerve, also known as the posterior interosseous nerve, can become entrapped, typically due to a fascial band over the supinator called the arcade of Frohse. The radial nerve here can also be compromised by vascular leashes, the edge of the extensor carpi radialis brevis, the edge of the proximal supinator, and the edge of the distal supinator. Proximal compression leads to weakness of extension of the wrist, finger, and thumb, often with radial deviation of the wrist because the extensor carpi radialis longus tendon is innervated proximally.

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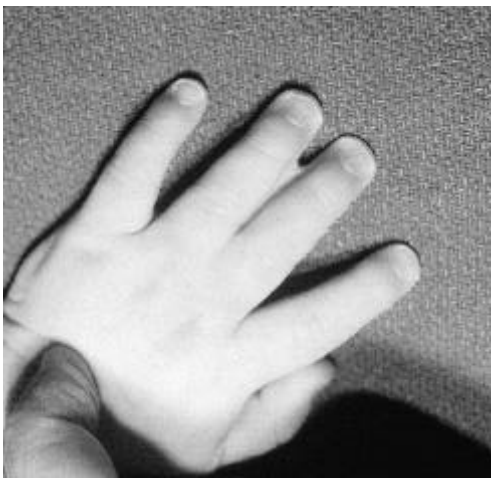
224



A 1-year-old infant has the malformation shown in the photograph above. Which of the following is most likely in this infant?

(A) Apert's syndrome
(B) Carpenter's syndrome
(C) Pfeiffer's syndrome
(D) Poland's syndrome
(E) No other associated syndromes

The correct response is Option E.

This infant with syndactyly will most likely have no other associated syndromes. Syndactyly occurs in one of every 2000 neonates and is typically an isolated deformity, although other malformations have been associated. Syndactyly can be complete or incomplete, reflecting the level of webbing distally to proximally, and complex or simple, reflecting the presence or absence of bony union. Complicated syndactyly implies involvement of other congenital abnormalities such as polydactyly.

Male infants are more commonly affected than female infants. Inheritance is more often sporadic than familial. Approximately 50% of affected patients have bilateral syndactyly. The third web space is affected most frequently.

Patients with Apert's syndrome have bilateral, symmetric, complex syndactyly with shortened fingers. Craniofacial deformities are characteristic. Carpenter's syndrome is characterized by simple syndactyly, shortened fingers, preaxial polysyndactyly, broad thumbs, and craniosynostosis. In Pfeiffer's syndrome, there is mild partial syndactyly, as well as broadened, deviated thumbs and severe midface hypoplasia. Poland's syndrome is associated with unilateral findings, including absence of the sternocostal portion of the pectoralis major muscle, hypoplasia of the upper extremity, simple syndactyly, and shortened fingers.

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225

A 17-year-old high school football player is unable to extend the proximal interphalangeal (PIP) joint of the ring finger two weeks after jamming the finger during a football game. Current physical examination shows hyperextension of the distal interphalangeal (DIP) joint with flexion of the PIP joint. There is full passive range of motion of the finger. Radiographs are unremarkable.

Which of the following is the most appropriate initial management?

(A) Extension splinting of the DIP joint
(B) Extension splinting of the PIP joint
(C) Extension splinting of the DIP and PIP joints
(D) Closed reduction and percutaneous pin fixation of the PIP joint
(E) Open repair of the central slip

The correct response is Option B.

This patient has a boutonnière deformity, which results from disruption of the central slip of the extensor tendon at the PIP joint with concomitant volar migration of the lateral bands. This volar migration may not be seen until 10 to 21 days after injury. Patients with boutonnière deformities have persistent flexion of the PIP joint resulting from loss of the central slip and the unopposed forces of the flexor digitorum superficialis tendon. The transverse retinacular ligaments become stretched, and the volarly migrated lateral bands exert direct pull on the DIP joint. This leads to the characteristic findings of hypertension of the DIP joint and worsening flexion of the PIP joint.

The most appropriate management is splinting of the PIP joint in extension; this can be performed successfully as late as six weeks after initial injury. The DIP joint should be left unencumbered to allow motion, which will result in dorsal migration of the lateral bands and reestablish the normal relationship of the tendinous structures within the finger.

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226

A patient with Dupuytren's disease has flexion contractures involving the proximal interphalangeal joints of the right ring and small fingers. The most likely cause is involvement of which of the following cords?

(A) Central
(B) Lateral
(C) Natatory
(D) Pretendinous
(E) Spiral

The correct response is Option A.

This patient's flexion contractures are most likely caused by involvement of the central cord. The central cord has no precursor band; it arises with the pretendinous cord and attaches to the tendon sheath or bone of the middle phalanx. It is the most common cause of contractures involving the proximal interphalangeal (PIP) joint. Contracted cords are typically seen on one side of the finger only; diseased cords on both sides are rare.

