

THE IN-SERVICE EXAM

S Y L L A B U S 2 0 0 4

**Educational
Assessment:
A Method of
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The management, discussion, and recommended answers for this test represent the combined opinions of the authors and reviewers. They are not endorsed by nor do they constitute a standard of practice of the American Society of Plastic Surgeons, Inc, or the Plastic Surgery Educational Foundation.

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FOREWORD

This educational assessment was developed by the Plastic Surgery Educational Foundation to aid you in identifying strong and weak areas in your knowledge base and in planning your continuing education.

This Syllabus contains the items from the 2004 In-Service Examination, with a discussion and at least one reference for each item. The preferred answer for each item represents the combined opinions of the author(s) and reviewers. In general, each discussion includes supporting evidence for the answer given and reasons why the other choices are incorrect. The Examination Book and Syllabus focus on four content areas of plastic surgery. These areas are Craniomaxillofacial, Aesthetic and Breast, Integument, and Hand and Extremities.

TABLE OF CONTENTS

Craniomaxillofacial	1
Aesthetic and Breast	46
Integument	85
Hand and Extremities	128

CRANIOMAXILLOFACIAL**1**

A 20-year-old woman is undergoing evaluation because she has a gummy smile. On examination, she has a long, narrow nose with an obtuse nasolabial angle. There is lip incompetence, excessive show of the upper incisors with the lips in repose, and mentalis muscle strain with lip closure. She has Angle class II malocclusion. Cephalometric analysis shows a normal SNB angle.

Which of the following is the most likely diagnosis?

- (A) Mandibular deficiency
- (B) Mandibular excess
- (C) Vertical maxillary deficiency
- (D) Vertical maxillary excess

The correct response is Option D.

The findings in this patient are consistent with vertical maxillary excess, or long-face syndrome. Patients with vertical maxillary excess have increased height of the lower third of the face. This condition is characterized by labial incompetence with the lips in repose, excessive incisal show, and a lip-to-tooth relationship greater than 3 mm. Mentalis muscle strain occurs as the patient attempts to obtain labial competence. In addition, the nose and alar bases are narrowed and the nasolabial angle is obtuse. The chin is retruded and vertically long. The mandible is retrognathic, which may occur secondary to true retrognathia or backward autorotation. Occlusion is Angle class II.

Mandibular deficiency is associated with true retrognathia. Although the physical findings, such as Angle class II malocclusion and lip incompetence, are similar to vertical maxillary excess, the SNB angle is decreased in patients with mandibular deficiency.

Mandibular excess, or prognathism, is characterized by a wide lower third of the face and a full, prominent lower lip below the vermilion border. Intraoral examination shows an anterior crossbite and Angle class III malocclusion. Excessive closure of the jaws results in decreased vertical facial height. Cephalometric analysis shows an increased SNB angle.

Patients with vertical maxillary deficiency, or short-face syndrome, have decreased facial height vertically, absence of maxillary incisor show with an edentulous look, an upper lip that appears short and flat, a deep bite with an excessively protruding chin, wide alar bases, and an acute mandibular plane angle. This is Angle class III malocclusion. The SNB angle is normal or larger than normal on cephalometric analysis.

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2

Which of the following is the most common indication for performing distraction osteogenesis of the mandible in a 6-month-old infant?

- (A) Malocclusion
- (B) Mandibular hypoplasia with tongue-based airway obstruction
- (C) Mandibular hypoplasia with tracheomalacia
- (D) Unilateral craniofacial microsomia

The correct response is Option B.

In patients younger than age 2 years, mandibular distraction osteogenesis should only be performed when there is tongue-based airway compromise secondary to mandibular hypoplasia. In these patients, pulling the mandible forward will also pull the base of the tongue forward, relieving the airway obstruction.

Children younger than age 2 years with congenital hypoplasia or aplasia of select portions of the mandible but without airway compromise should not undergo distraction osteogenesis of the mandible because of the risk for permanent dental injury. In addition, mandibular procedures are associated with the potential for injury to the inferior alveolar nerve. Similarly, any procedures to correct malocclusion should only be performed after the permanent dentition has been established. Because children younger than age 1 year have either no dentition or rudimentary dentition and because the tooth buds are difficult to identify, operative correction of malocclusion is inappropriate.

Advancing the mandible and the base of the tongue will not relieve airway obstruction secondary to other causes, such as tracheomalacia or laryngomalacia. In neonates with these conditions, tracheotomy may be required for airway control.

Although distraction osteogenesis is typically performed in patients who have hemifacial microsomia (which can involve absence of the ramus, condyle, and/or glenoid fossa), it is only initiated in patients older than 1 year.

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3

A 35-year-old man comes to the emergency department because he has been unable to close his mouth since hearing a popping sound in his jaw during a wide yawn. Which of the following is the most appropriate initial management?

- (A) Injection of a corticosteroid
- (B) Attempted closed reduction in the emergency department under sedation
- (C) Disk plication
- (D) Eminectomy

The correct response is Option B.

This 35-year-old man who is unable to close his mouth has an acute open lock deformity. This condition occurs when the condyle slips into a position anterior to the articular eminence and subsequently cannot return to the normal position. The most appropriate initial step in management of this patient is attempted manual reduction, which can be performed in the emergency department. Intravenous sedation is recommended to alleviate some of the muscle spasm. If reduction in the emergency department is unsuccessful, administration of succinylcholine in the operating room is the most appropriate next step, as reduction is almost always possible with patient sedation. If this problem persists, an MRI can be obtained to help in planning osseous reduction of the articular eminence. By reducing the slope of the eminence, the condyle returns to the articular fossa more easily, relieving the open lock deformity.

Intraarticular injection of a corticosteroid will not help to reduce the articular disk into its normal position and is administered only rarely in patients with inflammation resulting from an acute open lock deformity.

Disk plication involves plication or resection of the retrodiskal tissue to shorten the tissue and position the disk posteriorly over the condyle. It is not commonly used for treatment of open lock of the mandible.

Eminectomy is not an option in patients with acute open lock deformity of the mandible.

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4

A 16-year-old girl with a history of rheumatoid arthritis has mandibular retrusion and an anterior open bite. Skeletal maturity is complete. Which of the following is most appropriate for correction of the deformity?

- (A) Use of orthodontic functional appliances
- (B) Advancement sagittal split osteotomy and advancement genioplasty
- (C) Maxillary impaction and advancement genioplasty
- (D) Maxillary impaction, advancement sagittal split osteotomy, and genioplasty

The correct response is Option C.

Because episodes of juvenile rheumatoid arthritis can be triggered by increased loading on the temporomandibular joint, orthognathic procedures should be limited to those that minimize condylar load. Therefore, the most appropriate procedure for correction of this child's deformity is maxillary impaction, which will allow closure of the open bite without creating condylar load. The resultant mandibular autorotation of the mandible will increase the SNB (sella-nasion-point B) angle, thereby correcting the mandibular deficiency. Any subsequent sagittal deficiency of the mandible can be improved with advancement genioplasty.

Orthodontic functional appliances are not effective in a 16-year-old patient and are relatively contraindicated in patients with juvenile rheumatoid arthritis because of the forces exerted on the temporomandibular joint. Mandibular advancement will result in increased condylar load, leading to degenerative remodeling.

Advancement sagittal split osteotomy is less acceptable than maxillary impaction and advancement genioplasty because it will increase condylar load.

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A 35-year-old man has swelling and tenderness of the nose and deviation of the nose to the left after being accidentally struck in the face while playing squash. Intranasal examination shows a localized purple mass on the left side of the septum. A CT scan is shown on page 4. Which of the following is the most appropriate initial management?

- (A) Immediate closed reduction and placement of an external splint
- (B) Immediate open reduction of the nasal fractures
- (C) Immediate incision and drainage of the septal mass
- (D) Immediate submucous resection of the septal fracture

The correct response is Option C.

The most appropriate initial step in the management of this patient is immediate incision and drainage of the septal hematoma. If left untreated, septal hematomas cause fibrosis and narrowing of the nasal passages, distortion of the septum, and/or formation of an abscess. They can also cause pressure necrosis of the septum, leading to septal perforation and eventually to complete necrosis with formation of a saddle-nose deformity.

Fracture management is undertaken after the hematoma has been evacuated. In patients who have significant swelling obscuring the nasal structure, fracture reduction is delayed until the swelling resolves, typically within five to 10 days. If swelling is minimal, then reduction can be performed immediately after evacuation.

Although closed reduction is appropriate in most patients with nasal fractures, open reduction may be necessary to obtain anatomic reduction. If lacerations are present, they may be used as incisions for surgical reduction. However, it should be noted that open techniques have been associated with a small incidence of necrosis of the traumatized nasal mucosa. In addition, unsatisfactory results following surgery are likely to lead to severe injury of the nasal septum that may be difficult to correct. Formal rhinoplasty may be performed at a later date to resolve breathing difficulties or improve the aesthetic appearance of the nose.

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6

A 25-year-old man who sustained a fracture of the maxillary alveolus involving the right central and lateral incisors is scheduled to undergo operative reduction and application of an arch bar in the emergency department for stabilization of the fracture. Adequate local anesthesia in this patient involves blockade of which of the following nerves?

- (A) Greater palatine and anterior superior alveolar
- (B) Greater palatine and buccal
- (C) Nasopalatine and anterior superior alveolar
- (D) Nasopalatine and buccal
- (E) Infraorbital and middle superior alveolar

The correct response is Option C.

This 25-year-old man is to undergo operative reduction of a fracture of the maxillary alveolus involving the right central and lateral incisors, followed by application of an arch bar. To obtain a sensory blockade, the surgeon must anesthetize the nasopalatine nerve to block the palate (lingual surface) and the anterior superior alveolar nerve to block the teeth and alveolar mucosa (buccal surface). The nasopalatine nerve originates from the infraorbital nerve and passes through the incisive foramen to reach the anterior hard palate. It innervates the premaxilla at this point, then extends posteriorly to innervate the maxillary cuspids. The anterior superior alveolar nerve branches from the infraorbital nerve after it exits the infraorbital foramen and provides innervation to the maxillary incisors and canine teeth.

The greater palatine nerve emerges from the greater palatine foramen and provides sensation to the posterior portion of the hard palate.

The buccal nerve provides sensation to the buccal mucosa and lower gingiva.

The middle and posterior superior alveolar nerves are derived from the infraorbital nerve after it exits the pterygopalatine fossa. The middle superior alveolar nerve innervates the bicuspid, and the posterior superior alveolar nerve innervates the first, second, and third molars within the maxilla.

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7

A 54-year-old man has a recurrent multinodular tumor 18 months after undergoing superficial parotidectomy for removal of a pleomorphic adenoma. Physical examination shows normal function of the facial (VII) nerve. In addition to radical resection of the tumor, which of the following is the most appropriate management?

- (A) Chemotherapy
- (B) Cryotherapy
- (C) Hormone therapy
- (D) Immunotherapy
- (E) Radiation therapy

The correct response is Option E.

Multinodular local tumors are the most common form of recurrence in patients with previously removed pleomorphic adenomas, and the most appropriate management of these tumors is radical resection followed by radiation therapy. The extent of resection depends on the nature of the recurrence and the extent of the previous surgery; however, the facial nerve should be preserved if possible. If the facial nerve cannot be preserved, immediate reconstruction with

a nerve graft is indicated. In addition, radiation therapy has been shown to result in a marked decrease in the risk for multinodular recurrence in patients with parotid gland tumors when compared with surgery alone.

Chemotherapy is not used for treatment of multinodular local recurrent pleomorphic adenomas. Cryotherapy is recommended for control of nonresectable hepatic tumors. Hormone therapy and immunotherapy are not appropriate management options in patients with parotid gland tumors.

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8

In a 27-year-old man who has sustained bilateral parasymphiseal fractures, which of the following muscles exerts a distractive force on the anterior fracture segment?

- (A) Geniohyoid
- (B) Lateral pterygoid
- (C) Masseter
- (D) Medial pterygoid
- (E) Posterior belly of the digastric muscle

The correct response is Option A.

Both anterior and posterior muscles exert forces on the mandible. The anterior muscles consist of the geniohyoid, genioglossus, mylohyoid, and digastric muscles. The muscles from this group exert primary distractive forces on the anterior fracture segment of a parasymphiseal fracture, displacing the fracture segment downward, posteriorly, and medially. The geniohyoid muscle originates from the mental spine of the inner anterior mandible and inserts on the hyoid bone. It acts to depress and retract the mandible.

The masseter, temporalis, and medial and lateral pterygoids comprise the posterior muscles. These muscles do not exert any force on the anterior segment of a parasymphiseal fracture.

The digastric muscle has an anterior and a posterior belly. The posterior belly originates on the medial aspect of the mastoid and courses forward and inferiorly as a tendon, passing through a fascial sling on the hyoid to transition into the anterior belly, which inserts into the digastric fossa of the mandible. The posterior belly of the digastric muscle primarily functions to elevate the hyoid and exhibits only a secondary effect on the anterior mandible. In contrast, the anterior belly of the digastric muscle exerts force on the anterior fracture segment.

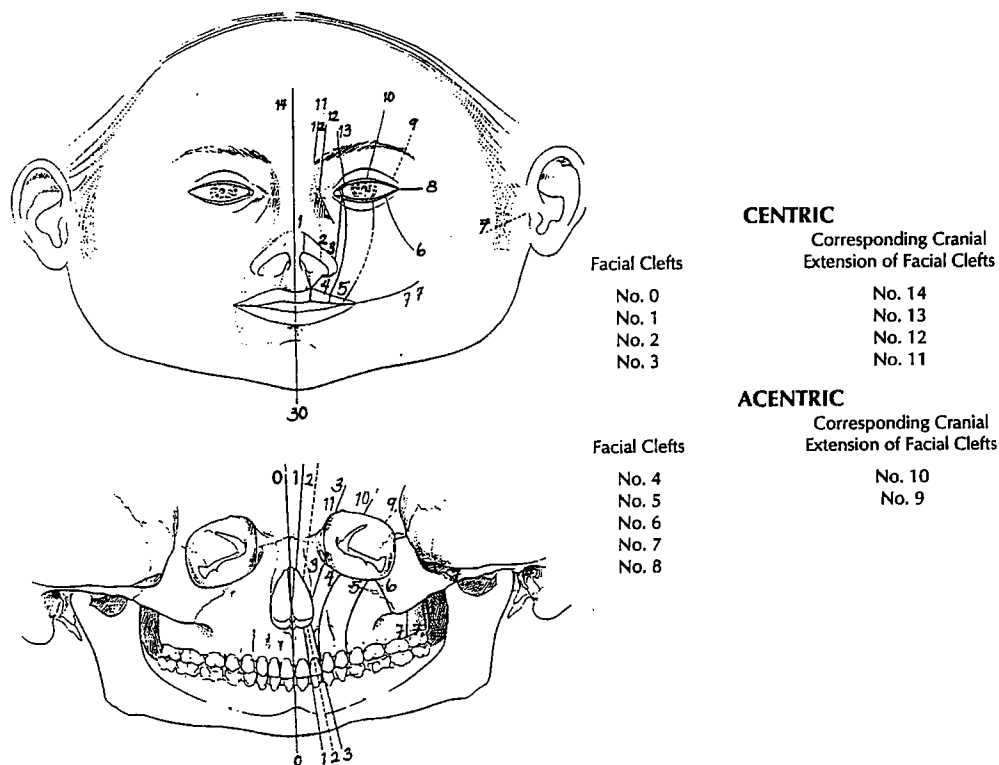
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9

According to Tessier's classification, patients with which of the following types of clefts have displacement of the medial canthus of the eyelid?

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



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The correct response is Option B.

The Tessier classification of craniofacial clefting, which was first proposed in 1973, integrates both tissue findings and underlying skeletal deformities. According to the Tessier system, displacement of the medial canthus of the eyelid is characteristic of the No. 3 cleft. This cleft begins in the alveolus, between the lateral incisor and canine, and extends through the maxilla and into the lacrimal bone. It is often referred to as a "naso-ocular" cleft because the inferomedial wall of the orbit is absent. Other 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, and malformations of the lower canaliculus. The lip deformity is similar to cleft lip.

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 No. 2 cleft is exceedingly rare and may be a transition between the No. 1 and No. 3 clefts.

The Tessier No. 4 cleft passes between the piriform aperture and the infraorbital foramen. It begins lateral to cupid's bow and the philtrum and then passes lateral to the nasal ala and onto the cheek, terminating in the lower eyelid medial to the punctum. The medial canthal tendon is unaffected.

The rare Tessier No. 5 cleft begins behind 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 No. 6 cleft is the incomplete form of Treacher Collins syndrome. This cleft passes inferior and lateral to the oral commissure, toward the angle of the mandible. Colobomas of the lateral lower eyelids occur.

The Tessier No. 7 cleft is the most common atypical cleft; it occurs in one of every 3000 births. It has sporadic transmission and highly variable expressivity. The zygomatic arch is typically absent.

The No. 8 cleft extends from the lateral commissure of the palpebral fissure to the temporal region and is also associated with colobomas of the lower eyelids.

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

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10

A 25-year-old woman sustains a frontal sinus fracture in a motor vehicle collision. On physical examination, there is cerebrospinal fluid rhinorrhea. A CT scan of the head shows displacement of both the anterior and posterior walls and fracture lines extending through the nasofrontal ducts. Which of the following is the most appropriate management?

- (A) Ablation
- (B) Cranialization
- (C) Exenteration
- (D) Nasalization
- (E) Obliteration

The correct response is Option B.

Cranialization of the frontal sinus is the most appropriate management of this patient who has a fracture of the posterior table of the frontal sinus with a concomitant cerebrospinal fluid leak. This procedure is often recommended for patients with severe comminution of the posterior table to resolve any cerebrospinal fluid leakage. Bifrontal craniotomy is performed first to repair the dura, and the posterior table of the frontal sinus and associated mucosa are removed. The nasofrontal duct is occluded with a pericranial flap, disrupting the communication of the duct with the frontal sinus. Following surgery, the brain gradually expands to fill the space previously occupied by the frontal sinus.

Ablation of the frontal sinus involves total removal of the anterior and posterior tables. This procedure is no longer performed due to its resultant cosmetic defects.

Exenteration involves removal of the anterior table of the frontal sinus only. Although it results in a cosmetic deformity, it may be considered in patients who have severe damage to the anterior table resulting from infection and who cannot undergo immediate reconstruction.

Nasalization is a technique in which the nasofrontal duct is either stented or enlarged to ensure adequate drainage of the frontal sinus. This procedure is typically used in patients with frontal basilar fractures involving the nasofrontal duct or floor of the sinus.

Obliteration of the frontal sinus is accomplished by removing all of the mucosa within the frontal sinus and allowing the nasofrontal duct to occlude. Graft material can be used for filling, or the space may remain open and eventually close through the process of spontaneous osteogenesis. This technique is recommended for patients in whom the patency of the nasofrontal duct is compromised.

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11

Simultaneous ipsilateral contractions of which of the following muscles produce the side-to-side grinding movements of the mandible?

- (A) Masseter and lateral pterygoid
- (B) Masseter and medial pterygoid
- (C) Masseter and temporalis
- (D) Medial and lateral pterygoid
- (E) Medial pterygoid and temporalis

The correct response is Option D.

Simultaneous contractions of the medial and lateral pterygoid muscles largely produce the side-to-side grinding and chewing movements of the mandible. Both pairs of medial and lateral pterygoid muscles have two heads. The heads of the medial pterygoids originate from the medial surface of the lateral pterygoid plate and the tuberosity of the maxilla and insert into the medial surface of the mandibular angle and ramus. These muscles act to elevate the

mandible. The heads of the lateral pterygoids originate from the lateral surface of the lateral pterygoid plate and the infratemporal surface of the greater wing of the sphenoid and insert into the neck of the mandibular condyle and articular disk. These muscles act to protrude the mandible forward and open the mouth. When the ipsilateral medial and lateral pterygoid muscles work together, rotation occurs around the vertical axis of the contralateral condyle. Grinding and chewing movements occur when both sides alternate this action in rhythmic fashion. Simultaneous action of all four pterygoid muscles results in protrusion of the mandible.

The masseter muscle arises from the lower border and medial surface of the zygomatic arch and attaches to the lateral aspect of the mandibular ramus. It functions primarily to elevate the mandible to occlude the teeth. The temporalis muscle originates in the temporal fossa of the cranium and attaches to the coronoid process of the mandible. Although its primary function is elevation of the mandible, it can also retract the mandible because of the action of the posterior muscle fibers. Both the masseter and temporalis muscles contribute only minimally to the side-to-side grinding movements of the mandible.

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12



A 10-year-old boy who underwent bilateral cleft lip repair during infancy has tightness of the upper lip. A photograph is shown above. On physical examination, the philtrum is excessively wide and hypoplastic with absence of muscle competence. Redundancy of the lower lip is also noted. Which of the following is the most appropriate method of flap reconstruction?

- (A) Abbe flap
- (B) Banked fork flaps
- (C) Gilles fan flap
- (D) Karapandzic flap
- (E) Nasolabial flap

The correct response is Option A.

The most appropriate management is reconstruction with an Abbe flap. This lip-switch flap has been designed specifically to create a functional philtrum in patients who have tightness of the upper lip following cleft lip repair. After the abnormal philtrum is excised, redundant tissue is harvested from the lower lip to replace the resultant defect as an aesthetic subunit. The Abbe flap is pedicled on the submucosal labial artery of the lower lip at the superior edge of the inner free border of the lip. The pedicle is subsequently divided during a delayed second procedure, which is performed a minimum of 10 days to four weeks after flap transfer.

In adults, the reconstructed philtrum should be no wider than 10 mm and no longer than 15 mm; however some surgeons advocate using a smaller flap that has a width of 7 to 9 mm at the cupid's bow and 4 to 5 mm at the labial-columellar junction.

Banked fork flaps were used previously for bilateral lip reconstruction. At the time of primary lip repair, extra tissue on either side of the new philtrum from the prolabium was "banked" within the creases of the alar base to be used as forked flaps for columellar reconstruction at a later date. However, it was subsequently determined that the columella in fact lies within the nasal region and that primary nasoplasty should be performed instead at the time of lip repair to create the columella. In addition to primary nasoplasty, adequate preoperative nasoalveolar molding has been determined to be more appropriate, and banked fork flaps are no longer used.

The Gilles fan and Karapandzic flaps are oral circumference advancement flaps that were originally designed for lower lip reconstruction, but are also used for upper lip defects. These flaps rotate around the commissure and narrow the oral aperture. They are not designed for reconstruction of the philtrum as an aesthetic subunit.

The nasolabial flap is a transposition flap that is derived from the nasolabial crease. It is most often used for reconstruction of the nasal alar subunit and has limited indications for lip reconstruction. It is not typically used for aesthetic subunit reconstruction of the philtrum.

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13

A 32-year-old man sustains a fracture of the mandible in a motor vehicle collision. The likelihood of concomitant cervical spine injury in this patient is closest to

- (A) 10%
- (B) 20%
- (C) 30%
- (D) 40%
- (E) 50%

The correct response is Option A.

In patients who sustain facial fractures in motor vehicle collisions, the incidence of cervical spine injury has been shown to range from 5% to 15%, according to the results of multiple studies. Overall, multiple studies have reported the incidence of concomitant injuries associated with facial fractures sustained during motor vehicle collisions as ranging from 11% to 99%. These injuries are most likely to include closed head injuries, soft-tissue lacerations to the face, head, or other regions, and fractures of the ribs, pelvis, and lower extremities.

Because of the correlation between facial fractures and cervical spine injuries, standard Advanced Trauma Life Support (ATLS) protocols recommend that the cervical spine be immobilized until the absence of cervical spine injury can be documented definitively. These injuries can result in paresis, paraplegia, and even death; therefore, the surgeon must maintain a high index of suspicion in any patient who sustains a mandibular fracture in a motor vehicle collision. Even patients who have mandibular fractures resulting from physical altercations should be evaluated carefully, although the incidence of concomitant cervical spine injury is not as high as in those patients who are involved in motor vehicle collisions.

Patients with mandibular fractures often have other associated injuries, such as lacerations of the face and head and other associated facial fractures. These patients should also be evaluated for potential closed head injury, which is a life-threatening concern associated with high mortality rates.

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14

A 5-year-old child who underwent cleft palate repair in infancy has velopharyngeal insufficiency. Nasoendoscopy shows closure of the central velopharyngeal mechanism with residual openings on the left and right. The patient is scheduled to undergo sphincter pharyngoplasty for reconstruction of the pharynx.

This procedure involves transposition of which of the following muscles?

- (A) Buccinator
- (B) Levator veli palatini
- (C) Palatoglossus
- (D) Palatopharyngeus
- (E) Tensor veli palatini

The correct response is Option D.

In this child who is scheduled to undergo sphincter pharyngoplasty, the palatopharyngeus muscle is incorporated within the flap. Two techniques are used primarily for reconstruction of the pharynx in patients with velopharyngeal

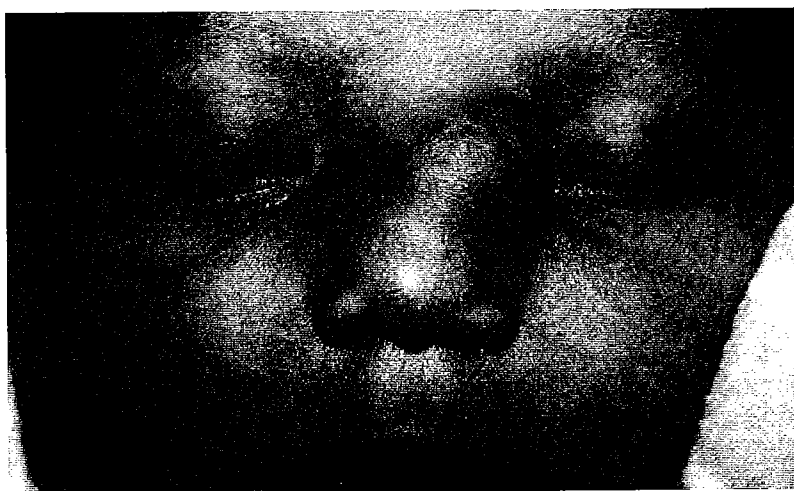
insufficiency. The sphincter pharyngoplasty elevates and insets the posterior tonsillar pillars, which contain the palatopharyngeus muscles, into the posterior pharyngeal wall to create a sphincter. In contrast, during pharyngeal flap reconstruction, a flap of tissue from the posterior pharyngeal wall is elevated and attached to the palate. This procedure is typically reserved for correction of deficits of the central palate.