The lateral and spiral cords can also cause flexion contractures of the PIP joint. In addition, the lateral cord can be a primary cause of flexion contractures of the distal interphalangeal joints. The spiral cords are composed of the spiral band, lateral digital sheath, and Grayson's ligament, which in the normal human hand form a spiral around the neurovascular bundle. However, in patients with Dupuytren's disease, the spiral cord contracts, causing the neurovascular bundle to form a spiral around the cord. Contraction of the spiral cord results in medial and superficial displacement of the neurovascular bundle.

The development of a natatory cord typically results in loss of finger abduction and flexion contractures of the PIP joints. Some fibers of the natatory cord may pass distally on the sides of the affected finger. The pretendinous cords cause contracture of the metacarpophalangeal joint. These cords evolve from the pretendinous bands; contracture of these bands causes pitting in the palm.

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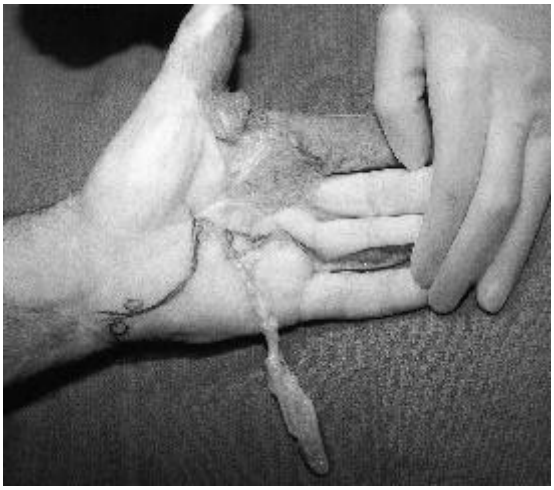

Which of the following best describes the flap used for thumb reconstruction shown in the photograph above?

(A) Based on the dorsal metacarpal artery to the ring finger
(B) Based on the posterior interosseous artery
(C) Supplied by a terminal branch of the median nerve
(D) Supplied by a terminal branch of the radial nerve
(E) Supplied by a terminal branch of the ulnar nerve

The correct response is Option E.

The photograph illustrates Littler's neurosensory island flap, which is based on the proper digital nerve to the ulnar aspect of the ring finger. This nerve is a terminal branch of the ulnar nerve. This flap is used to provide needed sensibility to the thumb and index finger pads. Its vascularity is supplied by the corresponding proper digital artery with venous return through multiple adventitial venae comitantes. The flap can be pedicled all the way to the superficial palmar arch by ligating the proper digital artery to the radial aspect of the small finger, creating a flap with adequate reach to resurface the volar aspect of the thumb. Adequate blood flow in the radial digital artery of the ring finger and ulnar digital artery of the small finger must be ensured prior to flap transfer. The common digital nerve to the fourth web space can be divided along the fascicles to allow for mobilization of the digital nerve to the level of the superficial arch.

This patient has third-degree burns of the thumb with destruction of the digital nerves resulting from an electrocution injury. In order to restore function and sensibility in the thumb, the neurosensory flap is elevated from the ulnar aspect of the ring finger, tunneled across the palm of the hand subcutaneously, and inset into the perimeter of the thumb wound to provide sensation to the thumb pad.

Flap vascularity is not supplied by the dorsal metacarpal artery or posterior interosseous artery. Nor do the radial and median nerves innervate the ulnar aspect of the ring finger, which would be transposed to provide sensation to the thumb pad.

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228

A 24-year-old woman has a 3-cm soft-tissue defect at the medial malleolus 10 months after sustaining an open fracture of the distal third of the tibia in a motorcycle accident. There were no vascular or nerve injuries at the time of the accident. Examination shows exposed bone with dense scarring of the skin and adherence to underlying tissue. Radiographs are consistent with osteomyelitis and fracture nonunion.

Which of the following is the most appropriate management?

(A) Total contact casting
(B) Split-thickness skin grafting
(C) Coverage of the wound with a soleus pedicle flap
(D) Coverage of the wound with a free latissimus dorsi flap
(E) Below-knee amputation

The correct response is Option D.

The most appropriate management of this patient with a soft-tissue defect and osteomyelitis is stabilization of the segment, debridement of the affected area, and coverage with a free latissimus dorsi pedicle flap. Application of an external fixator, radical sequestrectomy, placement of antibiotic beads, and autotransplantation of a free latissimus dorsi flap are performed initially; bone grafting of the tibial defect is performed secondarily.

There is controversy regarding the precise advantages offered by free flaps when applied to infected bone. However, the basic principles for use of these flaps include skeletal stabilization, radical debridement of infected or devitalized tissues, and coverage with vascularized tissues. The free flap provides an abundance of vascularized tissue necessary to close large wounds left by aggressive debridement, and the muscle free flap provides pliability to fill the dead spaces.