The levator veli palatini muscle, which is found in the midline of the soft palate, is used only for pharyngeal flap reconstruction, not for sphincter pharyngoplasty. The buccinator muscle lies anterior to the pterygomandibular raphe, the palatoglossus muscles are contained within the anterior tonsillar pillars, and the tensor veli palatini is located anterior to the levator veli palatini. None of these muscles are used in sphincter pharyngoplasty.

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15



A neonate has a reddish 1.5-cm mass of the nasal root with overlying cutaneous telangiectasias. A photograph is shown above. On physical examination, the mass is firm, noncompressible, and nonpulsatile. It does not transilluminate or change with Valsalva maneuver. Which of the following is the most likely diagnosis?

- (A) Dermoid cyst
- (B) Encephalocele
- (C) Glioma
- (D) Hemangioma
- (E) Lipoma

The correct response is Option C.

The findings in this neonate are consistent with a glioma. Nasal gliomas are thought to originate as encephaloceles but fail to maintain their intracranial connections. They may be external, internal, or a combination of both. External

gliomas typically appear at or just lateral to the nasal root. They are reddish, firm, noncompressible, lobular lesions that exhibit telangiectasias of the overlying skin, but do not transilluminate or pulsate. Bony defects, intracranial connections, and cerebrospinal fluid leakage occur only rarely. Histologic evaluation shows astrocytic neuroglial cells and fibrous and vascular connective tissue that is covered with skin or nasal mucosa.

A nasal dermoid cyst arises from a dermoid sinus, which is a cutaneous inward passage lined with stratified squamous epithelium. These masses can also be external or internal. An external nasal dermoid is a firm, noncompressible, nonpulsatile lesion that does not transilluminate and may be lobulated. Although bony defects are infrequent, cerebrospinal fluid leakage and meningitis may occur. Nasal dermoid cysts are derived from ectoderm and mesoderm, lined with squamous epithelium, and contain specialized adnexal structures such as hair follicles, pilosebaceous glands, and smooth muscles.

Encephaloceles involve herniation of cranial tissue through a skull defect. They may be classified as meningoceles (containing meninges only), meningoencephaloceles (containing meninges and brain), or meningoencephalocystoceles (containing meninges, brain, and part of the ventricular system). External, or sincipital, encephaloceles are soft, bluish, compressible, pulsatile masses that are located at the nasal root and transilluminate. They typically enlarge with crying and Valsalva maneuver.

Hemangiomas are raised lesions that arise from a proliferation of endothelial cells. Most appear shortly after birth and involute spontaneously after a period of rapid growth. Discoloration of the overlying skin is often associated.

Lipomas are soft, skin colored, compressible lesions that do not have cutaneous telangiectasias and do not transilluminate or pulsate. They may appear at the nasal root, but are not predisposed to that location.

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16

A 25-year-old woman is scheduled to undergo lip augmentation using dermal allograft. Blockade of the infraorbital and mental nerves will be performed bilaterally. In this patient, direct infiltration of local anesthetic is most likely to be required at which of the following sites?

- (A) Central upper vermillion
- (B) Central lower vermillion
- (C) Commissures
- (D) Cupid's bow
- (E) Philtrum

The correct response is Option C.

Because blockade of the infraorbital and mental nerves alone does not ensure adequate anesthesia of the oral commissures, direct infiltration of local anesthetic into the commissures is likely to be necessary. Although a portion of the sensibility of this region is supplied by contributions from the infraorbital and mental nerves, the greatest contributor is the buccal nerve, which is derived from the mandibular branch of the trigeminal nerve (V_3). The buccal nerve supplies sensation to a large area of skin of the cheek that lies just lateral to the commissure and overlaps the area of the modiolus and buccinator muscle, as well as to a portion of the buccal mucosa on the opposite side of the buccinator. Although the infraorbital nerve may reach the upper half of the commissure and extend to 1.5 cm laterally, the border of this region follows an upward curve away from the commissure.

Bilateral blockade of the infraorbital nerve in the midline provides complete anesthesia to all central components of the upper lip, including the vermillion, cupid's bow, and philtrum. In addition, bilateral mental nerve blocks effectively anesthetize the central section of the lower lip because the regions supplied by these nerves meet in the midline.

References

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17

A 10-month-old boy with uncorrected left coronal synostosis is brought for evaluation by his parents who have noticed that the boy's head is tilted to the right. On physical examination, the head can be straightened to a neutral position easily; there is no palpable mass or firmness within the sternocleidomastoid muscle.

Which of the following is the most likely cause?

- (A) Muscular torticollis
- (B) Paresis of the contralateral superior oblique muscle
- (C) Paresis of the ipsilateral superior oblique muscle
- (D) Paresis of the contralateral superior rectus muscle
- (E) Paresis of the ipsilateral superior rectus muscle

The correct response is Option C.

The most likely cause of the findings in this patient is paresis of the ipsilateral superior oblique muscle. Unilateral coronal synostosis is characterized by foreshortening of the orbital roof on the affected side. As a result, some patients have strabismus occurring secondary to relative paresis of the superior oblique muscle. The child may tilt the head and thus elevate the eye to compensate for this problem; covering the affected eye is likely to resolve the head tilt.

Muscular torticollis is thought to be caused by abnormalities in the sternocleidomastoid muscle. When palpated, the muscle is firm or has a mass. Resistance to passive correction of the abnormal head position is associated. Although

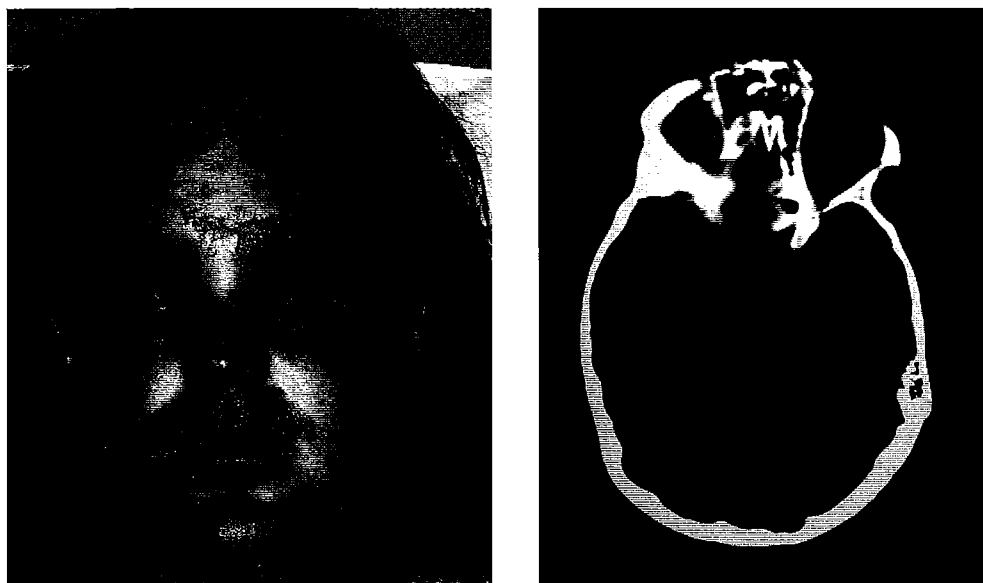
torticollis is unlikely to occur simultaneously with unilateral coronal synostosis, any long-term head tilt, regardless of the cause, may lead to persistent foreshortening of the sternocleidomastoid muscle and ultimately result in secondary torticollis.

Abnormalities may be present within the other extraocular muscles but would not cause these findings.

References

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2. Greenberg MF, Pollard ZF. Ocular plagiocephaly: ocular torticollis with skull and facial asymmetry. *Ophthalmology.* 2000;107:173-178.

18



A 27-year-old man has malocclusion and tenderness around the orbits and bridge of the nose after sustaining facial injuries in a motor vehicle collision. A photograph and CT scan are shown above. The patient is to undergo open reduction and internal fixation of the fractures.

Which of the following is the most appropriate management of the lacrimal system?

- (A) Observation
- (B) Exploration of the lacrimal duct
- (C) Placement of a silicone stent
- (D) Immediate dacryocystorhinostomy
- (E) Primary repair followed by dacryocystorhinostomy in three months

The correct response is Option A.

In this patient who has sustained a naso-orbitoethmoid fracture, the most appropriate management of the lacrimal system is observation. The incidence of injury to the nasolacrimal duct in patients who undergo open reduction and internal fixation of naso-orbitoethmoid fractures but have no overlying lacerations is fairly low. Although swelling or fracture may contribute to blockage of the duct at the time of the initial injury, approximately 90% of patients will experience improvement of symptoms with resolution of the swelling and reduction of the fracture.

Exploration and/or manipulation of the duct are not recommended if there is no obvious injury to the duct. These procedures may only result in further damage because of the edema and friability of the tissues. Immediate dacryocystorhinostomy is not warranted for the same reason.

Patients who have persistent epiphora after resolution of swelling should undergo further evaluation. Dacryocystography can be performed for assessment of possible nasolacrimal duct occlusion. If occlusion is present, dacryocystorhinostomy is indicated.

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19

Which of the following muscles courses around the pterygoid hamulus?

- (A) Levator veli palatini
- (B) Palatoglossus
- (C) Palatopharyngeus
- (D) Tensor veli palatini
- (E) Uvula

The correct response is Option D.

The tensor veli palatini muscle descends from the base of the skull at a point adjacent to the eustachian tube, courses around the hamulus of the pterygoid, and then forms a broad aponeurosis with the contralateral muscle within the anterior soft palate.

The levator veli palatini passes posterior to the pterygoid hamulus and creates a muscular sling that is critical to palatal function. The palatoglossus and palatopharyngeus muscles are components of the palate but do not pass around the hamulus. The musculus uvula is confined within the soft palate and acts to alter the shape of the uvula.

References

1. Clemente CD, ed. *Gray's Anatomy of the Human Body*. 30th ed. Philadelphia, Pa: Lea & Febiger; 1985:1440-41.
2. Moore KL, Dalley AF, eds. *Clinically Oriented Anatomy*. 4th ed. Philadelphia, Pa: Lippincott, Williams & Wilkins; 1999:938-939.

20

In patients with nasal deformities associated with complete unilateral cleft lip, which of the following best describes the displacement of the ala?

- (A) Lateral, inferior, and anterior
- (B) Lateral, inferior, and posterior
- (C) Medial, inferior, and posterior
- (D) Medial, superior, and anterior
- (E) Medial, superior, and posterior

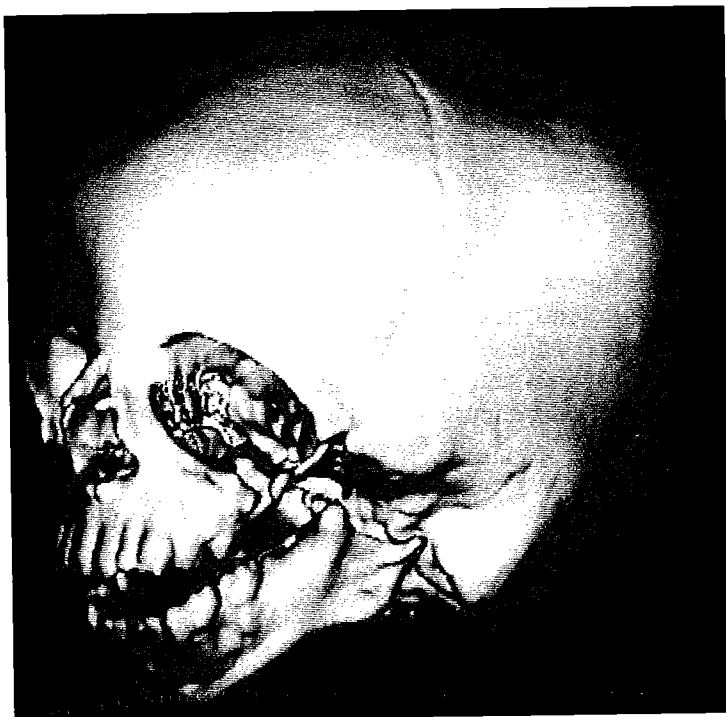
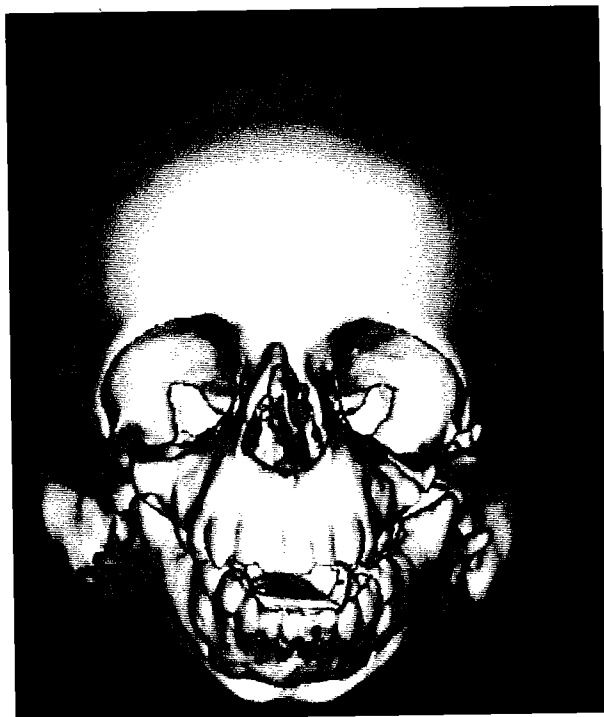


The correct response is Option B.

In patients who have nasal deformities associated with complete unilateral cleft lip, the ala is displaced laterally, inferiorly, and posteriorly. The orbicularis oris inserts onto the alar base abnormally, on the lateral cleft side, and pulls the ala laterally and inferiorly. The medial orbicularis inserts on the nasal spine and caudal septum and pulls these structures to the contralateral side. The piriform rim, which normally supports the ala, is also deficient, allowing the ala to be displaced posteriorly on the side of the cleft.

References

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In the patient who has the findings shown on the three-dimensional CT scans above, which of the following is the most likely diagnosis?

- (A) Craniofacial microsomia
- (B) Crouzon syndrome
- (C) Goldenhar syndrome
- (D) Romberg syndrome
- (E) Treacher Collins syndrome

The correct response is Option E.

These findings are consistent with Treacher Collins syndrome, also known as mandibulofacial dysostosis or Franceschetti-Klein syndrome. The skeletal deformity seen in the CT scan represents bilateral Tessier No. 6, 7, and 8 clefts. Varying hypoplasia of the zygoma is a differentiating feature of this condition. Occlusion is Angle class II, with an anterior open bite.

There are numerous characteristic findings in patients with Treacher Collins syndrome. The orbit is oval or egg-shaped and has a superomedial base and inferolaterally oriented axis. A cleft in the inferolateral orbital floor allows for herniation of the orbital contents into the cheek. The inferior orbital rim, lateral orbital wall, and orbital floor are underdeveloped or absent. In contrast, the maxilla protrudes, and the palatal plane is rotated counterclockwise or upward and posteriorly. There is micrognathia and decreased length of the mandibular ramus and body, with broad curvature of the inferior aspect of the mandibular body. The condyle is hypoplastic or absent. The gonial angle is obtuse with antegonial notching. The chin is dysplastic, vertically long, and retrusive.

Craniofacial microsomia is typically hemifacial but can occur bilaterally. Hemifacial microsomia is associated with a Tessier No. 7 cleft. There are varying degrees of mandibular hypoplasia. The forehead, orbit, and zygoma may also be hypoplastic. Anophthalmia and microtia occur in the most severe cases. Clefting of the lateral orbit and antegonial notching are not characteristic features.

Crouzon syndrome is a syndrome of bilateral coronal synostosis or acrocephalosyndactyly. Affected patients have retrusion of the forehead and superior orbital rim, proptosis caused by shallow orbits, and midface hypoplasia. Occlusion is Angle class III.

Goldenhar syndrome is a subset of hemifacial microsomia and is characterized by epibulbar dermoids and anomalies of the scapula and/or spine.

Romberg syndrome, or progressive hemifacial atrophy, appears initially as cutaneous pigmentation in otherwise healthy patients but progresses to destruction of the facial soft tissues and skeleton. This is a hemifacial condition that varies in severity.

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22

In mandibular distraction osteogenesis, the central region of the distraction gap is described as which of the following zones?

- (A) Chondrocytic zone
- (B) Fibrous zone
- (C) Remodeling bone zone
- (D) Transition zone of extending bone
- (E) Zone of mature bone formation

The correct response is Option B.

In mandibular distraction osteogenesis, the central region of the distraction gap is referred to as the fibrous zone because it is characterized by fibrous tissue. The transitional zone, which lies adjacent to the fibrous zone, contains fibrous tissue undergoing ossification. This zone is surrounded by the zone of remodeling bone, which is itself surrounded by the zone of mature bone.

Chondrocytes are only present in mandibular distraction osteogenesis when there is excessive motion.

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23

Which of the following nerves supplies sensory innervation to the buccal mucosa?

- (A) Trigeminal (V) nerve
- (B) Facial (VII) nerve
- (C) Glossopharyngeal (IX) nerve
- (D) Vagus (X) nerve
- (E) Lingual nerve

The correct response is Option A.

The buccal branch of the trigeminal (V) nerve provides sensation to the buccal mucosa. It is important for the surgeon to know the anatomy of this nerve branch to plan and perform neurotized free flap reconstruction and reinnervation of the intraoral cavity.

The buccal branch of the facial (VII) nerve innervates the muscles surrounding the buccal mucosa.

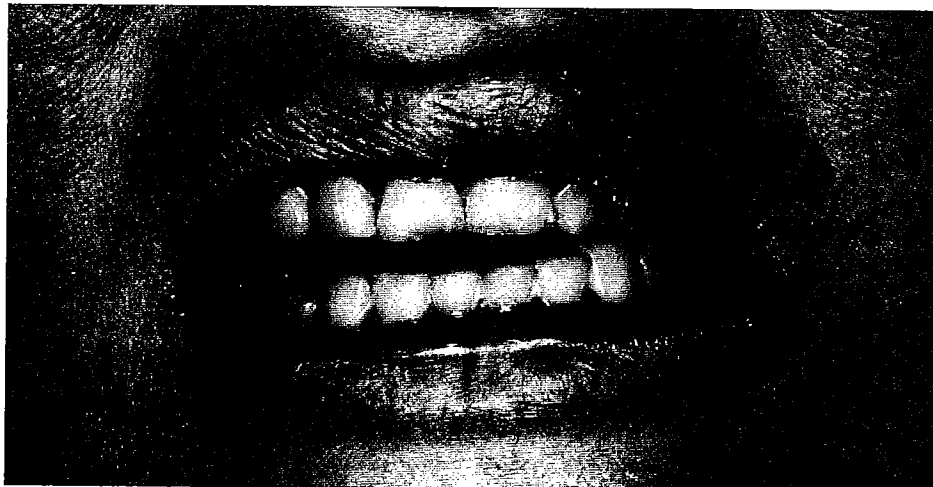
The glossopharyngeal (IX) and vagus (X) nerves do not provide sensory innervation to the intraoral mucosa.

The lingual nerve provides sensation to a portion of the tongue.

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2. Marieb EN, ed. Overview of the digestive system. In: *Human Anatomy and Physiology.* Redwood City, Ca: Benjamin/Cummings Publishing; 1995.

24



A 25-year-old man has trismus and malocclusion after being involved in a fistfight. A photograph is shown on page 22. These findings are most consistent with which of the following fracture types?

- (A) Bilateral condylar
- (B) Left-sided condylar
- (C) Right-sided condylar
- (D) Right-sided ramus
- (E) Symphyseal

The correct response is Option B.

This patient has an upward cant of the mandibular arch to the left and premature contact of the molars on the left, as shown in the photograph. These findings are consistent with a left-sided condylar fracture. Unilateral condylar fractures often result in trismus and loss of ipsilateral posterior vertical height of the mandible. This loss of height leads to premature closure ipsilaterally, with premature contact of the molars and a contralateral lateral open bite.

Bilateral condylar fractures result in a loss of posterior vertical height bilaterally, causing an anterior open bite that is often symmetric and is not associated with an upward cant of the mandibular arch.

A fracture of the mandibular ramus may also be characterized by loss of posterior vertical height of the mandible ipsilaterally and premature contact of the ipsilateral molars, resulting in a lateral open bite contralaterally.

Symphyseal fractures typically result in a step-off deformity of the anterior mandibular teeth with disruption of the anterior mandibular arch. Unilateral open bite is not characteristic.

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25

A 6-year-old boy who underwent repair of a right-sided unilateral cleft lip and palate in infancy has an unrepaired alveolar cleft. Which of the following best describes the malocclusion on the cleft side in this patient?

- (A) Angle class II, division I
- (B) Angle class II, division II
- (C) Deep overbite
- (D) Excessive overjet
- (E) Posterior crossbite

The correct response is Option E.

A child with an unrepaired alveolar cleft will exhibit collapse of the maxillary arch. The arch is deficient in all dimensions: anteroposterior, transverse, and vertical. Therefore, this child will have posterior crossbite of the maxillary dentition with respect to the mandibular dentition. In patients with crossbite, the lower dentition is positioned labial to the upper dentition; this is the opposite of normal occlusion. The arch form should be corrected orthodontically and dental compensation should be eliminated prior to bone grafting of the alveolar cleft.

The Angle classification of occlusion is based on the relationship of the mesiobuccal cusp of the maxillary first molar to the buccal groove of the mandibular first molar. 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, and in class II, division 2, the incisors are lingually inclined. In Angle class III malocclusion, the mesiobuccal cusp of the maxillary first molar lies distal (posterior) to the buccal groove of the mandibular first molar and is located instead in the buccal groove of the mandibular second molar.

Overbite describes the distance between the maxillary and mandibular incisors in the vertical plane with the jaws in centric occlusion, and overjet describes the distance between the maxillary and mandibular incisors in the horizontal plane with the jaws in centric occlusion.

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3. Vlachos CC. Orthodontic treatment for the cleft palate patient. *Semin Orthod*. 1996;2:197-204.

26

A 29-year-old man is involved in a fistfight and sustains bilateral fractures of the mandible in the region of the canine teeth. On examination, the fractures are vertically and horizontally unstable. The central segment of the mandible is most likely to be displaced in which of the following directions?

- (A) Downward and anterior
- (B) Downward and posterior
- (C) Rotationally
- (D) Upward and anterior
- (E) Upward and posterior

The correct response is Option B.

This 29-year-old man has sustained bilateral fractures of the mandible that are located in the region of the canine teeth and are unstable both vertically and horizontally. Therefore, the central segment is most likely displaced downward and posteriorly due to the action of the anterior bellies of the digastric muscles and the geniohyoid and genioglossus muscles. In addition, the power of the mylohyoid muscle pulls the posterior fracture segments medially.

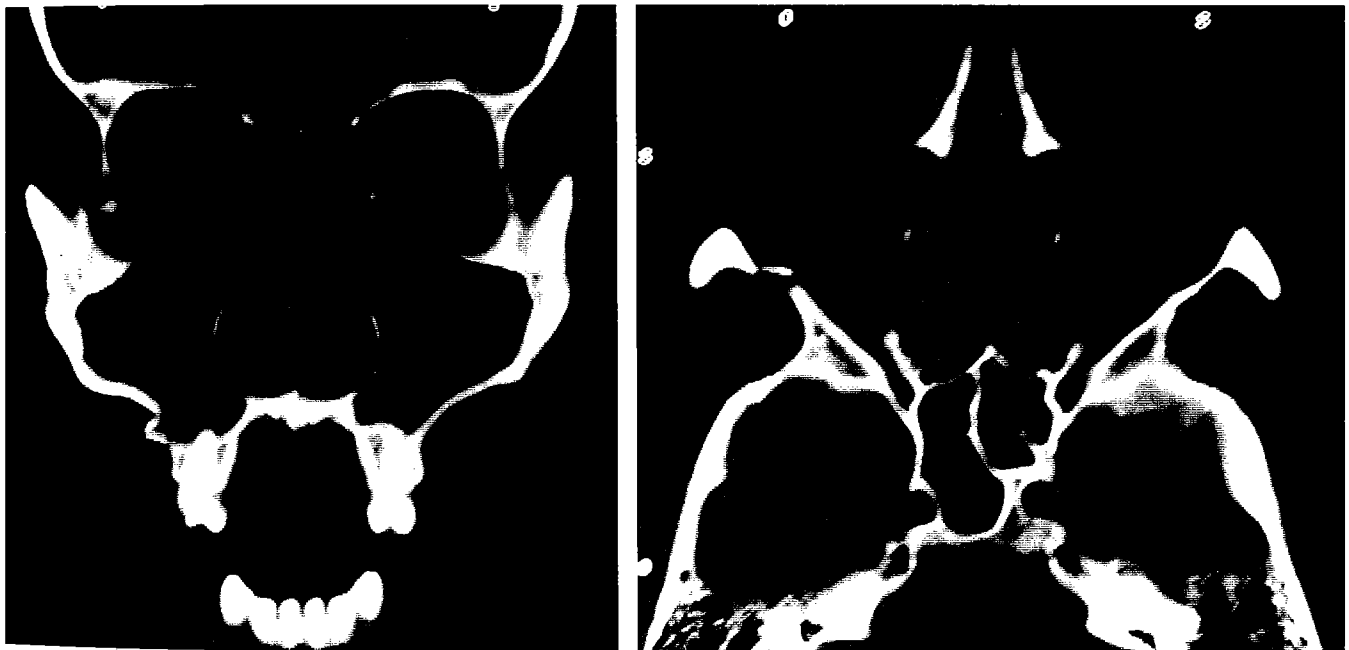
Rotational displacement of the central segment may occur if the fracture is stable either vertically or horizontally because the action of the muscles would then be opposed partially. Rotational displacement is characterized by hinging of the central segment on the upper or lower border of the mandible.

Upward and anterior displacement occurs only if the central fragment becomes detached from surrounding muscles, which is unlikely.

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27



The CT scans shown above are from a 25-year-old man who sustained facial injuries in a motor vehicle collision. In this patient, rigid fixation at which of the following points is most likely to result in stable reduction of the fractures?

- (A) Nasomaxillary buttress, inferior orbital rim, and zygomaticomaxillary buttress
- (B) Zygomatic arch, central fragment, and nasomaxillary buttress
- (C) Zygomatic arch, inferior orbital rim, and zygomaticomaxillary buttress
- (D) Zygomaticofrontal suture, inferior orbital rim, and zygomaticomaxillary buttress
- (E) Zygomaticofrontal suture, orbital floor, and zygomaticomaxillary buttress

The correct response is Option D.

This patient has sustained a fracture of the zygomaticomaxillary complex, also known as a zygoma fracture. To ensure stable reduction of the fracture, rigid fixation is applied at the zygomaticofrontal suture, inferior orbital rim, and zygomaticomaxillary buttress. Partial relapse may occur without this three-point rigid fixation.

Central fragments are associated with naso-orbitoethmoid fractures, not zygomaticomaxillary complex fractures. This fragment is comprised of the ascending frontal process of the maxilla and the descending internal angular process of the frontal bone. It provides the bony support for the medial canthus.

The nasomaxillary buttress is comprised of the piriform rim and is osteotomized routinely during elective Le Fort I maxillary advancement procedures. This structure is typically involved in midface fractures and not in fractures of the zygomaticomaxillary complex.

The orbital floor is often involved in zygomaticomaxillary complex fractures but not in simple fractures of the zygoma. Therefore, open reduction and internal fixation of the orbital floor may not be necessary to ensure correction of the zygomaticomaxillary fracture.

The zygomatic arch is contained within a periosteal sleeve and is often reduced and fixed adequately with adequate reduction and fixation of the zygomaticomaxillary complex. Open reduction and internal fixation through a coronal approach may be required if the zygomatic arch is comminuted significantly, but this is rare.

References

1. Crawley WA, Vasconez H. Midface, upper face, and panfacial fractures. In: Ferraro JW, ed. *Fundamentals of Maxillofacial Surgery*. New York, NY: Springer-Verlag; 1997:203-214.
2. Manson P. Facial fractures. In: Aston SJ, Beasley RW, Thorne CH, eds. *Grabb & Smith's Plastic Surgery*. 5th ed. Philadelphia, Pa: Lippincott-Raven; 1997:383.

28

The most common type of nonsyndromic single-suture craniosynostosis involves premature closure of which of the following sutures?

- (A) Coronal
- (B) Lambdoid
- (C) Metopic
- (D) Sagittal
- (E) Squamosal

The correct response is Option D.

Sagittal synostosis is the most common type of nonsyndromic single-suture craniosynostosis. It occurs in approximately 50% of patients with single-suture fusions. This condition manifests as an elongated skull with varying degrees of frontal and occipital bossing.

Fusion of the coronal suture may be unilateral or bilateral. Unilateral fusion is known as plagiocephaly and is characterized by flattening of the forehead and supraorbital bar on the affected side. Bilateral fusion results in turribrachycephaly, which is a shortened, wide skull with increased vertical height at the top of the skull.

Fusion of the lambdoid suture is extremely rare, occurring in only 1% to 2% of all patients with craniosynostosis.

Metopic suture fusion is known as trigonocephaly, which involves a prominent midline ridge in the forehead. This type of craniosynostosis comprises approximately 10% of all single-suture fusions.

The squamosal suture lies between the temporal and parietal bones; isolated fusion of this suture does not occur.

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29

A 38-year-old woman sustains an injury to the auriculotemporal nerve during superficial parotidectomy for removal of a mixed tumor. Which of the following is the most likely postoperative finding?

- (A) Numbness of the concha, helix, lobule, and temporal skin
- (B) Numbness of the tragus, external auditory canal, and temporal skin
- (C) Numbness of the entire pinna and paralysis of the temporalis muscle
- (D) Paralysis of the auricularis anterior, superior, and posterior muscles
- (E) Paralysis of the temporalis muscle

The correct response is Option B.

Injury to the auriculotemporal nerve is most likely to result in numbness of the tragus, external auditory meatus, tympanum, and temporal skin. The auriculotemporal nerve is a branch of the mandibular division of the trigeminal nerve (V_3). The fascicles of this nerve divide soon after the nerve originates to allow for passage of the middle meningeal artery. The nerve then courses between the sphenomandibular ligament and the neck of the condyle, emerges from behind the temporomandibular joint, and travels toward the posterior surface of the upper portion of the parotid gland, where it may be vulnerable to injury during parotidectomy. It ascends with the superficial temporal vessels over the posterior zygomatic arch and divides into three branches, which provide cutaneous sensory innervation to the tragus, external acoustic meatus, tympanic membrane, and temporal region. Minor branches of the auriculotemporal nerve convey secretomotor fibers to the parotid gland and articular fibers to the temporomandibular joint.

The concha and antihelix receive sensory innervation from the auricular branch of the vagus (X) nerve. Sensory innervation to the helix and lobule is supplied by the great auricular nerve and lesser occipital nerve, which are derived from C2-3.

The auricularis anterior, superior, and posterior muscles receive motor innervation from the temporal and posterior auricular branches of the facial (V) nerve.

The temporalis muscle is innervated by the deep temporal nerves, which are derived from the anterior, or motor, branch of the mandibular division of the trigeminal nerve (V_3).

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30



A 15-year-old girl with Apert syndrome has the deformity shown in the photograph and radiograph above. She underwent bifrontal craniotomy with bilateral supraorbital bar advancement at age 9 months. On examination, 25 mm of midface advancement is needed. Which of the following operative procedures is most appropriate?

- (A) Monobloc advancement
- (B) Le Fort I osteotomy with immediate advancement with bone grafting
- (C) Le Fort I osteotomy with advancement by distraction osteogenesis
- (D) Le Fort III osteotomy with immediate advancement with bone grafting
- (E) Le Fort III osteotomy with advancement by distraction osteogenesis

The correct response is Option E.

In this 15-year-old girl with Apert syndrome who requires 25 mm of midface advancement, the most appropriate management is Le Fort III osteotomy with distraction osteogenesis. Although the forehead and superior orbital bar are positioned appropriately, there is deficiency and retrusion of the midface and malocclusion. Le Fort III osteotomy will correct the midface deficiency and the skeletal portion of the malocclusion. Distraction osteogenesis is preferred over bone grafting for advancement of more than 10 mm because it produces a more stable result that is less prone to relapse and allows for more gradual stretching of the soft-tissue envelope. Distraction osteogenesis is also associated with a lower rate of morbidity and less need for secondary midface procedures when compared with bone grafting.

Monobloc advancement will correct the midface retrusion and malocclusion but will also advance the forehead.

Le Fort I osteotomy and advancement with either bone grafting or distraction osteogenesis will not correct the midface deficiency.

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31

In infants with hemifacial microsomia, which of the following deformities should be corrected initially?

- (A) Abnormalities of the temporomandibular joint abnormalities
- (B) Auricular deformities
- (C) Deficiency of the mandibular ramus
- (D) Deficiency of the mandibular body
- (E) Macrostomia

The correct response is Option E.

Hemifacial microsomia is a condition associated with embryologic abnormalities involving the first and second branchial arches, including a Tessier No. 7 cleft. It is characterized by incomplete development of the external and middle ear, mandible, zygoma, maxilla, temporal bone, parotid gland, tongue, and the muscles of the palate and those that control mastication and facial expression. Affected patients have multiple clinical manifestations such as macrostomia, first branchial cleft sinus, and abnormalities of the cranial nerves.

Multiple procedures are necessary to reconstruct the face in patients with hemifacial microsomia. Macrostomia repair should be performed within the first few months after birth, similar to a typical cleft lip repair. Skeletal and soft-tissue repair is indicated at age 5 to 6 years. The mandibular deformities are typically corrected first, followed by the maxillary defects. Correction of soft-tissue deformities is generally delayed until skeletal reconstruction has been completed.

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32

Which of the following structures passes through the foramen ovale?

- (A) Accessory nerves
- (B) Optic (II) nerve
- (C) Ophthalmic division of the trigeminal nerve (V_1)
- (D) Maxillary division of the trigeminal nerve (V_2)
- (E) Mandibular division of the trigeminal nerve (V_3)

The correct response is Option E.

The mandibular division of the trigeminal nerve (V_3) passes through the foramen ovale. This foramen is located in the region of the superior orbital fissure, which contains the nerves to the extraocular muscles, sympathetic fibers, and vessels and is found within the middle cranial fossa.

The accessory nerves, glossopharyngeal (IX) nerve, and vagus (X) nerve pass through the foramen jugulare.

The optic foramen transmits the optic (II) nerve and ophthalmic artery.

The ophthalmic division of the trigeminal nerve (V_1) passes through the superior orbital fissure.

The foramen rotundum transmits the maxillary division of the trigeminal nerve (V_2).

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A 40-year-old woman has a painless mass at the angle of the left mandible that has been enlarging over the past 10 years; a photograph and CT scan are shown above. Findings on physical examination are otherwise normal. Histologic examination of a biopsy specimen of the tumor shows luminal-type ductal cells mixed with sheets of myoepithelial cells and a mucoid extracellular matrix.

Which of the following is the most likely diagnosis?

- (A) Basal cell adenoma
- (B) Myoepithelioma
- (C) Pleomorphic adenoma
- (D) Sjögren's syndrome
- (E) Warthin tumor

The correct response is Option C.

The most likely diagnosis in this patient is pleomorphic adenoma, or mixed tumor. This is the most common benign tumor of the parotid gland, comprising 65% of all salivary gland neoplasms, 55% of all parotid masses, and 80% of all benign parotid tumors. Most pleomorphic adenomas arise from within the superficial lobe of the gland; only 10% are located deep to the facial nerve. These encapsulated tumors contain both epithelial and mesenchymal elements within a stroma, which can vary from mucoid to myxoid to chondroid. Because small lobules of cells may extend beyond the capsule, simple enucleation frequently results in tumor recurrence. Therefore, appropriate management is superficial lobe parotidectomy with preservation of the facial nerve.

Basal cell adenoma is the most common type of monomorphic adenoma found in the minor salivary glands of the upper lip. These tumors rarely occur in the parotid gland. Histologic examination is most likely to show rows of palisading cells with a thickened basement membrane.

Myoepithelioma is a well-circumscribed benign tumor that arises from myoepithelial cells. This tumor is rare and typically affects the parotid gland or palate. Although it is clinically similar to pleomorphic adenoma, histologic examination shows spindle cells.

Sjögren's syndrome is an autoimmune disease occurring most frequently in women and is characterized by destruction of the exocrine glands due to immune-related mechanisms. When associated with rheumatoid arthritis, it is known as secondary Sjögren's syndrome. Unilateral or bilateral salivary gland swelling, frequently affecting the parotid gland, is present in 80% of patients with primary Sjögren's syndrome and 40% of patients with secondary disease. Additional distinguishing findings include xerostomia, interstitial pneumonitis, Raynaud's phenomenon, lymphadenopathy, purpura, pancreatitis, renal disease, and recurrent parotitis.

Warthin tumor, or papillary cystadenoma lymphomatosum, is a slow-growing multicystic mass most frequently seen in men between the ages of 40 and 70 years. It is almost always localized to the parotid gland and rarely occurs in the submandibular gland. Warthin tumors comprise 10% of all parotid tumors; 10% of affected patients have multicentric lesions, while another 10% have bilateral findings. Histologic examination shows a papillary epithelium containing lymphoid stroma that projects into cystic spaces.

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34

During embryologic development, which of the following structures arises from the lateral nasal processes?

- (A) Columella
- (B) Nasal bridge
- (C) Nasal tip
- (D) Nasal ala
- (E) Nasal septum

The correct response is Option D.

The nasal structures form during the sixth week of gestation as the medial nasal processes enlarge and coalesce in the midline. Any abnormalities that occur during formation of the nasal structures may result in deformity, such as the cleft nasal deformity.

The nasal alae arise from the lateral nasal processes. The medial nasal processes give rise to the columella, nasal tip, philtrum, and premaxilla. The bridge and root of the nose arise from the frontonasal processes.

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35

Which of the following muscles of mastication pulls the mandible upward, medially, and forward?

- (A) Anterior digastric
- (B) Masseter
- (C) Medial pterygoid
- (D) Mylohyoid
- (E) Temporalis

The correct response is Option C.

Knowledge of the muscles of the mandibular region and their functions in the movement of the mandible and displacement of fracture segments is crucial to accurately diagnosing and effectively treating facial fractures.

The medial pterygoid muscle exerts upward, medial, and forward traction on the mandible. This muscle arises inferiorly, laterally, and posteriorly from the medial surface of the pterygoid plate and inserts on the medial ramus and mandibular angle. Contraction of the medial pterygoid muscle pulls the mandible medially, elevating the lower jaw. A patient who sustains a fracture medial to the mandibular angle has displacement of the mandibular ramus medially and cephalad because of the forces of this muscle.

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, while the posterior belly of the digastric extends between the hyoid bone and mastoid notch of the temporal bone. The digastric muscle is part of the suprahyoid musculature, which in a patient with a mandibular fracture would pull the anterior mandibular fragments posteroinferiorly.

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. In patients with zygomatic fractures, displacement of the zygoma is exacerbated by the chronic active traction of the masseter muscle. When performing open reduction of a zygomatic fracture, 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.

Because the bundles of the mylohyoid muscle join in the midline to form the muscular floor of the mouth, this muscle has only minimal influence on the movement of the mandible and hyoid bone. Instead, the mylohyoid functions to elevate the tongue.

The temporalis muscle elevates and retracts the mandible. In patients with subcondylar fractures, this muscle may elevate the mandibular ramus, resulting in loss of posterior facial height.

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36

Premature fusion of which of the following sutures is most often associated with abnormalities in the corpus callosum?

- (A) Coronal
- (B) Lambdoid
- (C) Metopic
- (D) Squamosal
- (E) Sagittal

The correct response is Option C.

Premature fusion of the metopic suture, or trigonocephaly, is most often associated with abnormalities of the corpus callosum or other neurologic structures in the midline of the skull. Agenesis of the corpus callosum is a common abnormality. Children with trigonocephaly also have a higher than expected incidence of developmental delay.

Premature fusion of the coronal, lambdoid, or sagittal sutures is less likely to be associated with underlying neurologic abnormalities. The squamosal suture does not typically fuse prematurely.

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37

According to the Angle classification, which of the following permanent teeth are used to determine the class of dental occlusion?

- (A) Central incisors
- (B) Lateral incisors
- (C) First premolars
- (D) Second premolars
- (E) First molars

The correct response is Option E.

According to the Angle classification, the permanent first molars are used to determine the class of dental occlusion. Angle class I, or normal, occlusion is defined as the mesiobuccal cusp of the maxillary first molar lying in the buccal groove of the mandibular first molar. In Angle class II malocclusion, the mesiobuccal cusp of the maxillary first molar lies mesial (anterior) to the buccal groove of the mandibular first molar. Angle class III malocclusion is defined as the mesiobuccal cusp of the maxillary first molar lying distal (posterior) to the buccal groove of the mandibular first molar and being located instead in the buccal groove of the lower second molar.

The central incisors are used to determine overbite and overjet. Both overbite and overjet refer to the distance between the maxillary and mandibular incisors; overbite is measured vertically, and overjet is measured horizontally. In reverse overjet, which can occur in patients with Angle class III malocclusion, the maxillary central incisor lies distal (posterior) to the mandibular incisor.

The premolars and lateral incisors are less relevant than the molars and central incisors in the evaluation of occlusion.

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38

A neonate is undergoing evaluation because of airway obstruction. Physical examination shows retrogenia and glossoptosis. Which of the following is the most appropriate initial management of the airway obstruction?

- (A) Prone positioning
- (B) Orotracheal intubation
- (C) Lip-tongue adhesion
- (D) Tracheostomy
- (E) Mandibular distraction osteogenesis

The correct response is Option A.

This neonate has the triad of symptoms associated with Pierre Robin sequence: retrogenia, glossoptosis, and respiratory distress. Approximately 50% of neonates with Pierre Robin sequence have a high-arched cleft in the midline of the soft palate; clefting of the hard palate also occurs in some patients. Glossoptosis is associated with airway obstruction, increased expenditure of energy, and impaired feeding resulting from decreased caloric intake. These feeding difficulties and failure to thrive can be fatal if not managed properly.

The most appropriate initial management of airway obstruction is to place the neonate in the prone position, which relieves the glossoptosis and opens the airway. In some infants, this position must be maintained constantly, even during feeding, bathing, and diaper changing. Intubation may be necessary if prone positioning does not resolve the respiratory distress.

Lip-tongue adhesion, tracheostomy, and mandibular distraction osteogenesis are secondary procedures that should only be considered if prone positioning is unsuccessful.

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39

A 25-year-old man has diplopia two days after sustaining an orbital fracture in a motor vehicle collision. On physical examination, he does not have enophthalmos; review of CT scans obtained immediately after injury shows no bony displacement or entrapment of the orbital contents within the fracture.

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

- (A) Observation
- (B) Administration of a corticosteroid
- (C) Administration of a diuretic
- (D) MRI
- (E) Immediate operative exploration

The correct response is Option A.

Conservative management is recommended in this patient who has diplopia after sustaining an undisplaced, stable orbital fracture without entrapment or enophthalmos. Diplopia often occurs following orbital trauma and may be caused by edema, neurovascular or muscle injury, or entrapment of surrounding structures within the fracture. If entrapment is the cause, surgical release should be performed within the first 24 to 48 hours after injury to prevent permanent muscle damage. However, if there is no entrapment, as in this patient, observation for 10 to 14 days is most appropriate. This will allow for resolution of any edema or temporary palsy. Repeat evaluation can then be performed at this time.

CT scan, not MRI, is most appropriate for evaluating the condition of the fracture site.

Corticosteroids or diuretics are not indicated in patients who have diplopia following orbital fracture.

Operative exploration is appropriate for reduction of bony fragments, release of entrapped, compressed, or prolapsed tissues, and accurate restoration of orbital volume, but is not the most appropriate next step in this patient.

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40

Mutations in the genetic loci for the fibroblast growth factor receptors (FGFR) have been shown to occur with greater frequency in patients with synostosis of which of the following sutures?

- (A) Coronal
- (B) Lambdoid
- (C) Metopic
- (D) Sagittal
- (E) Squamosal

The correct response is Option A.

Mutations in the genetic locus for fibroblast growth factor receptor 3 (FGFR-3) have been found, in a greater than expected incidence, in both unilateral and bilateral coronal synostoses. Although these craniofacial malformations are thought to occur sporadically, this genetic link may explain the familial occurrence of coronal synostosis in some patients.

According to the results of recent studies, the craniofacial dysmorphology was more severe in patients who had the FGFR-3 mutation than in patients who did not carry the mutation, and outcomes of reconstructive surgery were poorer.

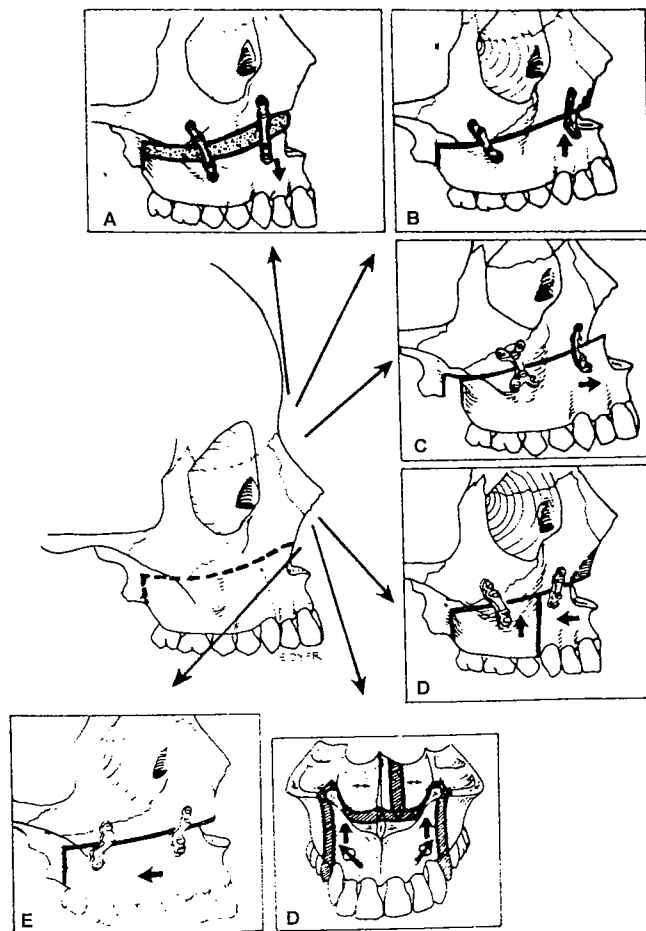
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41

Le Fort I osteotomy is performed through which of the following structures?

- (A) Lateral orbital wall
- (B) Maxillary sinus
- (C) Medial orbital walls
- (D) Nasofrontal junction
- (E) Orbital floor



The Le Fort I osteotomy sections the maxilla transversely at a level between the roots of the teeth (note that the root of the cuspid may extend as high as the piriform rim) and the infraorbital foramen. After the lower portion of the maxilla is mobilized, movement in a number of directions is possible. **A:** Lengthening of the maxilla with an interpositional bone graft (not the use of miniplates for fixation). **B:** Shortening of the maxilla after resection of bone above the osteotomy line. **C:** Advancement of the maxilla. **D:** Segmentalization of the maxilla after down-fracture and extraction of teeth. **E:** Setback of the maxilla.

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The correct response is Option B.

The Le Fort classification is used to identify the pattern of midface fractures. Identification of the lines of fracture is useful in planning osteotomies for patients requiring midface advancement.

Le Fort I midface advancement involves placement of the osteotomy at a level above the apices of the teeth. The entire alveolar processes of the maxilla, vault of the palate, and pterygoid processes are included in a single block. The osteotomy extends transversely across the base of the maxillary sinus and the floor of the piriform aperture.

The Le Fort II osteotomy begins above the level of the apices of the teeth laterally and extends through the pterygoid plates in a manner similar to the Le Fort I osteotomy, leaving a central maxillary segment undisturbed. The osteotomy procedure includes portions of the medial orbital walls, orbital floor, and nasofrontal junction. Patients undergoing Le Fort II midface advancement are at increased risk for injury to the ethmoid area and the lacrimal system. The lateral orbital wall is unaffected.

Le Fort III osteotomy extends through the zygomaticofrontal suture and the nasofrontal suture and across the orbital floor. The entire midface is completely detached from the base of the skull.

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42

The external auditory meatus develops from which of the following embryologic structures?

- (A) First branchial arch
- (B) Second branchial arch
- (C) Third branchial arch
- (D) First branchial groove
- (E) Second branchial groove

The correct response is Option D.

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.

During the sixth week of gestation, six hillocks appear on the first (mandibular) and second (hyoid) branchial arches, which give rise to the auricle. The first branchial arch gives rise to the anterior (first through third) hillocks, and the second branchial arch gives rise to the posterior (fourth through sixth) hillocks. By the end of the eighth week of gestation, the auricle assumes its characteristic shape following differential growth and fusion of the hillocks.

The external auditory meatus develops from the dorsal aspect of the first branchial groove, which is a cleft between the first and second branchial arches.

The second, third, and fourth branchial grooves are obliterated within the cervical sinus during the later stages of embryologic development. The cervical sinus develops as a result of caudal overgrowth of the second branchial arch.

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43

Which of the following cranial nerves provides innervation to the temporalis muscle?

- (A) Ophthalmic division of the trigeminal nerve (V_1)
- (B) Maxillary division of the trigeminal nerve (V_2)
- (C) Mandibular division of the trigeminal nerve (V_3)
- (D) Abducens (VI) nerve
- (E) Facial (VII) nerve

The correct response is Option C.

The temporalis muscle receives its innervation primarily from the branches of the mandibular division of the trigeminal nerve (V_3), which then exits the skull via the foramen ovale. The motor branches of the buccal, masseteric, and mandibular nerves are derived from V_3 and act to innervate the temporalis muscle. This muscle is a large, powerful muscle of mastication that originates along the temporal crest of the skull and inserts into the coronoid process of the mandible.

The ophthalmic division of the trigeminal nerve (V_1) provides sensation to the forehead and anterior scalp; this nerve branch exits the skull through the supraorbital foramen.

The maxillary division of the trigeminal nerve (V_2) provides sensation to the cheek and upper lip and to the upper teeth via the superior alveolar nerve. This nerve branch is transmitted through the infraorbital foramen.

The abducens (VI) nerve provides motor innervation into the lateral rectus muscle of the eye.

The facial (VII) nerve provides motor innervation to the muscles of facial expression.

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44

Hyphema results from traumatic hemorrhage of which of the following ocular structures?

- (A) Anterior chamber
- (B) Conjunctiva
- (C) Lens
- (D) Posterior chamber
- (E) Vitreous chamber

The correct response is Option A.

Hyphema is traumatic hemorrhage of the anterior chamber of the eye, typically resulting from blunt trauma to ocular structures. The anterior chamber of the eye is bordered by the cornea anteriorly and the iris and central portion of the lens posteriorly. This structure is filled with aqueous humor originating from the ciliary processes in the posterior chamber and flowing through the pupil into the anterior chamber. In patients with hyphema, vessels are torn in the iris or in the ciliary body, leading to onset of hemorrhage. The blood collects in the most inferior section of the anterior chamber, obscuring the lower portion of the iris.

Significant hyphema may result in increased ocular pressure and/or permanent staining of the cornea. Because of the potential for these complications, screening is recommended in patients with facial trauma, and ophthalmologic referral is indicated in any patient with positive findings. Treatment involves administration of acetazolamide and corticosteroid eye drops to decrease ocular tension.

Bleeding that occurs in the bulbar or palpebral conjunctiva is referred to as subconjunctival hemorrhage. This condition is seen in patients with facial trauma and results from extravasation of conjunctival capillaries. It also occurs in association with zygomatic fractures that extend through the lateral orbital wall in which there is bleeding along the side of the orbit and into the subconjunctival interstitium. Treatment of the fracture is likely to resolve the hemorrhage.

The lens is an avascular structure that does not retain blood. Instead, it may subluxate or dislocate and cause a premature cataract.

The posterior chamber is located behind the iris and anterior to the suspensory ligament; it appears as a halo around the lens. Although this chamber adjoins the ciliary processes, which may hemorrhage, the blood is not retained within it, but instead flows into the anterior chamber.

The vitreous chamber is bordered by the lens and suspensory ligaments anteriorly and the retina posteriorly. It contains a dense, jelly-like fluid that maintains slight pressure and provides even contact of the retina against the choroid. In patients with retinal hemorrhages, the blood typically remains within the retinal tissue. Debris or blood that is released into the vitreous body is consumed by phagocytic cells or remains as vitreal floaters within the chamber.

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Which of the following is the most common complication of sagittal split osteotomy?