Total contact casting can be performed in patients with clean, slowly healing wounds of the distal lower extremity, but would only aggravate the fracture nonunion and osteomyelitis in this patient. Adequate debridement of only the soft-tissue scar and skin grafting over the wound will not result in a stable, healed site without infection. A soleus pedicle flap would not reliably cover this complex distal leg wound. In addition, the posterior compartment leg muscles and their vascular supply are frequently injured by high-energy injuries. Therefore, the soleus muscle is not likely to be reliable for transfer. A below-knee amputation would not be appropriate in a healthy patient with a sensate distal extremity in which the circulation is fully intact.

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229

A 45-year-old woman has pain and numbness in the right hand and forearm. There are no motor disturbances. Semmes-Weinstein monofilament testing shows decreased sensation in the index and long fingers, thumb, and palm. Phalen's and Tinel's signs are negative over the carpal tunnel.

These findings are most consistent with which of the following?

(A) Anterior interosseous syndrome
(B) C5 cervical radiculopathy
(C) Carpal tunnel syndrome
(D) Cubital tunnel syndrome
(E) Pronator syndrome

The correct response is Option E.

Although the sensory and motor deficits of carpal tunnel syndrome and pronator syndrome are similar, the sensory deficit within the palmar cutaneous region best differentiates pronator syndrome from carpal tunnel syndrome. This patient has findings consistent with pronator syndrome, or compression of the median nerve within the proximal forearm. Sites of potential entrapment of the median nerve include the ligament of Struthers in the distal arm, the

lacertus fibrosis at the level of the elbow, the pronator teres muscle, and the arch of the flexor digitorum superficialis muscle. Although symptoms are similar to carpal tunnel syndrome, sensory findings typically occur more proximally. Symptoms can be reproduced with active elbow flexion with the elbow in pronation, resisted elbow flexion, or resisted pronation with flexion of the wrist. Phalen's sign is negative in most patients with pronator syndrome.

Anterior interosseous syndrome results from compression of the anterior interosseous branch of the median nerve in the forearm. Affected patients have poorly defined pain in the forearm and weakness of the profundus tendon of the index finger and the flexor pollicis longus tendon but no sensory deficit. Cervical radiculopathy at C5 is characterized by radicular-type pain in the lateral aspect of the upper arm and forearm. Cubital tunnel syndrome is caused by entrapment of the ulnar nerve in the region of the elbow. Affected patients have sensory deficits in the small finger and ulnar aspect of the ring finger.

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230

A 38-year-old man sustains a third-degree burn to the left hand. On examination, there is a 2 × 2-cm area of exposed extensor pollicis longus tendon at the interphalangeal joint with destruction of the paratenon. Which of the following is most appropriate for coverage of the wound?

(A) Split-thickness skin graft
(B) Full-thickness skin graft
(C) Kite flap
(D) Moberg flap
(E) Thenar flap

The correct response is Option C.

The patient has a burn wound with exposed tendon (no paratenon) over a joint. Appropriate coverage will permit tendon glide and joint motion. Sensation is not required. The kite flap can be based on the first or second dorsal metacarpal artery over the dorsal aspect of the index and long fingers, respectively. The flap territory includes the dorsal skin of the proximal phalanx of the index finger for the first metacarpal artery flap and the dorsal skin of the proximal phalanx of the long finger for the second metacarpal artery flap. The radial and dorsal proximal interphalangeal sensory branches can be used to create a sensate flap. The first dorsal metacarpal artery flap works well when used for coverage of dorsal thumb wounds; however, the second dorsal metacarpal artery flap will not reach the dorsal thumb.

Coverage of this patient's wound with a skin graft will be unsuccessful. Neither a split- nor a full-thickness graft will heal over exposed tendon without paratenon, which will not provide adequate vascularization to support a skin graft. Additionally, the graft would adhere to the tendon.

A Moberg flap advances volar tissue from the thumb pad 1 to 1.5 cm for volar pad coverage. A thenar flap is appropriate for index and long fingertip pad defects. The thenar flap will not reach the interphalangeal joint area of the dorsal thumb.

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231

Which of the following hand deformities is commonly associated with a delta phalanx?

(A) Brachydactyly
(B) Camptodactyly
(C) Clinodactyly
(D) Macrodactyly
(E) Symbrachydactyly

The correct response is Option C.