- (A) Avascular necrosis of the proximal segment
- (B) Injury to the mandibular molars
- (C) Loss of lower lip sensibility
- (D) Nonunion of the osteotomy site
- (E) Relapse from incorrect positioning of the condyles at surgery

The correct response is Option C.

The most common complication of sagittal split osteotomy is loss of lower lip sensibility. Studies have shown a significant incidence of both temporary and permanent disruption of sensibility in the lower lip following this procedure.

Sagittal split osteotomy involves only minimal muscle stripping on the lateral aspect of the mandible. The blood supply to the proximal bony segment is adequate, and the incidence of avascular necrosis is minimal.

Because the roots of the mandibular molars are closer to the lingual cortex than to the buccal cortex, they are not typically injured during osteotomy.

Nonunion is an extremely rare complication of sagittal split osteotomy.

During the osteotomy procedure, the proximal segment and condyle are seated gently into the fossa, and the surgeon takes great care to avoid displacing the condyle anteriorly and downward on the temporal bone. As a result, relapse from incorrect positioning occurs only rarely.

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46

Which of the following craniofacial anomalies does NOT demonstrate genetic transmission?

- (A) Acrocephalosyndactyly
- (B) Apert syndrome
- (C) Craniofacial microsomia
- (D) Mandibulofacial dysostosis
- (E) Nager syndrome

The correct response is Option C.

Craniofacial microsomia is the most common major craniofacial anomaly and does not demonstrate genetic transmission. Instead, it is believed to be caused by an intrauterine event, such as occlusion of the stapedia artery or development of hematoma. Craniofacial microsomia is far more likely to be unilateral (hemifacial) than bilateral. It manifests as facial paralysis and malformations of the mandibular ramus. Growth of the mandibular condyle is impaired, resulting in inadequate development of the mandible and the craniofacial osseous complex on the affected side.

Both Apert and Crouzon syndromes, which are syndromes of acrocephalosyndactyly, are inherited as autosomal dominant conditions. Their genetic mutations have been linked to fibroblast growth factor receptor-2 (FGFR-2).

These syndromes are characterized by craniosynostosis, exorbitism, and midface retrusion; however, each is differentiated 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. In Crouzon syndrome, the extremities are normal.

Mandibulofacial dysostosis, also known as Treacher Collins syndrome, is an autosomal dominant disorder; its gene has been mapped to chromosome 5q31.3-q33.3. Patients with this condition have facial clefting, an antimongoloid slant to the palpebral fissures, colobomas of the lower eyelids, absence of eyelashes on the medial portion of the lower eyelid, preauricular displacement of hair, malar and mandibular defects, and micrognathia.

Nager syndrome is an autosomal recessive disorder that has facial characteristics similar to Treacher Collins syndrome. Affected patients also have hypoplasia of the thumbs, metacarpals, and radius.

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47

In a patient undergoing LeFort I maxillary osteotomy and downfracture, what is the maximum bone defect (in mm) that will NOT require bone grafting?

- (A) 1 mm
- (B) 3 mm
- (C) 5 mm
- (D) 10 mm
- (E) 15 mm

The correct response is Option C.

Most surgeons believe that grafting should be performed for any bone defect of the craniofacial skeleton that is larger than 5 mm. In orthognathic surgery, any movement of the Le Fort I segment in excess of 5 mm without bone graft for support is likely to result in relapse.

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48

Which of the following neural structures does NOT pass through the superior orbital fissure?

- (A) Optic (II) nerve
- (B) Oculomotor (III) nerve
- (C) Trochlear (IV) nerve
- (D) Abducens (VI) nerve
- (E) Sympathetic nerve fibers

The correct response is Option A.

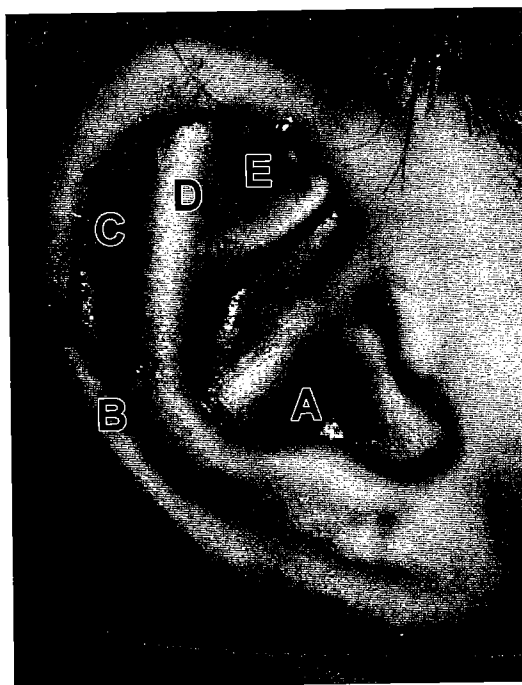
The superior orbital fissure transmits the oculomotor (III), trochlear (IV), and abducens (VI) nerves and sympathetic nerve fibers from the cavernous plexus. In patients who sustain high-velocity fractures of the orbital roof, the fractures may extend to involve the structures of the superior orbital fissure, resulting in a condition known as superior orbital fissure syndrome. This syndrome manifests as loss of ocular motion resulting from paralysis of the motor nerves that pass through the superior orbital fissure, but does not affect vision.

The optic (II) nerve and ophthalmic artery pass through the optic foramen, which is separated from the superior orbital fissure by the lesser wing of the sphenoid bone. Orbital apex syndrome, which involves injury to the optic nerve resulting from extension of the fracture into the optic canal, is characterized by loss of vision.

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49 to 50



For each deformity of the ear, select the corresponding anatomic site in the photograph shown on page 44 (A-E).

- (A) Concha cavum
- (B) Helical rim
- (C) Scapha
- (D) Superior crus of the antihelix
- (E) Triangular fossa

49 Effacement of this structure most commonly results in prominence of the ear.

50 Hypertrophy of this structure most commonly results in prominence of the middle third of the ear.

The correct response for Item 49 is Option D and for Item 50 is Option A.

In children with congenital ear prominence, the superior and middle thirds of the ear are most likely to be affected. The most likely cause of a prominent superior third of the ear is absence or effacement of the superior crus of the antihelix. As a result, the conchoscaphal angle is greater than 90 degrees and the helix is positioned more than 12 to 15 mm from the temporal region. The cephaloauricular angle is also increased, typically measuring more than 25 degrees. Appropriate management involves scoring and suturing of the cartilage to recreate the natural roll of the antihelix.

In contrast, prominence of the middle third of the ear is most likely caused by hypertrophy of the concha cavum. In affected patients, the concha cavum has a depth of more than 1.5 cm. The middle third of the ear is located more than 16 to 18 mm from the mastoid region. Options for correction include excision and/or reduction of the concha or setback with concha-mastoid sutures.

The scapha is the concave region between the helical rim and antihelix, and the triangular fossa is the concave area between the superior and inferior crura of the antihelix. Although the helical rim, scapha, and triangular fossa lie in the superior third of the ear, they do not typically cause prominent ears.

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AESTHETIC AND BREAST

51

A 77-year-old man has a 12-mm squamous cell carcinoma on the lateral margin of the right helix. He is scheduled to undergo excision of the lesion with confirmation of margins by frozen section, followed by immediate reconstruction. Which of the following flaps is most appropriate for ear reconstruction?

- (A) Antia-Buch flap
- (B) Postauricular flap
- (C) Temporoparietal fascial flap
- (D) Temporalis muscle flap



The correct response is Option A.

The Antia-Buch flap is most appropriate for reconstruction of this patient's ear defect. The lesion can be excised easily because of its location on the lateral rim and of the size of the auricle. Following excision, the resultant defect is effectively reconstructed using the Antia-Buch flap, which is a local flap that uses tissue from the helical rim based on the postauricular skin to reconstruct the helical margin. It is a reliable, single-stage procedure that is acceptable aesthetically. The surgeon may need to excise a "dog ear"-shaped area of tissue from the conchal bowl and incise and advance the helical margins separately. However, because the two ears are not viewed simultaneously, moderate differences in ear size are frequently unnoticed.

A postauricular flap does not provide thin, contoured, helical-type tissue and requires several procedures for adequate coverage. The temporoparietal fascial flap provides thin, pliable soft-tissue coverage for a cartilage or alloplastic

framework, as in patients undergoing microtia reconstruction. A temporalis muscle flap is excessively bulky and is not appropriate for ear reconstruction because it would obliterate the intricate detailing of the ear.

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52

A 14-year-old boy sustains an avulsion injury involving the entire pinna when he is bitten by a dog. The amputated part has been preserved on iced saline gauze. Following administration of antibiotics, tetanus toxoid, and rabies prophylaxis, microsurgical replantation of the ear is to be performed. Anastomosis of the arteries is most appropriate at which of the following anatomic locations on the ear?

- (A) Anterior surface
- (B) Inferior surface
- (C) Posterior surface
- (D) Superior surface

The correct response is Option C.

In patients undergoing microsurgical replantation of the ear, the tissues are debrided first, and dissection is performed to locate the appropriate vessels for replantation, with visualization provided by an operating microscope. Because the large arteries to the ear enter on the posterior aspect of the pinna, anastomosis is most appropriate on the posterior surface. These arteries include branches of the external carotid artery, the anterior auricular branch of the superficial temporal artery, and a branch of the occipital artery. In contrast, the smaller branches are located on the anterior surface.

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53

In a 56-year-old man who has a lesion on the tip of the nose, histopathologic examination of a punch biopsy specimen shows basal cell carcinoma. Mohs' micrographic resection is recommended if this patient has which of the following types of basal cell carcinoma?

- (A) Morpheaform
- (B) Nodular
- (C) Pigmented
- (D) Ulcerated

The correct response is Option A.

Mohs' micrographic resection involves serial excision of the visible tumor in layers of increasing depth followed by immediate microscopic examination of the excised tissue. A map of the specimen is created and divided into sections; the presence of tumor in a certain section necessitates further excision in that section only. Serial excision continues until there is no longer any microscopic evidence of tumor. Cure rates for this technique, when used for treatment of basal cell carcinoma, have been reported to range from 98.2% to 99.9%, compared with 94% to 95% for standard surgical excision.

Mohs' micrographic resection is appropriate for removal of basal cell carcinomas, especially recurrent lesions and those lesions that are located in anatomically sensitive sites, such as the eyelid margin, medial canthus, and nasal ala. This technique is particularly effective for the morpheaform variation of basal cell carcinoma, also known as sclerosing basal cell carcinoma, because of the difficulties encountered when attempting to visually determine the tumor margins, which are often not well demarcated. In addition, because morpheaform basal cell carcinoma is more prone to recur, pathologic evaluation of the margins is indicated prior to reconstruction.

Because nodulated, pigmented, and ulcerated basal cells typically have distinct margins and are amenable to primary excision, Mohs' micrographic resection is usually unnecessary.

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54



A 15-year-old boy undergoes reconstruction of a 15-mm² traumatic defect of the right ear with a graft harvested from the contralateral ear. On examination two days after the procedure, the graft appears dusky. A photograph is shown above. Which of the following is the most appropriate next step in management?

- (A) Hyperbaric oxygen therapy
- (B) Application of leeches
- (C) Release of the sutures
- (D) Debridement of the graft

The correct response is Option A.

In this 15-year-old boy who exhibits duskiness at the graft site two days after undergoing composite grafting of the ear, the most appropriate next step is initiation of hyperbaric oxygen therapy. This will provide oxygenation during the critical ischemia period for the graft and thus is likely to improve the outcome. Hyperbaric oxygen therapy enhances antimicrobial activity by facilitating the oxidative burst of polymorphonuclear neutrophils. It increases the hyperoxygenation of tissue to a level that is 10 to 15 times greater than normal. In addition, it stimulates angiogenesis and blunts the ischemia-reperfusion injury response.

Application of leeches is appropriate if arterial input is adequate but venous outflow is insufficient, as in patients undergoing microsurgical replantation who demonstrate thrombosis of the vein, or if a suitable vein does not exist for anastomosis. However, duskiness of the ear is an indication of arterial insufficiency, and leeches would fail to attach if they were applied.

Because a composite graft receives its vascularity through diffusion from the surrounding wound bed, releasing the sutures would inhibit the "take" of the graft to the bed. Similarly, performing debridement two days after grafting is excessive. Instead, the composite graft should be left in place for a minimum of two weeks in order to demonstrate healing and incorporation, as long as infection does not develop.

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55

Compared with traditional (nonendoscopic) transaxillary submuscular techniques for breast augmentation, endoscopic techniques are associated with a decreased risk for which of the following?

- (A) Capsular contracture
- (B) Deflation
- (C) Hypertrophic scarring
- (D) Infection
- (E) Malpositioning of the implant

The correct response is Option E.

Transaxillary breast augmentation is an established technique that allows the surgeon to make the incision in an aesthetically acceptable area, where it can be hidden. However, one disadvantage of traditional transaxillary

augmentation is a lack of visualization of the implant pocket, necessitating blind, blunt dissection at the origin of the pectoral muscle. This limitation may result in improper implant placement, leading to malpositioning of the implant and poor aesthetic results in some patients. In contrast, endoscopic transaxillary augmentation allows the surgeon to divide the origin of the pectoral muscle under direct visualization, thereby effectively lowering the inframammary crease.

Endoscopic techniques have not been shown to significantly decrease the incidence of capsular contracture, hypertrophic scarring, or infection. The method of pocket dissection has no effect on the rate of deflation.

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56

A 49-year-old man with well-controlled hypertension has worsening pain around the right eye five hours after undergoing upper and lower eyelid blepharoplasty with lower subseptal fat herniation. He has blurred vision in the right eye. Physical examination shows mild proptosis on the right.

Which of the following is the most appropriate initial management?

- (A) Application of ice packs and elevation of the head
- (B) Application of ice packs and administration of furosemide and a narcotic agent
- (C) Ophthalmology consultation
- (D) Administration of a corticosteroid and ophthalmology consultation
- (E) Administration of acetazolamide and a corticosteroid and repeat operative exploration

The correct response is Option E.

In this 49-year-old man who has worsening pain after undergoing four-eyelid blepharoplasty, the most likely diagnosis is retrobulbar hematoma. This is most likely caused by hemorrhage from a transected vessel within the periorbital fat pad. Retrobulbar hematomas are typically characterized by steady, severe, lancinating pain in the globe and orbit. Other characteristic symptoms include firmness and tenderness of the globe and early discharge from the eye. Because retrobulbar hematomas can ultimately result in loss of vision, emergent treatment is indicated. This includes intravenous administration of acetazolamide and a corticosteroid and release of the sutures, followed by operative exploration to release the hematoma and confirm or obtain hemostasis. An ophthalmologist should also be consulted, especially if the patient experiences changes in vision.

The other treatments mentioned above will not adequately treat the hematoma and instead will delay definitive care.

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57

A 16-year-old basketball player is undergoing evaluation 12 hours after sustaining a nasal fracture in a basketball game. Physical examination of the fracture site shows marked edema. The radix is stable. A single fracture fragment is displaced from the bony nasal pyramid. Intranasal examination shows septal hematomas bilaterally.

Which of the following is the most appropriate management?

- (A) Drainage of the septal hematomas followed by closed reduction and splinting in three days
- (B) Immediate operative drainage of the septal hematomas, followed by closed reduction and splinting
- (C) Drainage of the septal hematomas and intraoral open reduction and internal fixation of the nasomaxillary suture line in three days
- (D) Closed reduction of the nasal fracture in three days, followed by submucosal resection and inferior turbinate infraction in six months
- (E) CT scan of the face to rule out a naso-orbitoethmoid fracture, followed by open reduction and internal fixation of the fractures and septoplasty

The correct response is Option A.

In this patient who has sustained a nasal fracture with displacement of one fragment, intranasal examination shows septal hematomas bilaterally. Therefore, the most appropriate management is drainage of the hematomas, followed by closed reduction and splinting in three days. It is imperative to drain the hematomas immediately to prevent the development of complications, including thickening of the septum (ie, "cauliflower" deformity) or dissolution and collapse of the septum, which will ultimately result in a saddle-nose deformity. Because this patient has significant swelling, closed reduction should be delayed. After the swelling has decreased (typically at three to five days after injury), the septum and nasal pyramid should be reduced, and the nasal pyramid should then be splinted.

Immediate closed reduction is difficult in any patient with significant edema.

Internal fixation and/or septoplasty are not required for management of uncomplicated nasal fractures.

Submucous resection and turbinectomy are rarely necessary because most patients with nasal fractures do not experience airway compromise.

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58

The common canaliculus enters the lacrimal sac at a point posterior to which of the following structures?

- (A) Deep head of the preseptal muscle
- (B) Deep head of the pretarsal muscle
- (C) Lacrimal crest
- (D) Medial canthal tendon
- (E) Medial horn of the levator muscle

The correct response is Option D.

The common canaliculus enters the lacrimal sac at a point posterior to the medial canthal tendon. The medial canthal tendon is formed from the superficial heads of the pretarsal muscles and originates anterior to and above the lacrimal crest. The anterior and posterior lacrimal crests border the lacrimal fossa, which contains the lacrimal sac. The crests lie posterior to the canicular entrance to the sac.

The deep head of the preseptal muscle originates from the posterior lacrimal crest, just above the deep heads of the pretarsal muscles. The deep heads of the pretarsal muscles extend posterior to the lacrimal sac and join with the diaphragm of the scar to originate immediately behind the posterior lacrimal crest. The medial horn of the levator muscle lies superior to the medial canthal tendon.

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59

Elongation and laxity of which of the following structures are most likely to result in breast ptosis?

- (A) Clavipectoral fascia
- (B) Cooper's ligaments
- (C) Costoclavicular ligaments
- (D) Superficial fascia of the breast
- (E) Superficial fascia of the pectoralis muscle

The correct response is Option B.

Patients with breast ptosis have drooping of the breast parenchyma, skin, and/or nipple-areola complex occurring as a result of aging, pregnancy, lactation, or weight loss. Anatomically, ptosis is caused by disruption or elongation of Cooper's ligaments, which are fibrous projections that arise from the breast tissue and fuse with the superficial fascia

and dermis of the breast. These ligaments attach the breast parenchyma to the overlying skin. Tumors can stretch these ligaments and cause dimpling and retraction of the skin.

Several mastopexy techniques have used absorbable meshes, deep anchoring sutures, or crossing parenchymal slings in an attempt to recreate the tight Cooper's ligaments and thus correct the ptosis. However, scarring and recurrence of ptosis are frequent complications.

The clavipectoral fascia covers the axilla and pectoralis minor muscle; this layer is encountered during axillary dissection. The costoclavicular ligaments anchor the clavicle to the chest beneath the medial superior pole of the breast, but do not enter the breast parenchyma.

The superficial fascia of the breast is a filmy, white layer of connective tissue located 2 to 15 mm deep to the skin. The deep layer of the superficial fascia envelopes the breast posteriorly. A loose areolar plane is present between the superficial fascia of the breast and the deep fascia of the pectoralis muscle, and facilitates removal of the breast from the pectoralis muscle during mastectomy.

The superficial fascia of the pectoralis muscle covers the muscle but does not extend into the breast.

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60

During suction lipectomy using tumescent anesthesia, total blood loss is expected to be what percentage of the total aspirate?

- (A) 1%
- (B) 10%
- (C) 20%
- (D) 30%
- (E) 50%

The correct response is Option A.

The tumescent technique of suction lipectomy uses a dilute solution of lidocaine and epinephrine as infiltrate in the area that is to be suctioned. With this technique, 2 to 3 mL of infiltrate are used for every 1 mL of fluid that is to be aspirated. Blood loss is significantly decreased with this technique; many studies have shown blood loss of only 1% with tumescent anesthesia.

The dry technique of anesthesia is associated with the greatest blood loss, as 20% to 45% of the aspirate consists of blood. The wet technique infiltrates 300 mL of fluid per region and results in aspirate that is comprised of 25% blood.

The superwet technique has a blood-to-aspirate ratio of 3 to 10% and uses an injected volume of 1 mL for every 1 mL of aspirate.

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61

Which of the following branches of the facial nerve is most frequently injured during rhytidectomy?

- (A) Buccal
- (B) Cervical
- (C) Marginal mandibular
- (D) Temporal
- (E) Zygomatic

The correct response is Option A.

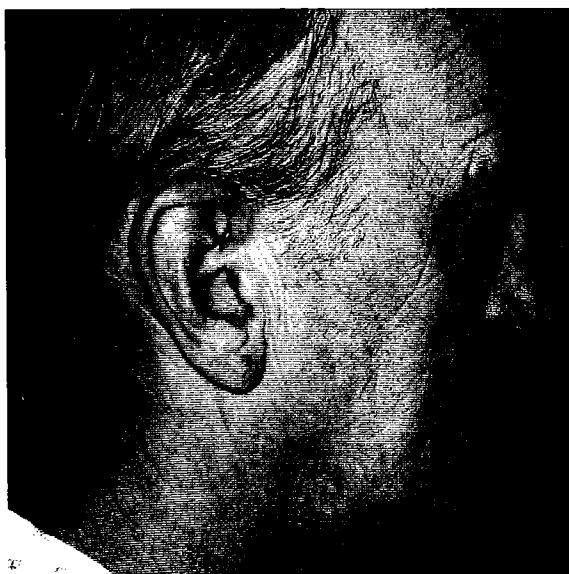
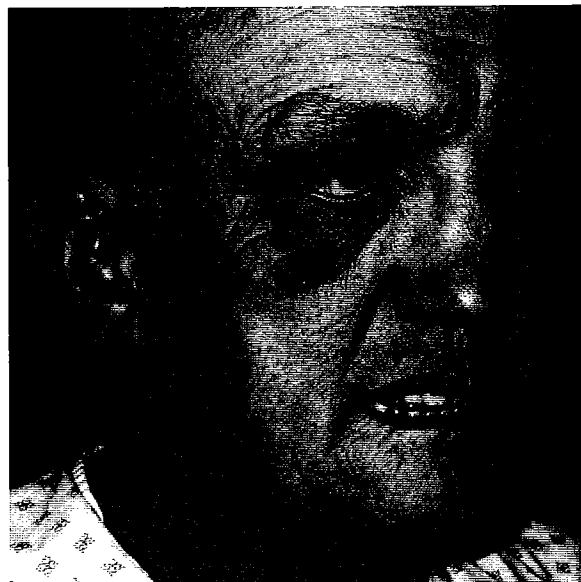
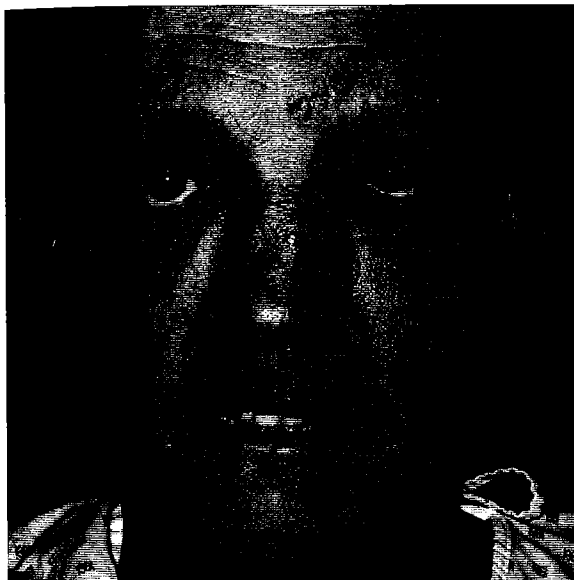
Less than 2% of rhytidectomy patients are at risk for facial nerve palsy, with an average risk for injury of 0.9%. The buccal branch of the facial nerve is most frequently injured during rhytidectomy. However, the symptoms associated with buccal branch injury are typically subtle, and recovery of sensorimotor function occurs rapidly as a result of the overlapping neural patterns within the upper lip and cheek.

The cervical and zygomatic branches of the facial nerve are injured less commonly than the buccal branch. Injury to these branches rarely produces symptoms because of their multiple crossover branches. Injuries to the marginal mandibular and temporal branches of the facial nerve are less common but have more noticeable symptoms; these injuries also resolve more slowly because these branches have minimal overlap with other facial nerve divisions. The marginal mandibular nerve is injured more frequently than the temporal branch because of its greater potential for retraction injury and direct sharp division during dissection of the platysma.

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62



The photographs shown above are of a 62-year-old man who sustained a nasal septal fracture in a high-speed motor vehicle collision five days ago. Following reduction of the fracture, which of the following grafts is most appropriate for correction of the deformity?

- (A) Alloplastic graft
- (B) Columellar strut graft
- (C) Shield graft
- (D) Spreader septal graft
- (E) Umbrella graft

The correct response is Option D.

Fractures of the nose can occur in three zones. Fractures of the upper vault of the nose involve the nasal bones, ethmoid, vomer, and cephalic septal border. Fractures of the middle vault involve the upper lateral cartilages, septum, and maxilla. In patients with fractures of the lower vault of the nose, the alar cartilages and inferior septum are affected. This patient has fractures involving both the upper and middle vaults of the nose. Following reduction of the septum and nasal bones, spreader grafts should be inserted to provide support to the septum.

Compared with autologous tissues, alloplastic grafts have higher rates of exposure and infection and are relatively contraindicated in a patient with recent trauma to the nose and multiple mucoperichondrial lacerations.

Columellar strut, shield, and umbrella grafts are used for correction of deformities in the lower vault of the nose.

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63

Which of the following muscles is injured most commonly during blepharoplasty?

- (A) Inferior oblique
- (B) Lateral rectus
- (C) Medial rectus
- (D) Superior oblique
- (E) Superior rectus

The correct response is Option D.

Because of its relatively superficial anatomic location, the superior oblique muscle is injured most commonly during blepharoplasty. Injury in this region is characterized by pain, diplopia accompanied by a tendency to close one eye, abnormal tilting of the head, and depression of the chin.

Blepharoplasty procedures of the upper eyelid typically involve resection of excess fat. The upper eyelid contains the medial and central fat compartments, which lie deep to the orbital septum and are separated by the superior oblique muscle-tendon unit and trochlea. To resect fat, the surgeon can make either one incision across the entire orbital septum to access the fat compartments, or two separate, smaller incisions in the orbital septum over each isolated compartment.

It is important for the surgeon to know the anatomy of the upper eyelid and orbit to incise in the area of the fat compartments without injuring the trochlea or superior oblique muscle. If the upper eyelid fat is not teased carefully,

the superior oblique muscle can be inadvertently crushed, attenuated, teased through the septum, and even excised. Resecting only the bulging fat that lies anterior to the septum is most likely to prevent injury. If there is no pressure on the orbit and no traction on the fat, the muscle will not bulge anterior to the orbital septum.