Clinodactyly, or "bent finger," is most commonly caused by the presence of a delta phalanx. Clinodactyly and triphalangeal thumb are most often associated with the presence of a delta phalanx, which has an angulated, short, tubular base, trapezoidal or triangular in shape. The growth plate is longitudinal, often a reverse C-shape or bracket, rather than transverse. The longitudinally bracketed epiphysis can interfere with normal longitudinal growth. Clinodactyly manifests as a radially or ulnarly curved digit. It is typically bilateral and is often transmitted as an autosomal dominant trait with variable expression. Although any digit can be involved, radial deviation of the small finger in the area of the distal interphalangeal joint is most common. In patients with delta phalanges, appropriate management includes bracket resection, fat grafting, and osteotomies, which can be either closing, opening, or reverse, as indicated by the findings in the affected patient.

The other hand deformities listed above can be associated with abnormally shaped phalanges but not with a delta phalanx.

Brachydactyly is a congenital deformity, typically autosomal dominant, that is characterized by abnormal shortening of the digits.

Patients with camptodactyly have a flexion deformity of the proximal interphalangeal joint, most frequently involving the small finger. Possible causes of camptodactyly include skin deficiencies, shortening of the volar plate, abnormalities of the palmar fascia and Landsmeer's ligament, deficiencies of the central slip, and shortening of the superficialis tendon. Static and dynamic splinting can be helpful; surgical correction is often incomplete.

Macrodactyly describes enlargement of all of the structures of a digit. Staged bony and soft-tissue reduction procedures can be performed to allow for some control. Attempting to halt digital growth with ligation of digital arteries or elastic compression is typically ineffective. Amputation is indicated for any large, unsightly digit that significantly impairs total hand function.

Symbrachydactyly is a congenital hand deformity characterized by shortened digits with syndactyly. Poland's syndrome is frequently associated. The digits are foreshortened but not angulated.

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232

In a patient with late Volkmann's contracture, which of the following is the most common finding?

(A) Fibrosis of the extensor muscles
(B) Fibrosis of the flexor muscles
(C) Intrinsic plus deformity
(D) Ischemic necrosis of the digits
(E) Radial nerve palsy

The correct response is Option B.

Volkmann's contracture may develop as a result of compartment syndrome occurring secondary to arterial injury or direct muscle trauma. Children who sustain supracondylar fractures are most frequently affected because the brachial artery is compromised. Affected patients have myonecrosis that leads to muscle fibrosis. The fibrosed muscle results in markedly decreased muscle strength and excursion. Ischemic or compressive neuropathy may be seen in surrounding peripheral nerves.

The severity of Volkmann's contracture correlates with the physiologic depth or location of the affected muscle and nerve. Patients with mild Volkmann's contracture have involvement of the muscle bellies of the flexor digitorum profundus (FDP) with mild impairment.

Moderate Volkmann's contracture occurs in most patients and is characterized by involvement of the FDP and flexor pollicis longus muscles; fibrosis of the flexor digitorum superficialis, flexor carpi ulnaris, and flexor carpi radialis muscles may also be seen. Affected patients have contractures of the extrinsic flexor muscles, resulting in claw hand. Neuropathy of the median nerve is most common. The ulnar nerve is less likely to be affected, and the radial nerve is rarely involved.

In patients with severe Volkmann's contracture, fibrosis of the forearm flexor muscles is most common and tends to be uniform. Involvement of the forearm extensor muscles varies.

Thus, the typical Volkmann's contracture deformity is characterized by flexion of the wrist, flexion and adduction of the thumb, extension of the metacarpophalangeal (MP) joints, and flexion of the proximal interphalangeal (PIP) and distal interphalangeal joints.

Intrinsic plus deformities, which can result from contracture of the intrinsic muscles, are characterized by flexion of the MP joints and extension of the PIP joints.

Although untreated severe compartment syndrome can lead to ischemic necrosis of the digits, this finding is not typical of late Volkmann's contracture.

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233

A 42-year-old man sustains open fractures of the tibia and fibula (Gustilo type IIIB) when he is thrown from his motorcycle. The wounds are irrigated, debrided, and covered with a free flap. Which of the following will NOT increase this patient's risk for the development of osteomyelitis?

(A) Dead space at the surgical site
(B) Inadequate soft-tissue coverage
(C) Internal fixation
(D) Presence of nonviable muscle
(E) Retention of devitalized bone

The correct response is Option C.

Patients who sustain open fractures of the long bones are susceptible to bacterial invasion of the wound site and the subsequent development of infection, especially osteomyelitis. Factors associated with persistent infection include the presence of dead space at the surgical site, inadequate soft-tissue coverage, the presence of nonviable soft tissue, including muscle, and retention of devitalized bone. Aggressive irrigation and debridement should be performed in any patient with an open fracture. All nonviable tissue must be removed, and the fracture site should be covered with adequate soft tissue from a local site or via a free tissue transfer.

Internal fixation has not been associated with development of osteomyelitis in patients who have open fractures of the tibia and/or fibula.

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