Cauterization of excised fat, especially with the clamp-and-cauterize technique, is also associated with injury to the superior oblique muscle and trochlea. When the clamp is removed, vessels that were cauterized inadequately will retract and bleed deep within the fat compartment. In addition, entrapment of the superior oblique tendon has been shown to occur with closure of the orbital septum.

The inferior oblique and superior rectus muscles can be injured during blepharoplasty, but trauma to these structures is less likely than injury to the superior oblique muscle. The lateral and medial recti are rarely injured during blepharoplasty.

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64

A 55-year-old woman is scheduled to undergo a rhytidectomy for facial rejuvenation. She would like to return to work as soon as possible. In this patient, perioperative administration of corticosteroids is most likely to have which of the following effects on edema and ecchymosis?

	Edema	Ecchymosis
(A)	Decreased	Decreased
(B)	Decreased	Unchanged
(C)	Increased	Increased
(D)	Unchanged	Decreased
(E)	Unchanged	Unchanged

The correct response is Option E.

Three prospective, randomized controlled trials with sample sizes of 30, 50, and 60 patients were recently undertaken to evaluate the effects of perioperative corticosteroids on edema and ecchymosis in patients undergoing rhytidectomy. According to evaluations performed by independent observers immediately after surgery and at a later interval, there was no difference in edema or ecchymosis between the control group and the group in whom corticosteroids were administered perioperatively.

Therefore, the evidence that corticosteroids decrease facial swelling remains anecdotal and unsubstantiated. In addition to no demonstrable benefit, this course of treatment is associated with increased cost and risk for

complications, including exacerbation of hypertension, deterioration of glucose control, an increased rate of infection, and the potential for avascular osteonecrosis. The studies mentioned above are small and statistically underpowered but provide Level I evidence (ie, prospective, randomized controlled trials) that perioperative administration of corticosteroids is unnecessary to control edema and ecchymosis.

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65

A 25-year-old man has excessive tear secretion and a chronic mucocele of the lacrimal sac. Jones I dye testing shows no dye, while Jones II dye testing shows dye within the tear sac. Dilatation of the puncta with probing and irrigation does not restore the patency of the lacrimal system. In order to restore nasolacrimal drainage in this patient, which of the following is the most appropriate operative procedure?

- (A) Insertion of a Jones tube
- (B) Canaliculodacryocystorhinostomy
- (C) Conjunctivodacryocystostomy
- (D) Conjunctivorhinostomy
- (E) Dacryocystorhinostomy

The correct response is Option E.

Jones dye testing is performed initially in this patient who has excessive tear secretion. The Jones I dye test involves the instillation of 2% fluorescein dye into the conjunctival fornices. Recovery of the dye (a positive test) indicates that flow through the lacrimal system is uninhibited. Negative findings on the Jones I test are indicative of functional obstruction; if this occurs, the Jones II dye test should be performed immediately. With this test, the nasolacrimal system is irrigated with 1 mL of saline via an irrigation cannula. If dye-stained fluid is found at the inferior turbinate, there is partial obstruction of the lower canalicular system, most likely at the nasolacrimal duct. If there is dye within the tear sac, obstruction of the nasolacrimal duct can be diagnosed; the canaliculus and lacrimal pump are unaffected. If no dye-stained fluid is found in the nose (a negative test), the obstruction is most likely at the canalicular level.

In patients with positive Jones II dye tests, dilation of the puncta should then be performed; any fluid that passes into the nose indicates that the obstruction of the nasolacrimal duct has been cleared, and further probing is unnecessary. However, probing and irrigation do not restore patency in this situation. Therefore, this patient has negative findings on the Jones I dye test but positive findings on the Jones II dye test, indicating a partial obstruction of the nasolacrimal duct. In this patient who has duct obstruction resulting from a chronic mucocele of the lacrimal sac, dacryocystorhinostomy is indicated.

Insertion of a Jones tube is indicated in patients who have complete obstruction of the lacrimal puncta.

Canaliculodacryocystorhinostomy, with intubation, is recommended for management of strictures found at the junction of the common canaliculus and the lacrimal sac, as well as for obstructions at the level of the canaliculus.

Although conjunctivodacryocystostomy is appropriate for patients who have obstruction at the canalicular level, this technique is associated with disruption of the lacrimal sac, resulting in unreliable long-term patency.

Conjunctivorhinostomy is indicated in patients who have absence or obliteration of the tear sac.

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66

A 32-year-old woman who smokes two packs of cigarettes daily wishes to undergo full abdominoplasty to correct excess skin and fat in the lower abdomen resulting from two pregnancies. The risk for development of complications in this patient is closest to

- (A) 10%
- (B) 30%
- (C) 50%
- (D) 70%
- (E) 90%

The correct response is Option C.

Because conventional abdominoplasty procedures involve significant undermining, there is increased potential for complications, such as skin necrosis, infection, wound dehiscence, seroma, and hematoma. In addition, plastic surgery procedures are associated with a high incidence of adverse effects when performed in patients who smoke. These complications are related to the release of nicotine and carbon monoxide during smoking, which decrease blood flow and oxygen delivery and induces thrombogenesis. There is dysfunction of leukocytes, macrophages, and fibroblasts, leading to impaired wound healing.

One recent study of 132 patients who underwent abdominoplasty reported a complication rate of 48% in smokers, compared with a complication rate of 15% in those patients who did not smoke. Another study of 199 abdominoplasty patients reported a complication rate of 52% in smokers and 24% in nonsmokers.

Patients should be advised to discontinue smoking four to eight weeks before the surgical procedure and for an additional four weeks after surgery. Serum levels of nicotine have been shown to return to normal when patients abstain from smoking for eight weeks. In addition, studies of patients who underwent flap reconstruction showed that complications were decreased significantly when smoking was discontinued a minimum of four weeks before surgery.

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67

Two years after undergoing modified radical mastectomy on the right, a 36-year-old woman desires reconstruction with an implant. Physical examination shows minimal bulk in the inferior and lateral portions of the right pectoralis major muscle.

The most likely cause is denervation of which of the following nerves during mastectomy?

- (A) Fourth intercostal
- (B) Lateral pectoral
- (C) Long thoracic
- (D) Medial pectoral
- (E) Thoracodorsal

The correct response is Option D.

The minimal bulk in the inferior and lateral portions of the right pectoralis major muscle in this patient most likely results from denervation of the medial pectoral nerve, which is injured often during mastectomy. The pectoralis major is innervated by the medial and lateral pectoral nerves, named for their respective cords of origin from the brachial plexus. The lateral nerve, which arises from C5-6, actually supplies the medial portion of the pectoralis major muscle, and the medial nerve, derived from C8-T1, supplies the lower and lateral sternal portion of the pectoralis major muscle and the pectoralis minor muscle.

Because injury to the medial pectoral nerve results in severe atrophy of the lower half of the muscle, implant coverage will be sparse in this region. It is important for the plastic surgeon to assess the status of the pectoralis muscle before attempting implant augmentation; this can be accomplished by having the patient place her hands on her hips and contract her chest muscles.

The fourth intercostal nerve supplies sensation to the nipple-areola complex. The long thoracic nerve, commonly referred to as the long thoracic nerve of Bell, supplies motor innervation to the serratus muscle, and injury may result in winging of the scapula. The thoracodorsal nerve provides innervation to the latissimus dorsi muscle.

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68

A 42-year-old woman has drooping of the left eyelid two weeks after undergoing upper eyelid blepharoplasty and injection of botulinum toxin into the forehead. Physical examination shows 3 mm of ptosis of the left eyelid and 13 mm of levator excursion. When the left eyelid is closed voluntarily, the iris shadow can be visualized through the eyelid. The left tarsal crease is elevated 3 mm when compared with the right tarsal crease.

Which of the following types of ptosis is the most likely cause of these findings?

- (A) Botulinum toxin-induced
- (B) Traumatic aponeurotic
- (C) Traumatic mechanical
- (D) Traumatic myogenic
- (E) Traumatic neurogenic

The correct response is Option B.

This patient has traumatic aponeurotic ptosis, which is characterized by the physical examination findings of good levator function, elevation of the eyelid crease, and the ability to visualize the shadow of the iris with eyelid closure (positive Nesi sign). In this type of ptosis, the levator aponeurosis is detached from the tarsal plate. Early reattachment of the levator is most likely to produce the best result.

Patients with botulinum toxin-induced ptosis will have a more prominent decrease in levator function. In patients with mechanical, myogenic, or neurogenic ptosis, the shadow of the iris cannot be visualized through the eyelid.

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69

In women undergoing augmentation mammoplasty with saline-filled implants, which of the following techniques is most likely to decrease the longevity of the implant and lead to early rupture?

- (A) Underfilling of the implants below the manufacturer's recommended minimum
- (B) Filling of the implants to the manufacturer's recommended minimum
- (C) Filling of the implants to the volume between the manufacturer's recommended minimum and maximum
- (D) Filling of the implants to the manufacturer's recommended maximum
- (E) Overfilling of the implants above the manufacturer's recommended maximum

The correct response is Option A.

Adequate fill volume is recommended to increase the longevity of a breast implant. This decreases both fold-flaw failure and the potential for premature failure resulting from filling the implant at or below the manufacturer's minimum volume. Implants are softer and more sloping at lower levels of fill volume, but these "underfilled" implants have also been shown to wrinkle more, leading to a shorter lifespan because of stresses induced by wrinkling. As the volume of the implant increases, palpable and visible wrinkling decreases, resulting in increased longevity.

Some studies have also shown that implant longevity can be maximized by filling the implants to the volume at which they exhibit the least wrinkles, even if it exceeds the manufacturer's maximum recommended volume. However, this technique, known as "overfill," is not recommended.

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70

Which of the following is the most likely adverse effect of performing infracture of the nasal bones?

- (A) Development of an open roof deformity
- (B) Development of a supratip deformity
- (C) Narrowing of the internal nasal valve
- (D) Narrowing of the nasal tip
- (E) Retraction of the columella

The correct response is Option C.

Infracture of the nasal bones is performed to narrow the nasal dorsum. However, because the upper lateral cartilages are attached to the nasal bones, this technique may lead to an excessively acute angle (less than 10 degrees) between the upper lateral cartilages and the septum. Narrowing and occlusion of the internal nasal valve can result, causing breathing difficulties.

Infracture is also a method of correcting an open roof deformity.

Supratip deformities are generally caused by inadequate resection of the dorsal spine or excessive resection of the nasal dorsum.

The nasal tip and columella are relatively unaffected by infracture.

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71

A 24-year-old man has pain and swelling of the left ear after injuring the ear in a fight. Physical examination shows obliteration of the normal contours of the lateral surface of the ear. Which of the following is the most appropriate management?

- (A) Application of a pressure dressing for several days, followed by evacuation of clotted blood
- (B) Needle aspiration of the ear
- (C) Needle aspiration of the ear and application of a pressure dressing
- (D) Incision and drainage of the skin and perichondrium and application of a pressure dressing
- (E) Excision of thickened tissue and placement of suction-drainage catheters

The correct response is Option D.

Hematoma formation is the primary complication of blunt trauma to the ear. The mechanism of injury involves disruption of blood vessels in the perichondrium, leading to hemorrhage. The blood fills the space between the perichondrium and cartilage, distorting the contour of the lateral ear into a convex shape and blocking the vascular supply to the cartilage, which is derived from the perichondrium. Necrosis or infection of the cartilage results.

Prompt treatment involves removing the accumulated blood while maintaining pressure on the affected area for several days to prevent recurrence. To accomplish this, an incision is made through the skin and perichondrium on the inner side of and parallel to the antihelix, which will conceal the scar. The blood is drained and the wound is inspected for further bleeding. When the surgeon is assured that the bleeding has stopped, a pressure dressing and a head dressing are applied.

Late treatment of a cauliflower ear deformity involves excision of the thickened tissue, including fibrous tissue and new cartilage, followed by application of a pressure dressing.

Simple needle aspiration of the blood is likely to result in development of seroma.

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72

Compared with traditional suction lipectomy, which of the following is more likely to occur with ultrasonic-assisted suction lipectomy?

- (A) Contour irregularity
- (B) Major blood loss
- (C) Nerve injury
- (D) Pulmonary edema
- (E) Thermal burns

The correct response is Option E.

Ultrasonic-assisted suction lipectomy (UAL) is currently performed as a complement to, not a replacement for, traditional suction lipectomy. This technique involves the transmission of ultrasonic energy via a transducer to cavitate adipocytes and emulsify the liquefied fat, making aspiration of fat easier. UAL is advantageous in removing fat from difficult or fibrous body areas, such as the epigastrium and upper abdomen. It is also purported to stimulate skin retraction after superficial treatment.

Many complications that occur with UAL are similar to those seen with traditional lipectomy procedures, including contour irregularities, perforations, paresthesia and hypoesthesia resulting from nerve injury, seroma formation, and adverse cardiopulmonary effects. In addition, UAL has been shown to elicit greater tissue damage and bleeding than traditional techniques; however, the decrease in hemoglobin level postoperatively is similar with either technique.

UAL is associated with an increased incidence of internal and external cutaneous burns resulting from the intense heat generated by sound waves; this complication does not occur with traditional suction lipectomy. In addition, there are concerns regarding the unknown long-term effects of sound waves and exposure to high temperatures, bond dissociation within molecules, production of free radicals within the body, and other factors.

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73

Endoscopic browlifting procedures are associated with a lower incidence of which of the following adverse effects when compared with conventional coronal browlifting?

- (A) Distortion of sideburns
- (B) Facial nerve injury
- (C) Formation of hematoma
- (D) Postoperative edema
- (E) Scalp sensibility changes

The correct response is Option E.

A primary advantage of the endoscopic approach to browlifting is prevention of sensibility changes in the scalp. Coronal incisions, which are performed for standard browlifting techniques, are associated with an increased incidence

of postoperative neuralgia and development of neuroma. Because endoscopic browlifting minimizes scalp incisions, these sensory changes do not occur.

Preauricular sideburns are affected by rhytidectomy procedures and not by browlifting. The incidence of injury to the frontal branch of the facial nerve, hematoma formation, and postoperative edema is similar with coronal and endoscopic procedures.

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74

Which of the following is the primary advantage of performing breast reconstruction with an extended latissimus dorsi myocutaneous flap instead of the standard latissimus dorsi myocutaneous flap?

- (A) Decreased donor site scarring
- (B) Decreased incidence of seroma at the donor site
- (C) Decreased need for adjuvant breast implantation
- (D) Decreased need for division of the humeral tendon attachment
- (E) Decreased risk for flap loss

The correct response is Option C.

The primary advantage of the extended latissimus dorsi flap is the autogenous tissue it provides, which can be used to enhance breast volume without the need for an implant. The standard latissimus dorsi myocutaneous flap was one of the first created for breast reconstruction. However, with the emergence of the TRAM flap, the latissimus dorsi flap has become a secondary choice for autologous reconstruction for many surgeons because it often does not provide sufficient volume and is, instead, often used in combination with an implant.

Variations of the latissimus dorsi flap have been created to increase volume and obviate the need for an implant. The first extended latissimus dorsi flap, described in 1983, was designed to include fat and fascia from the parascapular and scapular regions and fat from the lumbar spine. This transfer of additional tissue from the back eliminates the need for an implant; therefore, potential complications associated with implants, such as the development of capsular contracture and deformation of the reconstructed breast, are avoided. The technique was later modified by creating a fleur-de-lis skin paddle, which carries additional fat on the surface of the latissimus dorsi muscle and is thus a totally autogenous latissimus dorsi flap.

The contour and scarring of the donor site following flap transfer are acceptable. However, other complications, such as seroma formation and wound necrosis, can be a significant concern. Division of the humeral tendon allows for

increased mobility of the flap. Partial flap and/or fat necrosis are more commonly associated with the extended flap than the standard flap.

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75

A 21-year-old man sustains a complete amputation of the right ear at the level of the external auditory canal in a motor vehicle collision. There are no other injuries. Which of the following procedures will provide the best aesthetic result?

- (A) Delayed total ear reconstruction with a rib cartilage graft
- (B) Dermabrasion of the epidermis of the amputated ear, burial of the ear in a subcutaneous postauricular pocket, followed by removal and coverage with a skin graft or flap
- (C) Removal of the skin of the amputated ear, reattachment of the ear cartilage, and immediate coverage with a temporoparietal fascial flap and skin graft
- (D) Composite grafting of the amputated ear followed by surface cooling
- (E) Microsurgical ear replantation

The correct response is Option E.

Successful microsurgical replantation of the ear provides superior aesthetic results while eliminating the need for other complex reconstructive procedures. However, this technique is associated with increased operative time and the need for multiple blood transfusions. Hospitalization is typically prolonged, and failure rates associated with the procedure are high.

Delayed reconstruction results in only moderate cosmetic improvement, and secondary reconstruction does not sufficiently recreate the intricate architecture of the external ear.

Primary nonvascularized replantation of the ear produces a good appearance initially because of the survival of the avulsed cartilage; however, late distortion of the cartilage frequently limits the overall aesthetic result. Techniques used for nonvascularized replantation include primary reattachment of the ear with surface cooling, dermabrasion of the ear, and partial or complete burial of the ear in a postauricular skin pocket, followed by coverage of the filleted cartilage with a temporoparietal fascial flap and skin graft.

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76

Which area of the nose is most likely to provide an aesthetically unacceptable result if allowed to heal secondarily?

- (A) Canthal bowl
- (B) Columella
- (C) Glabella
- (D) Sidewall
- (E) Tip

The correct response is Option E.

If allowed to heal by second intention, the appearance of the tip of the nose is most likely to be unacceptable aesthetically. This is because of its prominent position and high visibility. During healing by second intention, contraction of the skin typically limits the acceptability of the result, as it leads to distortion of the underlying cartilaginous skeleton. According to the results of one study of 282 patients, an acceptable outcome was reported in only 32% percent of patients who had wounds of the tip subunit that were allowed to heal by second intention. In contrast, 100% reported acceptable results at the glabella and columella, 90% at the canthal bowl, and 85% at the nasal sidewalls.

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77

In patients who have undergone bilateral reduction mammoplasty using an inferior pedicle technique, which of the following findings is most likely to be identified on mammography six to 18 months after surgery?

- (A) Calcifications
- (B) Fat necrosis
- (C) Oil cysts
- (D) Periareolar fibrosis
- (E) Skin thickening

The correct response is Option A.

Mammography is recommended in women older than age 35 years for detection of carcinoma. One recent study, involving women who underwent bilateral reduction mammoplasty using an inferior pedicle technique, examined findings on radiographs of the breasts six to 18 months after surgery. According to the results of this study, the most common findings were parenchymal redistribution (90.2%) and elevation of the nipple (84.9%) caused by a downward shifting of the breast tissue. Calcifications occurred in 25.6% of patients, retroareolar fibrotic banding from the

transposed flap in 20.3% of patients, and oil cysts resulting from localized fat necrosis in 19.4% of patients. Thickening of the skin and areola caused by scar tissue were less common findings. Because such studies have delineated the "routine" mammography findings in patients who have undergone reduction mammoplasty, lesions can be diagnosed more easily and unnecessary biopsy procedures can be avoided.

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78

Suction lipectomy is a viable means of breast reduction because the percentage of the female breast that is comprised of fat is closest to

- (A) 10%
- (B) 25%
- (C) 50%
- (D) 75%
- (E) 90%

The correct response is Option C.

Suction lipectomy can be performed to remove fatty tissue in the breast without disturbing parenchymal tissue. It is an attractive option for breast reduction in women who would like to avoid the scarring associated with traditional surgical techniques. According to the results of one recent study that involved a significant population of overweight women, the mean percentage of fat in the breast was 61%. Another study of women predominantly of normal body weight showed a mean percentage of fat of 48%. In addition, these studies showed that younger patients have significant amounts of fat in the breast, even though the percentage of fat was shown to increase with age. Body mass index had more influence on the percentage of breast fat than age, and the amount of fat in the breast could not be accurately assessed on physical examination.

One clinical study reported that breast reduction via suction lipectomy alone produced the best results in women who had well-located or slightly ptotic nipples. Benefits of this technique include the avoidance of scarring and compromise to the blood supply and nerves to the nipple. However, many surgeons remained concerned about the effectiveness of suction lipectomy alone in patients with very large breasts, as well as the lack of skin excision, the potential for induction of microcalcifications, and the viability of pathologic examination of removed fat.

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79

The internal nasal valve is comprised anatomically of the septum and which of the following structures?

- (A) Caudal edge of the upper lateral cartilage and pyriform aperture
- (B) Inferior turbinate and nasal floor
- (C) Nasal floor and caudal edge of the upper lateral cartilage
- (D) Pyriform aperture and vomer
- (E) Vomer and inferior turbinate

The correct response is Option C.

The internasal nasal valve is a triangular shaped passage that is comprised of the septum, the nasal floor, and the caudal portion of the upper lateral cartilage. Patency of the internal nasal valve is crucial for breathing. The normal angle of the internal nasal valve is 10 to 15 degrees; if the angle is less than 10 degrees, airway occlusion at the internal nasal valve may result. Insertion of spreader grafts, which are stick-like strips of cartilage, is recommended to open the angle and improve the airway. The grafts are placed submucosally between the dorsum of the septum and the upper lateral cartilage. In contrast, infraction of the nasal bones will only narrow the angle and worsen breathing.

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80

A 68-year-old woman desires rejuvenation of the eyelids. Physical examination shows excessive skin of the lower eyelids and 2 mm of scleral show bilaterally. Which of the following is the most appropriate management?

- (A) Injection of botulinum toxin (Botox) into the lateral canthal region
- (B) Carbon dioxide laser resurfacing of the lower eyelids
- (C) Lower eyelid blepharoplasty with excision of skin
- (D) Lower eyelid blepharoplasty with lateral canthopexy
- (E) Transconjunctival blepharoplasty

The correct response is Option D.

This 68-year-old woman has substantially diminished elasticity of the skin of the lower eyelids. Because of this, she is at increased risk for development of ectropion postoperatively if blepharoplasty with skin excision is performed alone and the laxity of the lower eyelid skin is not corrected. Therefore, the most appropriate management is lower eyelid

blepharoplasty combined with lateral canthopexy, which will decrease the laxity of the lower eyelids and lower the risk for ectropion.

Injection of botulinum toxin will not rejuvenate the lower eyelids, and carbon dioxide laser resurfacing of the lower eyelids will only increase the risk for ectropion if canthopexy is not performed concomitantly. Transconjunctival blepharoplasty alone will not correct the excessive skin of the lower eyelids.

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81

A 36-year-old woman with carcinoma of the breast is scheduled to undergo modified radical mastectomy followed by postoperative radiation therapy. Which of the following operative techniques is most likely to provide the best aesthetic reconstruction?

- (A) Immediate reconstruction with autologous tissue
- (B) Immediate reconstruction with autologous tissue and an implant
- (C) Immediate reconstruction with an expander and a saline-filled implant
- (D) Delayed reconstruction with autologous tissue
- (E) Delayed reconstruction with an expander and a silicone gel-filled implant

The correct response is Option D.

Delayed reconstruction with autologous tissue will provide the best aesthetic reconstruction in this patient. Transfer of autologous tissue alone is the best method in any patient who has previously undergone radiation therapy. In the absence of autologous reconstruction, a latissimus dorsi flap can be used, especially in 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.

One recent study evaluated patients who underwent immediate TRAM flap reconstruction followed by radiation therapy and compared them with patients who had radiation therapy first followed by TRAM flap reconstruction. Although the incidence of early complications did not differ significantly between the two groups, late complications were much more common in the immediate reconstruction group than in the delayed reconstruction group. In addition, 28% of those patients undergoing immediate reconstruction experienced severe shrinkage and contraction of the flap and subsequently required an additional procedure for correction. Therefore, in patients who require radiation therapy following mastectomy, it is recommended that reconstruction is delayed until radiation therapy has been completed.

Use of an implant, whether saline- or silicone gel-filled, is associated with a significant increase in capsular contracture and other complications in patients who have previously undergone radiation therapy.

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82

A 45-year-old woman has ptosis of the left eyelid two days after undergoing injection of botulinum toxin A (Botox) for forehead rejuvenation. This finding is most likely an inadvertent sequela of planned injection into which of the following muscles?

- (A) Corrugator supercilii
- (B) Frontalis
- (C) Lateral orbicularis oculi
- (D) Levator labii superioris
- (E) Procerus

The correct response is Option A.

This patient's blepharoptosis is most likely caused by injection of botulinum toxin A into the corrugator supercilii muscle. Botulinum toxin is increasingly used for temporary dispersion of hyperkinetic facial rhytides and furrows. Although it does not replace cosmetic procedures, such as rhytidectomy, skin resurfacing, or soft-tissue augmentation, it can result in facial rejuvenation when used alone or in combination with other treatment options, leading to a more youthful appearance. Glabellar frown lines can be best managed with injection into the medial eyebrows (corrugator muscles). Lateral canthal rhytides (crow's feet) and horizontal forehead furrows can also be treated. To minimize adverse effects, the surgeon should have a thorough knowledge of the soft-tissue anatomy of the face and the lowest effective doses of botulinum toxin.

In this patient who has undergone injection into the corrugator supercilii muscle, diffusion of the toxin into the surrounding levator muscles has occurred, resulting in eyelid ptosis on the left. However, this side effect lasts only for a few weeks, because the dose of migrated toxin to the affected muscle from the site of injection typically becomes significantly reduced.

Injection of botulinum toxin into the frontalis, lateral orbicularis oculi, or procerus muscles is not associated with the potential for diffusion into the levator muscles; therefore, eyelid ptosis is not likely. The levator labii superioris muscle is located in the upper lip and would not be injected during facial rejuvenation.

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83

Three months after undergoing bilateral lower eyelid blepharoplasty, a 45-year-old woman has scleral show, round, sad-looking eyes, and symptoms of ocular irritation, including photophobia and excessive tearing. The most likely cause of these findings is scarring between the orbital septum and which of the following structures?

- (A) Capsulopalpebral fascia
- (B) Inferior oblique muscle
- (C) Orbicularis oculi muscle
- (D) Orbital rim
- (E) Tarsal plate

The correct response is Option A.

The findings seen in this patient are consistent with retraction of the lower eyelids, a common complication following surgery of the lower eyelids and midface. Lower eyelid retraction is defined as inferior malpositioning of the lower eyelid margin without eyelid eversion. Affected patients have round, sad-looking eyes, scleral show, and symptoms of ocular irritation, including photophobia, excessive tearing, and nocturnal lagophthalmos. Ocular lubricants typically provide only minimal relief.

Potential causes of lower eyelid retraction include scarring between the orbital septum and capsulopalpebral fascia, laxity of the lateral canthal tendon, and descent of the structures of the midface. Appropriate management is based on patient findings, which may include relaxation of the tarsal margin, skin shortening, and/or deep lamellar scar contracture.

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84

A 6-year-old boy has prominent ears. Physical examination shows an obtuse concha-mastoid angle. The antihelical fold is normal. Which of the following is the most appropriate management?

- (A) Use of a headband splint at night
- (B) Use of Mustardé sutures
- (C) Setback of the concha using concha-mastoid sutures
- (D) Excision of excess skin
- (E) Resection of the concha

The correct response is Option C.

Because prominent ears can be caused by an enlarged conchal bowl, an obtuse concha-mastoid angle, or loss of the antihelical fold, appropriate management should be based on the cause of the deformity. This 6-year-old boy has ear prominence caused by an obtuse concha-mastoid angle. Conchal setback is recommended in children to correct the enlarged conchal bowl and obtuse concha-mastoid angle deformities. This is accomplished using concha-mastoid sutures, which are mattress sutures placed between the posterior conchal wall and the mastoid periosteum to create a more acute concha-mastoid angle and decrease the height of the protruding concha.

In contrast, elliptical conchal excision may be required to perform conchal setback in adults, whose ear cartilage is typically stiff.

Ear prominence resulting from loss of the antihelical fold is best corrected by abrading or scoring the antihelix and placing Mustardé mattress sutures between the conchal eminence and the scaphoid eminence.

Splinting is effective only in infants because of the pliability of the ear cartilage in this age group.

Excess skin may need to be excised following placement of concha-mastoid sutures, but this is unlikely to produce adequate setback if performed alone. This technique is appropriate instead to decrease the prominence of the lobule or superior helix.

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85

In a 30-year-old woman who carries the BRCA-2 genetic mutation, the lifetime risk of development of breast carcinoma is closest to what percentage?

- (A) 10%
- (B) 20%
- (C) 40%
- (D) 60%
- (E) 100%

The correct response is Option D.

In persons who carry the BRCA-1 or BRCA-2 genetic mutation, the lifetime risk for development of breast carcinoma varies from 50% to 85%. Although initial studies showed a lifetime risk of 85%, more recent studies have reported that the risk is actually closer to 56%. Genetic testing for BRCA mutations is now available, and patients who carry a mutation may wish to undergo bilateral mastectomy and reconstruction.

The BRCA genes are autosomal dominant genes whose loci code for proteins; these proteins facilitate DNA repair and thus suppress tumor growth. Although only 5% to 10% of all cancerous tumors have been shown to result from the BRCA genes, a mutation of either gene results in a marked increase in the incidence of carcinoma.

BRCA-1, whose locus lies on chromosome 17, has also been linked to carcinoma of the ovaries, prostate, and colon. More than 100 different mutations of this gene have been reported. The BRCA-2 locus is located on chromosome 13. This mutation is associated with an increased risk for carcinoma of the breast, but not with ovarian carcinoma. According to the results of recent studies, administration of tamoxifen appears to decrease the risk for breast carcinoma in patients with the BRCA-2 mutation.

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86

Which of the following adverse effects is more likely to occur in patients undergoing secondary rhytidectomy than in patients undergoing primary rhytidectomy?

- (A) Distortion of the hair line
- (B) Facial nerve injury
- (C) Formation of hematoma
- (D) Hypertrophic scarring
- (E) Skin slough

The correct response is Option A.

Compared with primary rhytidectomy, secondary rhytidectomy is more likely to result in distortion of the hair line. Incision placement is often difficult in a secondary procedure because of the shifting of the hair line. If the same incision patterns are used, the patient may ultimately develop recession of the temporal hairline, obliteration of sideburn hair, and postauricular alopecia. Therefore, the surgeon should create new incisions when performing secondary rhytidectomy.

Although the SMAS is thinner in patients undergoing secondary rhytidectomy, the overall risk for injury to the facial nerve is the same for both procedures. The risk for intraoperative bleeding and hematoma are lower following a secondary procedure than following the initial surgery, as flap dissection is technically easier. Because the facial skin is delayed surgically from the primary procedure, the vascular supply to the cervicofacial skin is typically healthy at the time of secondary rhytidectomy, and the risk for hypertrophic scarring or skin slough is minimal.

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87

A 13-year-old boy with gynecomastia desires corrective surgery. An initial preoperative evaluation of this patient should include examination of which of the following?

- (A) Eyes
- (B) Thyroid gland
- (C) Pectoralis muscle
- (D) Abdomen
- (E) Genitalia

The correct response is Option E.

The genitalia should be examined in this 13-year-old boy with gynecomastia. Although most adolescent boys with breast development do not exhibit other signs of feminization caused by hormonal excess or other genetic problems, examination of the genitalia could reveal an underlying cause of the gynecomastia. Testicular tumors are typically palpable on physical examination, and some adolescent boys will have nonpalpable and/or undescended testes. In patients with these findings, genetic and/or endocrine evaluation is required before any operative procedures are performed.

Visual fields may be altered in a patient who has a pituitary tumor, and patients with adrenal tumors may have palpable abdominal masses. Examination of these sites should be performed secondarily to examination of the genitalia.

Thyroid abnormalities are not associated with gynecomastia. The pectoralis muscle may be partially absent in patients with Poland syndrome but not in patients with gynecomastia.

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88

Which of the following best describes eyelid function in patients with unilateral idiopathic facial nerve paralysis (Bell's palsy)?

- (A) Ectropion resulting from dysfunction of the orbicularis muscle
- (B) Ectropion resulting from dysfunction of the trigeminal (V) nerve
- (C) Entropion resulting from dysfunction of the facial (VII) nerve
- (D) Ptosis resulting from dysfunction of the oculomotor (III) nerve
- (E) Ptosis resulting from dysfunction of the levator muscle

The correct response is Option A.

Bell's palsy, or unilateral idiopathic facial nerve paralysis, is the most common cause of facial paralysis, occurring in approximately 80% of symptomatic patients. Diagnosing this condition involves excluding other causes, such as trauma, stroke, and tumor; as a result, thorough evaluation should be undertaken.

Patients with Bell's palsy have dysfunction of the orbicularis oculi muscle, which is innervated by the zygomatic branches of the facial (VII) nerve. Ectropion, rather than entropion, is characteristic, and the patient is often unable to close the eye on the affected side.

The trigeminal (V) nerve is a sensory nerve that does not affect the muscle function of the eyelid.

Ptosis of the eyelids does not occur, because the levator muscle is innervated by the oculomotor (III) nerve and is thus uninvolved.

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89

Which of the following techniques is indicated to preserve sensation to the nipple-areola complex in a patient undergoing augmentation mammoplasty?

- (A) Avoiding periareolar incisions
- (B) Avoiding sharp dissection near the clavicle
- (C) Identifying and tagging of the sensory nerves as they exit the fascia
- (D) Performing blunt dissection lateral to the lateral edge of the pectoralis muscle
- (E) Positioning the implant subpectorally

The correct response is Option D.

Performing blunt dissection lateral to the lateral edge of the pectoralis muscle only is indicated to preserve sensation to the nipple-areola complex. The fourth and fifth anterolateral intercostal nerves primarily supply sensation to the nipple-areola complex; these nerves perforate the fascia just lateral to the pectoralis muscle through the interdigitation of the serratus anterior muscle. By performing blunt dissection only lateral to the pectoralis muscle, these nerves are stretched but not cut. Although the stretching of sensory nerves may still result in loss of sensation, it is more likely to be temporary than if the nerves are cut sharply.

Periareolar incisions do not disrupt the sensory innervation to the nipple-areola complex. It is not necessary to identify and tag the sensory nerves as they exit the fascia. The positioning of the implant (whether subpectoral or subglandular) and the type of dissection performed in the superior aspect of the pocket also will not affect sensation.

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A 25-year-old woman is undergoing evaluation of microgenia. Cephalometric analysis shows marked bony deficiencies in both the anteroposterior and vertical dimensions. Occlusion is normal. Which of the following is the most appropriate management?

- (A) Chin implantation
- (B) Intraoral vertical osteotomy
- (C) Sagittal split osteotomy
- (D) Osseous genioplasty
- (E) Distraction osteogenesis

The correct response is Option D.

In this patient who has microgenia with anteroposterior and vertical deficiencies of the chin, the most appropriate management is osseous genioplasty. Microgenia is one of several terms used to describe abnormalities of the chin. In this condition, the chin is small and bone is deficient in all three planes. Macrogenia describes a large chin; both macrogenia and microgenia can be associated with normal occlusion or mandibular prognathism. In patients with retrogenia, the chin is positioned posteriorly but is not necessarily small. Occlusion is normal in pure retrogenia. Patients with mandibular retrognathia have secondary retrogenia. Any of the above conditions can be associated with vertical abnormalities and chin asymmetry.

This patient has moderate-to-severe vertical microgenia, which frequently includes anteroposterior deficiency of the chin. This results in decreased height of the lower face, creating an imbalance between the midface and lower face. This abnormality can be corrected by performing osseous genioplasty, which will increase the projection of the mental symphysis within the sagittal plane while compensating for the vertical deficiency.

Chin implantation is recommended to increase the anteroposterior projection of the chin but does not correct vertical deficiency or excess.

Both intraoral vertical osteotomy and sagittal split osteotomy of the mandibular ramus will alter dental occlusion and are not indicated for correction of vertical or horizontal deficiencies, especially in a patient who has normal occlusion.

Distraction osteogenesis is indicated for treatment of skeletal deficiencies (ie, Pierre Robin sequence) but is an unnecessary, excessive option for correction of this deformity.

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91

A 35-year-old woman is scheduled to undergo reduction mammoplasty with removal of approximately 700 g of tissue bilaterally using an inferior pedicle technique. During preoperative marking of the patient, which of the following points should be used as a landmark to best determine the new position of the nipple?

- (A) 7 cm above the inframammary fold
- (B) 21 cm below the sternal notch
- (C) Inframammary fold
- (D) Midhumerus
- (E) Xiphoid

The correct response is Option C.

In patients undergoing reduction mammoplasty, the new nipple position should be determined when the patient is in an upright position, before the procedure is performed. During preoperative marking, the inframammary fold is used as a landmark to determine the most appropriate position of the nipple on the midbreast line. This is consistent regardless of the reduction technique performed.

The midhumerus, the xiphoid, and the measured distance below the sternal notch (19 to 23 cm) are helpful but less reliable landmarks. The measurement of 7 cm above the inframammary fold is essential during surgery, when the new nipple position is being marked during closure of the incisions, but is not a reliable preoperative measurement.

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92

A 40-year-old woman is to undergo rhinoplasty to increase projection of the nasal tip. In addition to tip grafting, which of the following techniques will provide the greatest tip projection?

- (A) Resection of the lateral crura
- (B) Resection of the lower lateral cartilages
- (C) Resection of the nasal spine
- (D) Suturing of the medial crura
- (E) Transfixion incision

The correct response is Option D.

Projection of the nasal tip can be increased by applying a cartilage graft to the tip, suturing the medial crura, and placing a strut graft between the medial crura. In addition, the caudal margin of the septum and cephalic alar rim can be resected to rotate the nasal tip and increase its projection subtly.

Tip projection is decreased by resecting the lateral and medial crura and the nasal spine. Complete transfixion incision ultimately decreases projection because it weakens nasal support.

It should be noted that procedures to correct tip projection can lead to a broad-based appearance of the nose. Weir-type alar resection or nasal sill resection is appropriate for rectifying this problem.

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93

The sensation to the nipple-areolar complex is derived from the

- (A) anterior cutaneous branches of the sixth and seventh intercostal nerves
- (B) anterolateral branches of the third through fifth intercostal nerves
- (C) branches of the lateral pectoral nerve
- (D) nerves of the cervical plexus
- (E) nerves traveling with the internal mammary artery

The correct response is Option B.

The sensation to the nipple-areolar complex is derived primarily from the fourth intercostal nerve, with lesser contributions from the third and fifth intercostal nerves. The superior portion of the breast derives its sensation from the nerves of the cervical plexus; sensory innervation to the medial skin and inframammary gland is provided by the anterior cutaneous branches of the second through seventh intercostal nerves.

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94

A 35-year-old woman who weighs 80 kg (176 lb) is undergoing large volume suction lipectomy with expected removal of 5 L of aspirate. In this patient, the total dose of lidocaine should NOT exceed how many milligrams?

- (A) 300
- (B) 400
- (C) 1600
- (D) 2800
- (E) 4800

The correct response is Option E.

The maximum safe dose of lidocaine is controversial. Some standard anesthesia texts list a maximum safe dose of 300 mg. In contrast, other texts report of maximum dose of 5 mg/kg or 7 mg/kg with the addition of epinephrine. However, more recent studies, from patients undergoing suction lipectomy with tumescent anesthesia, have reported the use of higher doses of lidocaine without complication. Several large studies have reported a maximum safe dose of lidocaine of 35 mg/kg, and some published dermatologic studies have cited the maximum safe dose to be as high as 55 mg/kg.

Although recent articles on fatalities related to suction lipectomy have attributed most patient deaths to pulmonary emboli, there has been speculation regarding the role of lidocaine toxicity, because lidocaine levels are typically not obtained at autopsy. Other recent articles suggest that a portion of the infused lidocaine is subsequently suctioned out, and that the use of general anesthesia versus local anesthesia may affect patient mortality rates.

Of the levels listed, 4800 mg is 60 mg/kg in an 80-kg patient, and is higher than the reported safety standards.

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95

A 23-year-old man is undergoing evaluation one week after sustaining a nasal fracture. Each of the following is appropriate management of this patient's injuries EXCEPT

- (A) closed realignment of the nasal fracture with forceps
- (B) drainage of septal hematomas
- (C) intranasal packing
- (D) osteotomy and realignment of the nasal fracture
- (E) use of a dorsal nasal splint

The correct response is Option D.

Complications associated with fracture of the nasal bones include hemorrhage and hematoma. Bleeding is common with nasal trauma because of the rich blood supply of the mucoperichondrium. Fracture of the nasal septum can lead to hematoma, which frequently occurs bilaterally, as septal fractures communicate between both sides of the nose. If untreated, a septal hematoma can become thick and fibrotic, obstructing the nasal passage, or can cause pressure necrosis of the nasal mucosa and cartilage, ultimately leading to septal perforation. Therefore, appropriate management involves incision along the base or most inferior portion of the hematoma, which will allow for drainage and prevent blood from refilling the cavity. In addition, closed reduction is appropriate for septal fractures and deviated nasal bones. Intranasal packing and dorsal nasal splints are typically used to aid in maintaining the reduction.

Osteotomy should not be performed in patients with acute fractures because nasal collapse may result. This procedure should be delayed until the fracture has healed significantly.

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96

Suction lipectomy is an effective procedure for management for each of the following conditions EXCEPT

- (A) axillary hyperhidrosis
- (B) HIV-associated lipodystrophy
- (C) liposarcoma
- (D) lymphedema
- (E) Madelung's disease

The correct response is Option C.

Suction lipectomy is recommended for many conditions because it effectively removes tissue while limiting incisions. Indications for suction lipectomy include axillary hyperhidrosis, in which apocrine and eccrine glands are removed from the axilla using a superficial technique. This results in reduced sweating with a minimal amount of scarring. Although repeat procedures are necessary in approximately 30% of patients, suction lipectomy produces longer lasting effects than treatment with botulinum toxin (Botox).

In patients with HIV infection, administration of protease inhibitor agents may cause abnormal redistribution of fat. Affected patients may develop adiposity in the abdominal and mandibular regions and atrophy in other areas, such as the nasolabial fold. Suction lipectomy is appropriate to remove the excess fat.

Madelung's disease, or benign symmetric lipomatosis, is a disorder of unknown cause that is characterized by diffuse growth of nonencapsulated lipomas, especially in the neck, shoulders, and posterior trunk. Suction lipectomy can increase range of motion and provide good cosmesis.

Patients with both congenital and acquired lymphedema can benefit from suction lipectomy to decrease tissue thickness. Although its effects are temporary, it provides significant relief and increases function. Other measures, such as massage and use of compressive garments, can be performed in combination with the lipectomy procedure.

Suction lipectomy is not recommended for removal of malignant tumors, such as liposarcoma, because this method of resection is often incomplete. In addition, such tumors may be seeded and histopathologic examination of the tumor specimen may be compromised.

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97

A 30-year-old man is undergoing evaluation for rhinoplasty. He has a 20 pack/year history of cigarette smoking and says that he has difficulty breathing through his nose. Evaluation of this patient's breathing difficulties should address each of the following anatomic structures EXCEPT the

- (A) dorsal nasal hump
- (B) internal nasal valve
- (C) nasal septum
- (D) nasal vestibule
- (E) turbinates

The correct response is Option A.

In a 30-year-old man who has breathing difficulties, the internal nasal valve, nasal septum, nasal vestibule, and turbinates should be evaluated. Obstruction can result from collapse or narrowing of the internal nasal valve that occurs as a result of scarring or excessive resection of cartilage. Deviation or perforation of the septum can cause obstruction or turbulent air flow; however, it is common to have significant septal deviation with no obstructive symptoms. The position of the nostrils and nasal vestibule may also affect breathing; ptosis of the nasal tip or an obtuse nasolabial angle can cause turbulent air flow. In addition, the middle and inferior turbinates regulate breathing. Chronic hypertrophy of the inferior turbinate is the most common cause of obstruction in a patient who has had no trauma or previous surgery. If this condition does not resolve with topical administration of decongestant agents, turbinateotomy should be considered. Obstruction of the nasal passages may also be caused by vasomotor or allergic rhinitis and exposure to cigarette smoke or other environmental toxins.

The dorsal nasal hump is a bony and cartilaginous prominence that does not affect internal nasal air flow.

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98

Each of the following deformities is commonly associated with microtia EXCEPT

- (A) cervical spine abnormalities
- (B) inner ear abnormalities
- (C) macrostomia
- (D) mandibular hypoplasia
- (E) preauricular pits

The correct response is Option B.

Patients with microtia have partial or complete absence of the external ear structures due to abnormal embryologic development of portions of the first, or mandibular, and second, or hyoid, branchial arches. This 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. Several abnormalities can occur in conjunction with microtia. Orbital auricular vertebral syndrome, also known as Goldenhar syndrome, and the Tessier No. 7 cleft also result from abnormalities in the development of the first and second branchial arches. Orbital auricular vertebral syndrome is characterized by microtia, cervical spine abnormalities, mandibular hypoplasia, preauricular pits and sinuses, and hemifacial microsomia. The Tessier No. 7 cleft manifests as microtia, macrostomia, and preauricular sinuses.

Because the external auditory meatus and internal ear are derived from different structures, the internal ear is usually well constructed in patients with microtia. Likewise, patients with orbital auricular vertebral syndrome have abnormalities of the middle and external ear but not the inner ear.

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99 to 100

For each patient, select the nerve most likely to cause the findings (A-E).

- (A) Acoustic nerve
- (B) Auriculotemporal nerve
- (C) Chorda tympani
- (D) Great auricular nerve
- (E) Tympanic nerve

99 A 62-year-old man has gustatory sweating three months after undergoing rhytidectomy.

100 A 56-year-old woman has persistent numbness in the right ear one year after undergoing deep-plane rhytidectomy.

The correct response for Item 99 is Option B and for Item 100 is Option D.

The 62-year-old man with gustatory sweating has Frey's syndrome, which may occur following rhytidectomy or parotidectomy. This condition is caused by dysfunction of the auriculotemporal nerve, which is a branch of the mandibular division of the trigeminal nerve (V_3). During surgery, the pathways of the auriculotemporal nerve become disrupted and then regenerate incorrectly, resulting in parasympathetic innervation of sympathetic nerve receptors. As a result, affected patients have facial flushing and sweating that occur with gustatory stimulation. Appropriate management includes injection of botulinum toxin (Botox) and operative placement of acellular dermal homograft (Alloderm) or a dermis-fascia-fat graft over the affected area to curb the symptoms.

The 56-year-old woman has persistent numbness of the right ear caused by injury to the great auricular nerve, which is derived from branches of cervical nerve roots C2-3 within the cervical plexus. The great auricular nerve crosses the sternocleidomastoid muscle 6.5 cm inferior to the tragus and provides sensation to the ear and postauricular region. If it is not identified prior to dissection, it can be injured easily because of its superficial location. It is the most commonly injured nerve during rhytidectomy, resulting in numbness of the ear.

The acoustic (VIII) nerve, also known as the vestibulocochlear nerve, divides into vestibular and cochlear branches near the lateral end of the internal acoustic meatus. The function of these branches is related to balance and hearing. This nerve is not encountered during dissection for rhytidectomy.

The chorda tympani is a branch of the facial (VII) nerve and is not injured in rhytidectomy. This nerve branch provides taste sensation to the anterior two-thirds of the tongue and parasympathetic secretory fibers to the submaxillary and sublingual glands.

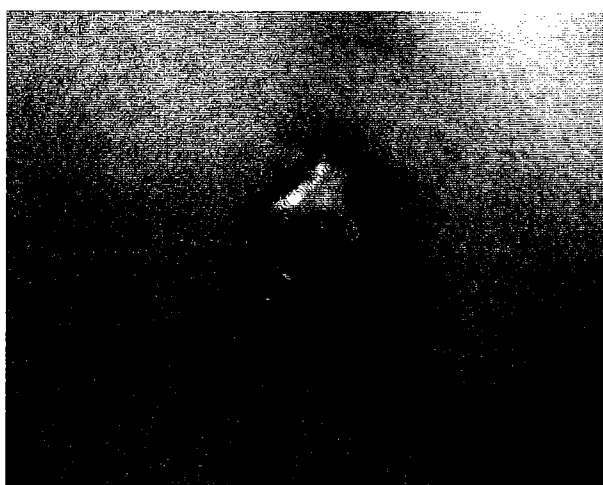
The glossopharyngeal (IX) nerve provides taste sensation to the posterior third of the tongue and sensation to the mucous membranes of the pharynx and palatine tonsil. The tympanic branch of the glossopharyngeal nerve, also known as the nerve of Jacobson, provides sensation to the tympanic cavity and can cause referred pain to the ear in patients with carcinoma of the head and neck.

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INTEGUMENT

101



A 16-year-old boy has the scar on the left shoulder shown in the photographs above. What is the minimum recurrence rate of this type of scar following surgical excision only?

- (A) 5%
- (B) 10%
- (C) 25%
- (D) 55%

The correct response is Option D.

This 16-year-old boy has a keloid on the left shoulder. Unlike hypertrophic scars (which remain within their original boundaries), keloids are abnormal scars that extend beyond the confines of the healing wound and do not regress. Recurrence rates following surgical excision alone have been shown to be at least 55% and as high as 100%, according to the results of some studies. Therefore, excision alone is not recommended; it should instead be combined with postoperative injection of corticosteroids and/or application of gel sheeting or compression garments to minimize recurrence.

In patients with more severe keloids, a short postoperative course of radiation therapy is recommended following excision to decrease recurrence rates to an acceptable level.

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102

In a 50-year-old woman who underwent augmentation mammoplasty with silicone implants 12 years ago, a silicone granuloma is noted in the axillary region on clinical examination. Which of the following statements best characterizes this finding?

- (A) Silicone granulomas are a frequent complication following augmentation mammoplasty or reconstruction with silicone implants
- (B) Silicone granulomas indicate a link to the existence of implant-related systemic disease
- (C) Silicone granulomas represent a common tissue response to foreign materials
- (D) Surgical resection is rarely indicated

The correct response is Option C.

Although silicone granulomas are a well-recognized tissue response to the presence of foreign material, such as silicone, these granulomas are found only rarely in patients who have undergone augmentation mammoplasty or reconstruction with silicone gel breast implants. Any granulomas that are detected should be resected if they are symptomatic or of diagnostic concern. No evidence has been presented in peer-reviewed scientific literature to support the theory that silicone granulomas help to cause implant-related systemic disease, and in fact the existence of implant-related systemic disease is controversial in itself.

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103



A 23-year-old woman has carbonaceous material embedded in the skin after sustaining injuries in a combustion accident at work. A photograph is shown above. Which of the following is the most appropriate management?

- (A) Carbon dioxide laser therapy
- (B) Nd:YAG laser therapy
- (C) Deep dermabrasion
- (D) Wide local excision and coverage with a thin split-thickness skin graft

The correct response is Option B.

In patients who have certain types of foreign material embedded in the skin, especially road asphalt, carbonaceous material, or ink from amateur tattoos, the most appropriate method of removal is multiple treatments with the Nd:YAG laser.

In the past, traumatic tattoos were removed with mechanical abrasive techniques, including dermabrasion, salabrasion, and the rubbing of table salt into the skin, each of which produced satisfactory results in superficial tattoos. However, better results have recently been demonstrated with laser therapy, which involves the removal of successive layers of skin to expose the intradermal pigment, which is subsequently vaporized.

The surgeon should take great care while administering Nd:YAG laser treatments in any patient who has sustained injuries resulting from a gunpowder or fireworks accident, as the unburned, embedded gunpowder can actually combust during treatment, leading to unacceptable scarring.

Although laser therapy is the treatment of choice for traumatic tattoos, the carbon dioxide laser is not recommended because it does not effectively remove embedded carbonaceous material. In addition, this laser has no selective absorption; as a result, epidermal structures are injured more easily and scarring is increased.

Deep dermabrasion and wide local excision combined with thin split-thickness skin grafting are excessively invasive procedures that will yield poor cosmetic results.

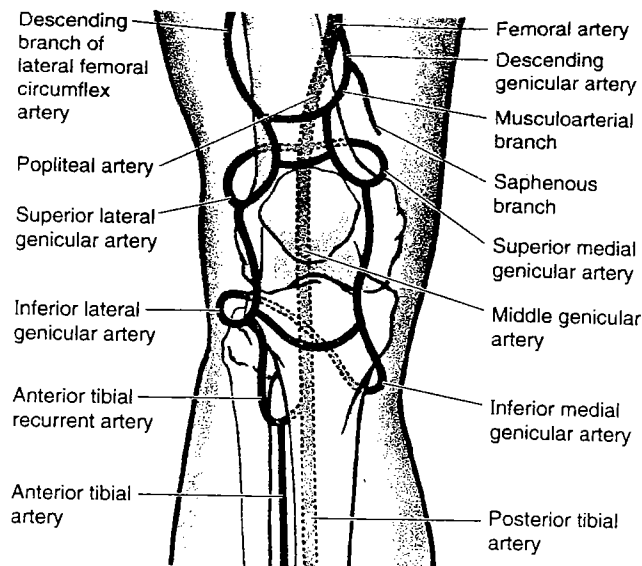
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104

The saphenous artery originates from which of the following arteries?

- (A) Descending lateral femoral circumflex
- (B) Genicular
- (C) Profunda femoris
- (D) Superficial femoral



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The correct response is Option B.

The saphenous artery supplies vascularity to the saphenous flap, a fasciocutaneous flap that provides only limited coverage of small defects in the region of the knee. The saphenous artery is a branch of the descending genicular artery. The genicular artery arises from the superficial femoral artery.

The descending branch of the lateral femoral circumflex artery arises from the profunda femoris and continues distally in the leg as the superior lateral genicular artery. The profunda femoris artery gives off its major branches more proximally in the leg. The superficial femoral artery becomes the popliteal artery at the popliteal fossa.

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105

Which of the following medications is most appropriate to prevent and to treat heterotopic ossification?

- (A) Calcitonin
- (B) Etidronate
- (C) Mithramycin
- (D) Phosphate

The correct response is Option B.

Heterotopic ossification is an abnormal proliferation of bone that occurs in patients who have sustained burns, spinal cord injuries, and closed head trauma. This condition becomes apparent initially on radiographs one to four months after injury. It may occur in up to 40% of patients who sustain spinal cord injuries and is clinically significant in one-half of those patients.

Etidronate (Didronel) and pamidronate (Aredia) are most appropriate for prevention or treatment of heterotopic ossification. These agents act primarily on bone to inhibit the formation, growth, and dissolution of hydroxyapatite crystals and do not impair fracture healing.

Calcitonin, mithramycin, and phosphate decrease serum calcium levels and do not directly affect heterotopic ossification.

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106

Which of the following is the most appropriate method for decreasing the depth of a phenol chemical peel?

- (A) Applying antibiotic ointment
- (B) Taping the skin
- (C) Using croton oil
- (D) Using liquid soap

The correct response is Option D.

The depth of a phenol peel is decreased by using liquid soap, which increases the surface tension and thus decreases the penetration and absorption of the phenol.

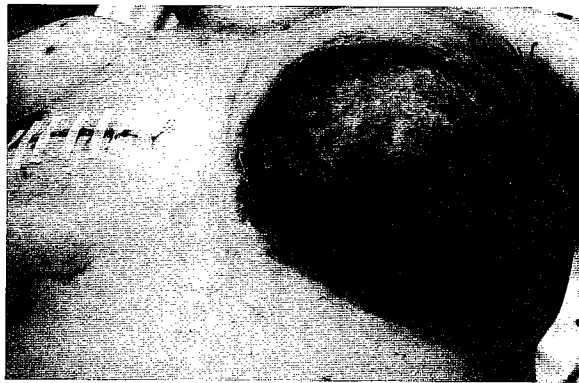
Applying antibiotic ointment and taping the skin increase the depth of a phenol peel by providing a vapor barrier.

Phenol peels are typically based on croton oil, a skin irritant that increases the speed and depth of epidermal destruction. Phenol peels were previously performed according to the Baker formula, which involved placement of the phenol in a solution of distilled water, croton oil, and liquid soap. This formula is no longer used because the solution did not effectively dilute the toxicity of the phenol.

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107



Six hours after undergoing breast reconstruction with a free TRAM flap, a 35-year-old woman has swelling of the reconstructed area and bluish discoloration of the skin. A photograph is shown above. Capillary refill time is increased. Findings on Doppler ultrasonography of the flap are within normal limits.

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

- (A) Fluid resuscitation
- (B) Anticoagulant therapy
- (C) Release of sutures and observation
- (D) Operative exploration

The correct response is Option D.

This 35-year-old woman who underwent breast reconstruction now exhibits signs of venous outflow obstruction, including increased capillary refill time, dark or bluish discoloration of the skin, and swelling of the affected area. In addition, complete venous obstruction does not always manifest as abnormal findings on Doppler ultrasonography, and the Doppler signal may indeed fall within normal limits in many affected patients. Therefore, in the presence of these clinical signs, the only appropriate option is to perform repeat operative exploration.

Fluid resuscitation and anticoagulant therapy are not appropriate treatment of venous obstruction in patients who have undergone free tissue transfer. In the same way, release of the sutures will not resolve the obstruction.

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108

In patients undergoing dermabrasion, which of the following is the most likely finding at the level of the superficial reticular dermis, indicating the endpoint of treatment?

- (A) Coarse, nonbleeding tissue
- (B) Confluent bleeding with a coarse tissue background
- (C) Smooth, nonbleeding tissue
- (D) Sparse, punctate bleeding with a pink tissue background

The correct response is Option B.

Dermabrasion, which is a method of skin resurfacing involving controlled mechanical abrasion of the epidermis and a variable portion of the dermis, is especially useful for treatment of scars, facial rhytides, and the skin deformities associated with rhinophyma. This process results in mechanical depression of scars and elevated tissues and induction of collagen synthesis. Following dermabrasion, wound repair begins in the remnant dermal appendages.

The depth of dermabrasion is determined by clinical endpoints encountered during the treatment process. The epithelium is removed initially; the dermal-epidermal surface is smooth and does not bleed. Sparse, punctate bleeding indicates that the surgeon has reached the superficial papillary dermis. This sparse bleeding becomes greater as the surgeon planes deeper into the papillary dermis, and the background is notably coarser. The level of the superficial reticular dermis is characterized by brisk, confluent bleeding on a coarse tissue background. This indicates the endpoint of treatment because further dermabrasion can lead to permanent scarring.

Although re-epithelialization typically occurs within seven to 10 days following dermabrasion, erythema may persist for as long as six weeks after treatment.

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109

What is the theoretic gain in length achieved by performing a Z-plasty with angles of 75 degrees?

- (A) 25%
- (B) 50%
- (C) 75%
- (D) 100%

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, increasing the length of the central limb and changing 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 scars within the lines of minimal tension. The theoretic gain in length correlates directly with the angle and length of the flap limbs. The actual gain in the length of the central axis will be decreased by 30% to 50% because of the contractile properties of skin.

The theoretic gain achieved with each angle is illustrated in the table below.

Z-plasty	Theoretic gain
30 degrees	25% gain
45 degrees	50% gain
60 degrees	75% gain
75 degrees	100% gain
90 degrees	120% gain

A 60-degree Z-plasty is performed most commonly because it produces a significant gain in length while minimizing the tension of closure.

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110

Which of the following best describes the mechanism of action of botulinum toxin (Botox)?

- (A) Inhibition of acetylcholine release at the neuromuscular junction
- (B) Inhibition of messenger RNA-mediated production of acetylcholine
- (C) Potentiation of the acetylcholine effect at the neuromuscular junction
- (D) Prevention of acetylcholine binding at the neuromuscular junction

The correct response is Option A.

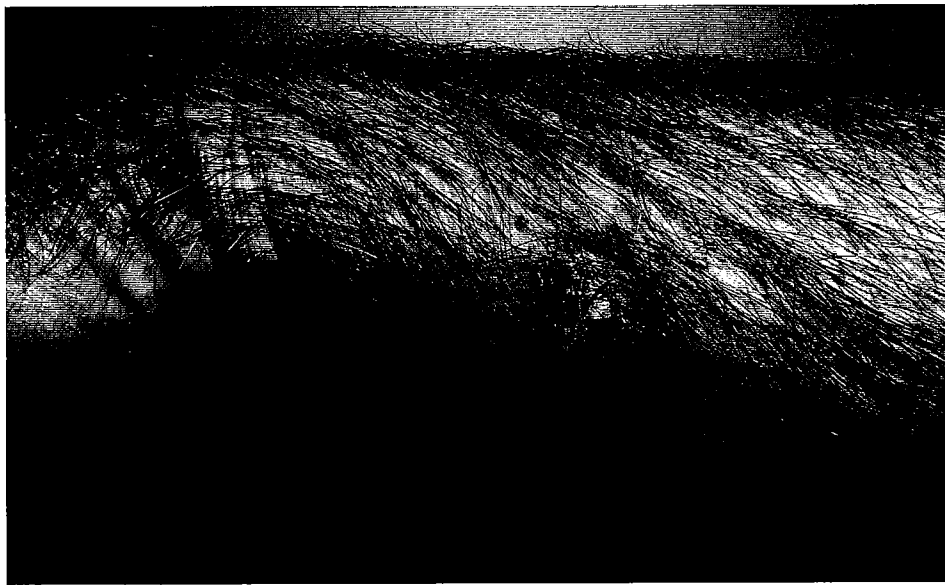
Botulinum toxin, also known as Botox, is an exotoxin derived from *Clostridium botulinum* bacteria. Its neuromuscular mechanism of action involves inhibition of the release of acetylcholine. Botulinum toxin is packaged (typically in units of 100) in a sterile, vacuum-dried form, which must be stored at -5°C (23°F). It can also be reconstituted by diluting it with nonpreserved saline at a rate of 2.5 U/.1 mL.

Botulinum toxin is currently approved by the Food and Drug Administration (FDA) for treatment of glabellar rhytides. However, it is increasingly being used as an "off label" treatment for dispersion of rhytides of the forehead and the periorbital, perioral, and platysmal regions.

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111



A 55-year-old man has a lesion on the right forearm that has enlarged over the past six weeks. A photograph is shown above. Which of the following is the most likely diagnosis?

- (A) Cyndroma
- (B) Dermatofibroma
- (C) Keratoacanthoma
- (D) Seborrheic keratosis
- (E) Syringoma

The correct response is Option C.

The most likely diagnosis is keratoacanthoma, a common cutaneous neoplasm that typically occurs in men older than age 50 years. Keratoacanthomas grow rapidly over several weeks and are believed to regress spontaneously if left untreated. They are characterized by an umbilicated center with a keratin plug. Because they are difficult to distinguish from squamous cell carcinoma and may indeed be linked, excision for histopathologic confirmation is recommended.

Cylindromas are round, firm, fleshy tumors of the scalp that are rarely solitary.

Dermatofibroma is a fibrous, papular lesion characteristically found on the lower extremities in young adults.

Seborrheic keratosis has a waxy, greasy, or pressed-on appearance and generally occurs on the face and trunk of older persons.

Syringoma is a flesh-colored or yellow papule that typically develops in females during adolescence or early adulthood. These lesions may be multiple and often occur only on the lower eyelids.

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112

A 28-year-old man with quadriplegia is undergoing debridement of a massive grade IV sacrococcygeal pressure ulcer. The entire coccyx and a large portion of the sacrum are necrotic. Which of the following is the highest level at which bony debridement can be performed without entering the dural space?

- (A) Juncture of S2-3
- (B) Juncture of S3-4
- (C) Juncture of S4-5
- (D) Juncture of the coccyx and sacrum
- (E) Mid coccyx

The correct response is Option A.

The juncture of S2-3 is the highest level at which bony debridement can be performed without risking entry into the dural space. Extensive debridement in the dural space may damage the nerve plexuses of the sacrum and coccyx.

The conus medullaris, which is the terminal end of the neural portion of the spinal cord, lies at the level of L2. The cauda equina, or intravertebral portion of the nerves of the lower spine, continues on through the sacral canal to the

coccyx, and the dural and subarachnoid sheaths terminate at the level of the second vertebral body. Vascular fibrofatty tissue surrounds the dura mater. The coccyx is formed by the fusion of four rudimentary vertebrae at the end of the spinal cord; it articulates with the caudal end of the sacrum.

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113

A 35-year-old woman with hidradenitis suppurativa and cellulitis affecting the axillae is scheduled to undergo incision and drainage and initiation of antibiotic therapy. In addition to *Staphylococcus aureus*, which of the following organisms is most commonly isolated in patients with hidradenitis?

- (A) *Peptostreptococcus* sp.
- (B) *Pseudomonas aeruginosa*
- (C) *Staphylococcus epidermidis*
- (D) *Streptococcus faecalis*
- (E) *Viridans streptococcus*

The correct response is Option E.

Staphylococcus aureus and viridans streptococcus are the two most commonly isolated organisms in hidradenitis suppurativa. As a result, initial management should include empiric administration of antibiotics effective against these organisms until the results of cultures are received.

Hidradenitis suppurativa is a condition that is poorly understood but is thought to result from chronic infection of the apocrine sweat glands. Although the axillae are affected most commonly, the perineum, groin, and genitalia may also be involved. Extensive scar tissue and fistula tracts develop over time, and the condition becomes progressively more difficult to treat. In patients with hidradenitis, appropriate management is application of warm compresses, incision and drainage of the appropriate areas, and administration of antibiotics. Patients with more severe cases should undergo excision of the involved skin and subcutaneous tissue followed by coverage with a local flap or skin graft. Investigational studies of a method of immunotherapy, based on the staphylococcal phage lysate vaccine, have shown promising results in patients with chronic hidradenitis suppurativa.

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114



A 51-year-old woman has had multiple lesions around the nostrils for the past two years. She says that the lesions first appeared similar to pimples and have enlarged. A photograph is shown above. The lesions have not resolved with intralesional injections of corticosteroids. Findings on nasal smear and tissue cultures are negative. Histologic examination of a biopsy specimen of a lesion shows noncaseating epithelioid granulomata.

Which of the following is the most likely diagnosis?

- (A) Cutaneous sarcoidosis
- (B) Keloids
- (C) Neurofibromatosis
- (D) Rhinosporidiosis
- (E) Wegener's granulomatosis

The correct response is Option A.

In this 51-year-old woman who has the findings shown in the photograph, the most likely diagnosis is cutaneous sarcoidosis. This condition occurs in 10 Caucasians and 35 African Americans per 100,000 of population. Although sarcoidosis typically affects the lungs and intrathoracic lymph nodes, cutaneous symptoms, such as maculopapular eruptions, sarcoidal plaques, lupus pernio lesions, and subcutaneous and cutaneous nodules, occur in 25% of patients. Histologic examination of a biopsy specimen of affected skin shows noncaseating granulomata and aggregates of epithelioid cells and giant cells containing Schaumann (asteroid bodies) within the dermis.

Appropriate treatment of cutaneous sarcoidosis is intralesional administration of a corticosteroid or oral administration of hydroxychloroquine sulfate or methotrexate. Oral corticosteroids are reserved for patients with severe cutaneous disfigurement or symptomatic involvement of internal organs. Surgical options are limited because of the systemic nature of this condition.

In patients with keloids, histologic examination shows extensive fibrous tissue with scattered collagen fibers but without a definite architecture or a granulomatous pattern.

Neurofibromatosis is characterized histologically by swirls of fibroblastic cells, collagen, and nerve fibers. Granulomas are not present.

Rhinosporidiosis is a fungal granulomatous condition of the nose caused by *Rhinosporidium seeberi* bacteria. Affected patients have pedunculated masses with reddish-purple discoloration. Although findings on culture are usually negative, microscopic examination of nasal smears typically shows sporangia.

Wegener's granulomatosis is a systemic disease that initially causes localized perforation of the septum or multiple intranasal ulcerations. Histologic examination shows findings consistent with necrotizing granulomatous vasculitis.

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115

Which of the following biologic dressings contains only human-derived materials?

- (A) Alloderm
- (B) Apligraf
- (C) Biobrane
- (D) Integra
- (E) Transcyte

The correct response is Option A.

Each of the biologic dressings listed above is either a synthetic or tissue-engineered biologic skin substitute that will provide a clean, moist environment and protect the open wound until definite wound coverage is obtained.

Alloderm is lyophilized acellular human cadaveric dermis. This dressing contains only human-derived materials. Because it is devoid of immunogenic cells, it does not undergo the rejection that occurs with cadaveric skin. Alloderm can also be used as soft-tissue filler in patients undergoing cosmetic procedures. In some instances, thin layers of this dressing can be placed on a wound bed to vascularize and support a skin graft.

Apligraf is comprised of a bilayer of neonatal epidermal keratinocytes and dermal fibroblasts within a matrix of bovine collagen. This dressing is used for coverage of venous stasis ulcers and foot ulcers. Its mechanism of action involves graft adherence and subsequent remodeling on the wound bed.

Biobrane is a synthetic wound dressing composed of nylon and silicone fabric coated with porcine collagen. It provides temporary coverage of partial-thickness wounds and can be removed when epithelialization of the wound occurs.

Integra is a bioengineered dermal substitute that consists of a dermal matrix of bovine collagen and shark-derived chondroitin-6-sulfate covered by a bilayer of Silastic epidermis. When the dermal replacement layer becomes infiltrated with capillaries, fibroblasts, and inflammatory cells, the Silastic cover can be removed and autografting can be performed.

Transcyte is a dermal substitute comprised of neonatal dermal fibroblasts cultured onto a thin, semipermeable membrane of silicone that is bonded to a nylon mesh and bovine collagen. The fibroblasts secrete structural proteins and growth factors, creating a dermal matrix for future grafting or temporary coverage of partial-thickness burns.

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116

In a patient who has retinal hemangiomas and cerebellar hemangioblastomas, which of the following is the most likely diagnosis?

- (A) Klippel-Trénaunay syndrome
- (B) Parkes-Weber syndrome
- (C) Rendu-Osler-Weber syndrome
- (D) Sturge-Weber syndrome
- (E) von Hippel-Lindau disease

The correct response is Option E.

Patients with von Hippel-Lindau disease have hemangiomas affecting the retina and hemangioblastomas of the cerebellum and visceral organs. Seizures and mental retardation may also be associated.

Klippel-Trénaunay syndrome is characterized by a port-wine stain (typically involving one extremity) overlying venous and lymphatic malformations.

Parkes-Weber syndrome is similar to Klippel-Trénaunay syndrome but is differentiated by the presence of arteriovenous fistulas.

Rendu-Osler-Weber syndrome, or hereditary hemorrhagic telangiectasia, is an autosomal dominant disorder characterized by multiple ectatic vessels involving the skin, mucous membranes, and visceral organs. Epistaxis, hematuria, hematemesis, and melena are frequently 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 (V_1 and V_2). Other findings include focal motor seizures, hemiparesis, and visual field defects, especially glaucoma. Mental retardation may result from leptomeningeal venous malformations.

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117



A 46-year-old woman has had painful purpura-like lesions on the breasts, abdomen, and lower extremities for the past three weeks. She currently undergoes dialysis for end-stage renal disease. Physical examination shows several dry, leathery, full-thickness areas of skin necrosis. A photograph is shown above. Calciphylaxis is diagnosed.

Laboratory studies are most likely to show an increased serum level of which of the following?

- (A) Calcium
- (B) Glucose
- (C) Parathyroid hormone
- (D) Protein C
- (E) Thyroid-stimulating hormone

The correct response is Option C.

Calciphylaxis, also known as uremic gangrene syndrome, is a rare complication of end-stage renal disease. This condition is characterized by painful, ischemic, violaceous skin lesions on the extremities and sometimes the trunk that exhibit a livido reticularis pattern. Full-thickness skin necrosis ensues, leading first to secondary infection, then to sepsis, and frequently to death; the mortality rate in patients with calciphylaxis has been reported to be as high as 60%. Histologic examination of affected skin shows fat necrosis, calcification of the subcutaneous tissues, and microcalcifications in the intima and media of small arteries. Luminal narrowing of the vessels with intimal hyperplasia is common, and complete occlusion also occurs.

Calciphylaxis is a result of the metabolic imbalance in calcium and phosphate homeostasis that is frequently observed in patients with renal failure. Secondary hyperparathyroidism causes an abnormal increase in calcium X phosphate product, which can lead to soft-tissue calcification. In these patients, serum levels of parathyroid hormone are most likely to be increased. Hyperphosphatemia is also characteristic.

The lesions that occur in patients with calciphylaxis rarely heal spontaneously and frequently become infected. Therefore, various management options should be considered, including debridement of the lesions, topical administration of antimicrobial agents, and frequent dressing changes, followed by skin grafting, or direct excision and closure of the lesions. However, in this patient, the dry, leathery composition of the affected skin suggests that infection has not yet developed. Subtotal thyroidectomy is also advocated for treatment in some patients.

Although hypercalcemia may be present, serum calcium levels are normal in most patients with this condition.

Many patients with end-stage renal disease also have diabetes mellitus, but hyperglycemia is not typically associated with calciphylaxis.

A deficiency of, and not an increase in, serum protein C levels has been proposed to be a contributing factor to tissue death in these patients because it causes thrombosis in small vessels.

Increased serum levels of thyroid-stimulating hormone occur in patients with hypothyroidism.

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Which of the following findings is more likely in patients who undergo resurfacing with the erbium:YAG laser than in patients treated with the carbon dioxide laser?

- (A) Erythema
- (B) Hypopigmentation
- (C) Scarring
- (D) Skin tightening
- (E) Transudate wound

The correct response is Option E.

The erbium:YAG (Er:YAG) laser is now the treatment of choice for ablative resurfacing of the skin. This laser emits light at a wavelength of 2940 nanometers (nm) and is absorbed by water within the epidermis a minimum of 10 times more efficiently than the carbon dioxide laser. The decreased dermal heating that occurs during treatment with the Er:YAG laser results in minimal long-term contraction of the dermis, but produces a transudative wound once the epidermis has been eliminated. The transudation becomes more profuse as the surgeon ablates deeper into the dermis.

Because the mechanism of action of the Er:YAG laser is photomechanical rather than photothermal, coagulation necrosis is limited and hyperemia is decreased. As a result, permanent hypopigmentation occurs in less than 5% of patients undergoing treatment with the Er:YAG laser. In contrast, permanent hypopigmentation has been reported in as many as 40% of patients undergoing carbon dioxide laser therapy.

Scarring may occur with any type of laser and is related to the amount of heat generated from the laser, also known as its pulse.

Likewise, skin tightening occurs with both the Er:YAG and the carbon dioxide laser.

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119

Which of the following is a physiologic manifestation of shock following acute burn injury?

- (A) Decreased cardiac output
- (B) Decreased systemic vascular resistance
- (C) Increased peripheral blood flow
- (D) Increased plasma volume
- (E) Increased urine output

The correct response is Option A.

Patients with acute burn shock exhibit hemodynamic changes similar to those seen with hypovolemic shock. Management should focus on volume resuscitation and maintenance of tissue perfusion.

Following burn injury, cardiac output is decreased to 40% to 60% of normal as a result of decreased plasma volume and increased systemic vascular resistance. The release of myocardial depressants further diminishes cardiac output. In addition, angiotensin II, catecholamines, neuropeptide Y, and vasopressin all act on arterial smooth muscle to cause vasoconstriction.

Decreased plasma volume and capillary pressure occur as a result of factors released from both injured and uninjured tissue and excessive fluid shifting that occurs within the first hour after injury. Although the total body water level remains constant, there is an increase in cell water content of 70% to 80%. Volume resuscitation is required to maintain tissue perfusion; unfortunately, this will also exacerbate burn wound edema.

Decreased urine output is caused by inadequate fluid resuscitation and occurs as a response to decreased tissue perfusion and increased systemic vascular resistance. Aggressive volume replacement is required during the first 24 to 48 hours after injury to restore intravascular fluid.

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120

Which of the following best characterizes male-pattern alopecia?

	Anagen phase	Telogen phase
(A)	Decreased	Decreased
(B)	Decreased	Increased
(C)	Increased	Decreased
(D)	Increased	Increased
(E)	Unchanged	Unchanged

The correct response is Option B.

Male-pattern alopecia is characterized by a decrease in the anagen, or active, phase of the hair follicle and an increase in the telogen, or resting, phase. Patients with this condition have more of their hair follicles in the resting phase, and those in the active phase produce hair growth for a shorter time. Hair follicles can also be classified as either terminal, which produce larger, pigmented fibers, or villous, which produce finer fibers that have less pigmentation and are more difficult to visualize. Terminal fibers are found typically on the adult scalp, eyebrows, axilla, and pubic region, while villous fibers are noted on the forehead, bald scalp, and along the hairline itself. In patients with male-pattern alopecia, many follicles in the scalp are transformed from terminal to villous.

Minoxidil is the recommended treatment of male-pattern alopecia. This agent halts the hair loss and increases the number of hairs as well as the diameter of the existing hairs, but is only effective in patients with mild to moderate baldness.

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121

A 26-year-old man who weighs 80 kg (176 lb) is brought to the emergency department three hours after sustaining superficial burns involving 20% total body surface area (TBSA), partial-thickness burns involving 15% TBSA, and full-thickness burns involving 25% TBSA. According to the Parkland formula, which of the following is the most appropriate method of fluid resuscitation for this patient?

- (A) Administration of lactated Ringer's solution 800 mL/hr for the next eight hours
- (B) Administration of lactated Ringer's solution 1300 mL/hr for the next five hours
- (C) Administration of hypertonic saline solution 1000 mL/hr for the next 12 hours
- (D) Administration of hypertonic saline solution 1500 mL/hr for the next five hours
- (E) Administration of hypertonic saline solution 600 mL/hr for the next eight hours

The correct response is Option B.

In a patient who has second- and/or third-degree burn injuries that cover more than 20% of the total body surface area (TBSA), acute fluid resuscitation should be performed with administration of lactated Ringer's solution 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 (second-degree burns involving 15% TBSA and third-degree burns involving 25% TBSA) will require 12,800 mL of fluid during the first 24 hours: 6400 mL during the first eight hours and 3200 mL in both the second and third eight-hour periods. Because he received no fluid during the first three hours immediately following injury, 6400 mL of lactated Ringer's solution, or 1280 mL/hr, should be administered over the next five hours in order to adequately resuscitate the patient.

Vital signs and urine output should also be monitored in this patient to determine the success of resuscitation efforts.

Administration of hypertonic saline solution for fluid resuscitation in burn patients is controversial and is not universally recommended.

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122

Which of the following best explains the long duration of bupivacaine when compared with lidocaine?

- (A) Lipid solubility
- (B) Longer onset of action
- (C) pK_a
- (D) Protein binding
- (E) Vasoconstrictor activity

The correct response is Option D.

The pharmacokinetic properties of local anesthetics, including lipid solubility, pK_a , protein binding, and nonspecific tissue binding, determine their clinical characteristics. The duration of action correlates directly with protein binding; ie, greater protein binding results in a longer duration of action. This best explains the long duration of action of bupivacaine when compared with lidocaine; bupivacaine has been shown to be 96% protein-bound, while lidocaine is 64% protein-bound.

The lipid solubility of a local anesthetic determines its potency. Higher solubility leads to a higher potency drug.

Bupivacaine has a longer onset of action (5 to 8 minutes) than lidocaine (2 to 4 minutes), but its duration of action (up to 10 hours) is much longer than that of lidocaine (up to 3 hours). This small difference in onset of action does not account for the prolonged duration of action.

The pK_a is defined as the negative logarithm of the acid ionization constant. This determines the onset of action of a local anesthetic because the uncharged (or base) form is the active component. Local anesthetics with a high pK_a have the slowest onset of action because the pK_a varies more greatly from the physiologic pH of the drug. Lidocaine, with a pK_a of 7.9, has a more rapid onset of action than bupivacaine, which has a pK_a of 8.1.

Addition of epinephrine, a vasoconstrictor, to a local anesthetic prolongs the duration of action of the anesthetic and decreases its toxicity. However, all local anesthetics, with the exception of cocaine, have natural vasodilator activity.

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123

Which of the following pigmented nevi is classified as a hamartoma?

- (A) Acral nevus
- (B) Becker nevus
- (C) Dysplastic nevus
- (D) Halo nevus
- (E) Spitz nevus

The correct response is Option B.

A Becker nevus is a common benign cutaneous hamartoma with epidermal and/or dermal elements. These lesions can occur at birth but often develop during the second and third decades of life, and males are affected more frequently. Becker nevi are typically brown patches or plaques on the upper trunk. Hypertrichosis is commonly associated, and an underlying smooth muscle hamartoma is present. The term "nevus" is actually a misnomer because histologic examination of this lesion shows no nevus cells.

Acral nevi are typically junctional or compound and are located on the palmar or plantar surfaces.

A dysplastic nevus is referred to by several terms, including Clark's nevus, atypical nevus, or atypical mole. This lesion is a precursor to malignant melanoma.

A halo nevus, or Sutton's nevus, is a central melanocytic nevus surrounded by a rim or halo of hypopigmented skin. This loss of pigmentation typically corresponds with spontaneous regression of the central nevus and is thought to occur secondary to a cell-mediated and humoral immune response to nevus antigens.

A Spitz nevus is a benign proliferation of melanocytes on the face, trunk, or extremities. This lesion develops in children and is characterized by a rapid, irregular growth phase. Because it is difficult to differentiate from malignant melanoma, excision for histopathologic confirmation is recommended.

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124

Silver sulfadiazine is administered topically to a patient with severe burns of the trunk and upper extremities. Which of the following is the most likely adverse effect?

- (A) Hyponatremia
- (B) Metabolic acidosis
- (C) Metabolic alkalosis
- (D) Neutropenia
- (E) Pain with application

The correct response is Option D.

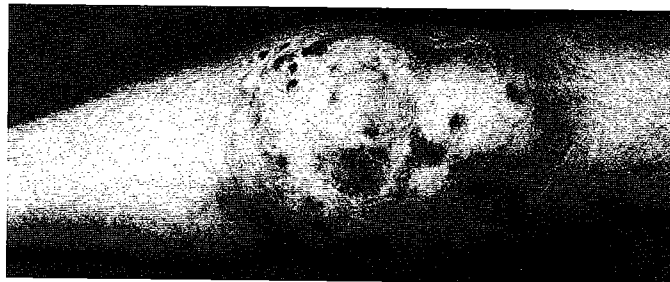
The most likely adverse effect of treatment of severe burns with topical application of silver sulfadiazine (Silvadene) is neutropenia, a self-limiting condition that is not thought to increase mortality in burn patients. Silver sulfadiazine is an effective treatment because it has a broad spectrum of activity and a low incidence of development of resistant organisms. Application is painless, and wound dressings are not required.

Hyponatremia occurs with administration of silver nitrate, a topical agent that is applied painlessly and has no resistance to organisms but penetrates tissue poorly. Metabolic acidosis and pain with application are adverse effects of topical administration of mafenide acetate (Sulfamylon), which provides excellent penetration of burn eschar. Metabolic alkalosis does not occur with application of silver sulfadiazine.

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125



A 26-year-old man has had progressive enlargement of the left arm over the past 10 years. A photograph is shown above. Neurapraxia of the median and ulnar nerves developed recently. The right arm decompresses when he lifts his hand over his head.

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 E.

This patient most likely has a venous malformation, which is characterized by compressibility and 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, which may affect the function of the involved extremity. When a venous malformation is associated with thrombosis, pain may result.

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.

Capillary malformations, or port-wine stains, have abnormalities limited to the capillaries in the dermis. These lesions are present at birth and do not regress spontaneously. If left untreated, cobblestoning, ectasia, and progressive

darkening may occur. 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.

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.

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126

A 60-year-old farmer with multiple actinic keratoses undergoes topical therapy with administration of 5% 5-fluorouracil cream for three weeks. Six months later, a 3-mm ulcer develops in the right infraorbital region and enlarges to 1 cm over three months.

Which of the following is the most likely diagnosis?

- (A) Basal cell carcinoma
- (B) Bowen's disease
- (C) Keratoacanthoma
- (D) Seborrheic keratosis
- (E) Squamous cell carcinoma

The correct response is Option E.

This 60-year-old farmer with a 1-cm ulcerated lesion in the right infraorbital region most likely has a squamous cell carcinoma. Actinic keratoses occur in older, fair-skinned persons and are thought to represent the cumulative effects of exposure to ultraviolet light. Treatment of actinic keratoses (typically with administration of 5-fluorouracil) is recommended because of the potential for malignancy; it has been estimated that 20% of patients with actinic keratoses will eventually develop cutaneous squamous cell carcinoma. However, this type of carcinoma rarely metastasizes.

Basal cell carcinomas can arise in this region and appear similar to but are less common than squamous cell carcinoma. The rapid growth (enlarging to 1 cm over a period of three months) would not be consistent with a basal cell carcinoma.

Bowen's disease, or intraepithelial squamous cell carcinoma, occurs commonly in both sun-exposed and non-sun-exposed areas in older persons. These are typically solitary, sharply defined lesions that have red discoloration and

are covered with plaque. Potential causes of Bowen's disease include exposure to ultraviolet light or arsenic, viral infections, chronic trauma, and heredity.

Keratoacanthomas grow rapidly over several weeks and regress spontaneously over four to six months if left untreated. Because they have been shown to progress to invasive or metastatic carcinoma in rare instances, excision for histopathologic confirmation is recommended. They are initially firm, round, flesh-colored or reddish solitary papules, then progress to dome-shaped nodules with a smooth, shiny surface and an umbilicated center with a keratin plug. The face, neck, and dorsal aspect of the arms are affected most commonly; lesions on the trunk are rare.

Seborrheic keratoses are common lesions that occur on the trunk and upper and lower extremities in middle-aged and older persons. They are sharply circumscribed and have a waxy, greasy, or pressed-on appearance with a friable hyperkeratotic surface. Pigmentation varies from mild to deep black. This is not a premalignant condition.

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127

A 70-year-old man has a T3 N0 M0 melanoma involving the skin of the preauricular region. In addition to wide local excision and superficial parotidectomy, which of the following is the most appropriate next step in the management of the regional lymph nodes?

- (A) Observation
- (B) Prophylactic radiation therapy
- (C) Sentinel node biopsy
- (D) Modified radical neck dissection
- (E) Radical neck dissection

The correct response is Option C.

This patient has a T3 melanoma, which is defined as a tumor that has a Breslow's thickness between 1.5 and 4 mm, or is designated as Clark's level IV. Because this melanoma is of intermediate thickness and there are no palpable regional lymph nodes, it is classified as Stage II. In addition to local excision and superficial parotidectomy, sentinel node biopsy is currently recommended to rule out the presence of micrometastases in patients with these lesions.

Lymphatic invasion has the greatest influence on prognosis, but the amount of tumor burden within the lymphatic system also affects prognosis. Approximately 30% to 40% of patients with melanomas of intermediate thickness and no palpable lymph nodes in the neck have subclinical nodal micrometastases; lymph node dissection results in

increased survival in this subgroup. However, performing elective lymph node dissection in all of these patients, without identifying those who would benefit most, would subject the remaining 60% to 70% who do not have demonstrable micrometastases to unnecessary morbidity without increasing survival advantage. Sentinel lymphadenectomy using vital blue dye and radiocolloid for mapping can be performed to identify the subgroup in which regional lymphadenectomy should be performed.

Clinical observation followed by neck dissection when regional lymph nodes become apparent is not an acceptable option.

Although prophylactic radiation therapy has been shown to produce benefits similar to elective lymph node dissection in patients with tumors of intermediate thickness, it subjects approximately 66% of patients to unnecessary morbidity. As other means of identifying micrometastases become available, radiation therapy should be considered as a valid treatment alternative in selected patients.

Neck dissection is indicated for patients with stage II tumors who have micrometastases identified via sentinel lymphadenectomy and in patients who have stage III melanoma. The dissection should include levels I through V as well as any other nodal groups that may be at risk. Neck dissection has more of a staging role when it is performed in a patient with a Stage II tumor who has not undergone sentinel lymphadenectomy. A modified dissection, which spares the sternocleidomastoid muscle, internal jugular vein, and spinal accessory nerve, is often preferred. Radical neck dissection is typically performed only if these structures are involved with tumor or the surgeon is inexperienced and/or unfamiliar with the modified approach.

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128

Which of the following laser wavelengths has the greatest affinity for water?

- (A) 585 nm
- (B) 1064 nm
- (C) 1320 nm
- (D) 2940 nm
- (E) 10,600 nm

The correct response is Option D.

The erbium:YAG (Er:YAG) laser emits light at a wavelength of 2940 nanometers (nm) and is absorbed by water within the epidermis a minimum of 10 times more efficiently than the carbon dioxide laser. Its mechanism of action involves photomechanical injury to the targeted tissue.

The 585-nm pulsed-dye laser is used in the treatment of cutaneous vascular lesions.

The lesser-energy, variable pulsed-width frequency, double Q-switched Nd:YAG laser and the higher-energy, millisecond pulsed Nd:YAG laser both have a wavelength of 1064 nm. The double Q-switched Nd:YAG laser is appropriate for the removal of hair or tattoos, and the millisecond pulsed Nd:YAG laser is indicated for treatment of vascular lesions.

The 1320-nm wavelength is incorporated by many nonablative lasers that stimulate collagen production within the dermis. Although the target of these 1320-nm lasers is water, they have 50% less affinity for water than the Er:YAG laser.

The carbon dioxide laser emits light at a wavelength of 10,600 nm. In contrast to the photomechanical action of the Er:YAG laser, the carbon dioxide laser produces photothermal injury. In addition, it has less specificity for its target, resulting in greater collateral injury, including greater contraction of the skin and dermis and increased collagen remodeling. As a result, recovery time is prolonged, and the risk for hyperpigmentation and other associated complications is greater.

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129

A 52-year-old man with quadriplegia has pressure ulcers of the left and right ischia after sitting in his wheelchair for prolonged periods. Physical examination of the ulcers shows involvement of the reticular dermis on the left and exposure of underlying muscle with purulent drainage on the right.

Which of the following is the correct clinical staging of these ulcers?

	Left	Right
(A)	Stage I	Stage II
(B)	Stage II	Stage III
(C)	Stage II	Stage IV
(D)	Stage III	Stage III
(E)	Stage III	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

This 52-year-old quadriplegic man has pressure ulcers on both the left and right ischia. Because the pressure ulcer on the left involves the reticular dermis, it would be correctly classified as stage II. In contrast, the pressure ulcer on the right involves muscle and is thus classified as Stage III.

Staging systems for pressure ulcers address depth only and do not consider the presence of osteomyelitis, rates of recurrence, and the nutritional status and compliance of the patient. In addition, they do not necessarily reflect the underlying cause of the ulcer.

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130

A 6-year-old boy with sudden onset of fever and septic shock has disseminated intravascular coagulation. Physical examination shows hemorrhagic necrosis of the skin of the upper and lower extremities. Which of the following is the most likely causative organism?

- (A) *Escherichia coli*
- (B) Group A beta-hemolytic streptococcus
- (C) *Neisseria meningitidis*
- (D) *Staphylococcus aureus*
- (E) Varicella-zoster virus

The correct response is Option C.

This 6-year-old boy has purpura fulminans, an uncommon illness that typically affects young children but can also occur in adults. Purpura fulminans often develops in association with a predisposing condition. It manifests as severe hemorrhage and necrosis of skin associated with disseminated intravascular coagulation. Affected patients have petechial rashes, which progress to confluent areas of ecchymosis, and then to necrotic, hard, full-thickness eschar. Bilateral symmetric gangrene of the extremities necessitates amputation in as many as 20% of patients. Reconstructive procedures, including free tissue transfer, are frequently required to resurface necrotic areas and salvage extremities with exposed joints. Septic shock and organ failure may also result. Mortality rates have been reported to be as high as 60%.

Purpura fulminans is associated with endotoxin-producing bacteria. Although *Neisseria meningitidis* is the most common causative organism, *Streptococcus pneumoniae*, *Haemophilus influenzae*, and *Rickettsia* have also been implicated. The mechanism of this condition is believed to be liposaccharide-mediated endothelial damage caused by bacteria, leading to decreased serum levels of proteins C and S. Skin necrosis results from a low-flow coagulative state and microemboli. Management of affected patients includes general hemodynamic support, intravenous administration of an appropriate antibiotic, wound care, eventual soft-tissue reconstruction, and amputation when necessary.

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131

Which of the following is the predominant cell type involved in wound contracture?

- (A) Eosinophil
- (B) Erythrocyte
- (C) Fibroblast
- (D) Monocyte
- (E) Neutrophil

The correct response is Option C.

Fibroblasts, specifically myofibroblasts, are the predominant cell type involved in wound contracture. These cells first appear approximately three days after injury and are typically located at the periphery of the wound, but contain actin-rich filaments that act throughout the area of injury to initiate contracture and alter the shape of the open wound. Wound contracture is a cell-mediated process that typically begins four to five days after the initial injury and continues until at least 21 days after injury. It can be influenced by many factors, including the degree, area, and shape of the injury and the length of time that the wound remains open. Transforming growth factor-beta and possibly other cytokines may also contribute to wound contracture.

Although erythrocytes, monocytes, and neutrophils are important cell mediators in the wound healing process, they are not primarily involved in wound contracture. Eosinophils are typically involved in hypersensitivity and allergic reactions.

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132

Which of the following vascular lesions is characterized by an arteriole central vessel?

- (A) Macular stain
- (B) Port-wine stain
- (C) Pyogenic granuloma
- (D) Spider angioma
- (E) Strawberry hemangioma

The correct response is Option D.

Spider angioma, or arteriolar malformation, is a small vascular malformation that contains a central blanching arteriole vessel. Spider angiomas occur on the face in both children and adults. Obliteration of the central feeding arteriole is the goal of treatment; otherwise, the lesion will continue to enlarge. Laser therapy or electrocautery is recommended.

Macular stains are typically seen on the skin of neonates and are not true vascular nevi.

Port-wine stains are capillary vascular malformations of the face that are seen at birth and grow commensurately with the child.

Pyogenic granulomas are reparative vascular lesions commonly seen on the head and neck in children. Because these lesions receive their blood supply primarily from capillaries, they are not true vascular malformations.

A strawberry hemangioma is a venous malformation that is typically seen at birth and enlarges during the first few months of life. These lesions do not grow commensurately with the child.

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133

According to the donor dominance concept of hair transplantation, which of the following is the most appropriate donor site?

- (A) Frontal scalp
- (B) Occipital scalp
- (C) Parietal scalp
- (D) Sideburn
- (E) Vertex

The correct response is Option B.

In order to successfully transplant hair using minigrafting or micrografting techniques, the surgeon must understand the concept of donor dominance, which states that each hair follicle possesses its own individual, genetically-defined lifespan. Because of this, hair follicles located in those areas that tend to have a longer lifespan will continue to possess the same lifespan even after they have been transplanted. The hairs of the occipital scalp have the longest genetically-defined lifespan in most patients; in addition, this donor site is acceptable aesthetically.

Depending on the classification of male-pattern alopecia, early hair loss can occur in the frontal, parietal, or vertex regions. The sideburns often have a lifespan that is genetically similar to the occipital area, but the donor site is quite small and usually unacceptable.

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134

A 24-year-old woman has been hospitalized for the past week because she has toxic epidermal necrolysis syndrome involving 90% of total body surface area (TBSA) with sparing of the lower legs and feet. She has been mechanically ventilated, and her hands have been splinted in a functional position except during passive occupational therapy. Following discontinuation of the ventilation, this patient's hands should be splinted for how long to prevent contractures?

- (A) 6 weeks
- (B) 3 months
- (C) 6 months
- (D) 1 year
- (E) No additional splinting is required

The correct response is Option E.

Toxic epidermal necrolysis syndrome is an uncommon systemic condition characterized by acute inflammation of the skin and mucous membranes and sometimes the bowel and respiratory epithelium. In patients who develop this life-threatening condition, the mortality rate ranges from 20% to 60%. Although it is thought to be caused by an adverse reaction to an antibiotic, anti-inflammatory agent, or anticonvulsant, other factors, including viral, bacterial, and fungal infections and neoplasms, have also been implicated.

Patients with toxic epidermal necrolysis syndrome have sloughing of the skin at the dermal-epidermal junction. However, because injury occurs only to the level of the superficial dermis, the skin will heal without contracture. Therefore, no additional splinting is required following discontinuation of ventilation. Long-term sequelae of this condition include complications involving the eyes and fingernails and changes in skin pigmentation.

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135

Which of the following is the most likely mechanism of action of silicone sheeting/gel pads in enhancing scar maturation?

- (A) Decreasing wound tension
- (B) Deregulating cellular integrins
- (C) Enhancing epidermal contact inhibition
- (D) Increasing the static electronegative field
- (E) Maintaining regulated wound temperature

The correct response is Option D.

Silicone sheeting and silicone gel pads are used to treat hypertrophic or immature scars and keloids. Although their exact mechanism of action is unknown, some surgeons postulate that their positive effect is associated with the generation of an increased static electronegative field by the silicone. This mechanism of action results in favorable wound effects. Other theories propose that the wound-healing mechanism is related to the decreased oxygenation, sustained pressure, or hydrating effects of silicone oil resulting from the use of these products.

Silicone sheeting/gel pads have not been shown to decrease wound tension, affect epidermal contact inhibition, or regulate intracellular integrins or wound temperature.

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136

A 15-year-old girl has an 8 × 8-mm traumatic, full-thickness defect of the right ala that extends to the alar margin. Which of the following is most appropriate for reconstruction of the defect?

- (A) Split-thickness skin graft from the thigh
- (B) Full-thickness skin graft from the retroauricular area
- (C) Composite graft from the ear
- (D) Forehead flap
- (E) Nasolabial flap

The correct response is Option C.

Reconstruction of this patient's defect is best accomplished using a small composite graft from the ear. When reconstructing deep defects of the nasal ala, the primary goals are re-establishing the structural support of the nose and matching the skin color and texture for an optimal aesthetic result. In addition, lining, support, and cover are required because the defect is full thickness. A small auricular composite graft will provide appropriate structural support, soft-tissue vascularity, an excellent color match, and the necessary lining and cover for the nose. The donor site of the auricular composite graft is inconspicuous.

Because nasal reconstruction without cartilage grafting for structural support typically results in notching of the alar margin, split-thickness and full-thickness skin grafts are inadequate. Forehead and nasolabial flaps provide an excellent color match but no support and leave obvious scars on the face, which is unacceptable aesthetically in a 15-year-old girl.

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137

Which of the following is the most likely result of treatment of the skin with topical tretinoin (retinoic acid)?

- (A) Cellular atypia
- (B) Consolidation of melanin granules
- (C) Decreased collagen synthesis
- (D) Thinning of the epidermis
- (E) Thinning of the stratum corneum

The correct response is Option E.

Tretinoin, or retinoic acid, is used for antiaging therapy because it can accelerate the reversal of skin damage caused by sun exposure. Its mechanism of action is believed to involve stimulation or oppression of specific genes within nuclear receptors. Tretinoin has been shown to inhibit the binding of AP1 transcription factor to DNA by 70%, thereby decreasing the activation of collagenase, gelatinase, and stromelysin.

Histologic effects associated with tretinoin use include thinning of the stratum corneum, reversal of cellular atypia, and thickening of the epidermis. In the dermis, collagen synthesis is increased and melanin granules are dispersed more evenly.

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138

A 35-year-old man with paraplegia undergoes debridement of a pressure ulcer of the ischium followed by coverage with a fasciocutaneous flap. What is the approximate likelihood that the patient will develop a recurrent or new pressure ulcer within the next year?

- (A) 20%
- (B) 40%
- (C) 60%
- (D) 80%
- (E) 100%

The correct response is Option D.

In patients with pressure ulcers, conservative management, including debridement and dressing changes, is recommended as first-line treatment. Surgical management should be considered for patients who have pressure ulcers classified as Stage III or IV; however, this depends on the overall health and status of the patient. The goals of surgical treatment of pressure ulcers include debridement of the ulcer and/or bursa, excision of heterotopic soft-tissue calcification, and excision of any bony prominences, followed by thorough irrigation. The wound should then be closed using muscle, myocutaneous, and/or fasciocutaneous flaps to achieve maximum durable coverage. If these goals are not accomplished, the pressure ulcer is likely to recur, even if patient compliance is high and nutritional support and wound care are adequate.

According to the results of recent studies, 80% of patients undergoing debridement and flap closure for treatment of pressure ulcers had positive results at the time of patient discharge; however, it has also been shown that 79% of paralyzed patients subsequently developed a new or recurrent pressure ulcer at the same site within nine months. In addition, the operative complication rate was 36% and the average hospitalization time was 45 days. Another study reported a recurrence rate of pressure ulcers of 82% within 18 months in patients with paraplegia.

Although surgery is acceptable for wound management, other lifestyle modifications should be considered in patients who are susceptible to pressure ulcers, including relief of pressure, patient education, and maintenance of good nutritional status.

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139

Which of the following is the primary advantage of using Integra (artificial skin) for coverage of full-thickness burns?

- (A) Allowing for immediate use of cultured epithelial autografts
- (B) Allowing for use of thinner autografts
- (C) Avoidance of autografting
- (D) Complete revascularization within seven days
- (E) Prevention of fibroblast ingrowth into the dermal replacement layer

The correct response is Option B.

Integra, or artificial skin, is the most widely used skin substitute. It is a synthetic bilaminar membrane composed of a dermal matrix of porous bovine collagen cross-linked with shark-derived chondroitin-6-sulfate and covered by temporary Silastic epidermis. It does not contain neonatal fibroblasts or autologous keratinocytes. A two-stage application process is required; the initial stage is application of the dressing.

Following its application, the dermal matrix of the Integra dressing acts as a template, becoming infiltrated with host fibroblasts, endothelial cells, and inflammatory cells. The host collagen gradually replaces the bovine collagen during the healing process, and the silicone cover controls moisture loss and protects the wound. Adequate revascularization occurs within two to three weeks, at which time the superficial silicone layer will have sloughed off as a result of ingrowth through the collagen and glycosaminoglycan matrix. At this time, the Integra graft can be removed, and a thinner autograft, such as a very thin sheet of split-thickness skin graft, can be applied for durable coverage.

In addition to allowing for use of thinner autografts, advantages of Integra include immediate temporary coverage, more rapid healing of donor sites, and improved cosmesis.

Because the revascularization process is delayed, cultured epithelial autografts would fail to take if applied immediately because of the lack of vascularization in the wound bed.

Although Integra can be used to cover partial-thickness burns, it does not relieve the need for autografting over full-thickness burns.

As mentioned above, Integra is revascularized in two to three weeks, not within seven days, and allows for fibroblast ingrowth into the dermal replacement layer.

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140

A patient is scheduled to undergo injection of bovine collagen (Zyderm) in the glabellar region. A test dose should be administered how many weeks prior to injection?

- (A) 1
- (B) 2
- (C) 4
- (D) 8
- (E) 12

The correct response is Option C.

Zyderm and Zyplast are highly purified forms of bovine collagen typically injected to provide improvement of rhytides and depressed scars. Because approximately 3% of all treated patients will have an allergic reaction to injectable bovine collagen, skin testing must be performed prior to any treatment. Following intradermal injection of a single test dose, the patient should be assessed 48 hours after injection and again at four weeks after injection. Any adverse changes noted at the test site indicate an allergic reaction, and occasionally reactions appear as long as four weeks after injection. Recently, some physicians have begun to advocate two episodes of antigen exposure, potentially increasing the number of positive reactions and identifying additional patients who may subsequently develop allergic reactions.

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141

Which of the following vascular structures supply the secondary vascular pedicle of the gracilis muscle flap?

- (A) Lateral femoral circumflex artery and vein
- (B) Medial femoral circumflex artery and vein
- (C) Obturator artery and vein
- (D) Profunda femoris artery and vein
- (E) Superficial femoral artery and vein

The correct response is Option E.

The gracilis flap is a type II muscle flap (one dominant pedicle and one secondary pedicle) that is used for pedicled and free tissue reconstructive procedures. This flap is comprised of one primary vascular pedicle, which is supplied by the profunda femoris artery via the ascending branch of the medial femoral circumflex artery and vein, and one secondary vascular pedicle, which is supplied by the superficial femoral artery and vein.

The lateral femoral circumflex artery and vein supply the rectus femoris and vastus lateralis muscle flaps.

The obturator artery is a branch of the internal iliac artery and divides further to give off vascular branches, primarily in the thigh.

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142

A 59-year-old man is undergoing follow-up evaluation one year after excision of a recurrent basal cell carcinoma involving the skin of the cheek. Current examination shows a slight bulge at the site of excision that is firm to palpation and is covered by a well-healed scar.

Which of the following is the most appropriate initial management?

- (A) Observation
- (B) Antibiotic therapy
- (C) Massage therapy
- (D) Incision and drainage
- (E) Incisional biopsy

The correct response is Option E.

The recurrence rate following initial treatment of a basal cell carcinoma smaller than 2 cm is 10%. This rate increases to 25% following treatment of recurrent tumors and can be as high as 82% if tumor excision is incomplete. Recurrence rate is highest for tumors of the periorbital, periauricular, and perinasal regions. Morpheaform basal cell carcinoma, which is characterized by indistinct margins, is also prone to recurrence. Any patient who has had one recurrent tumor should be considered at risk for a second recurrent tumor.

Because of the risk for recurrence, any patient who has had a basal cell carcinoma (and especially those with recurrent carcinomas) should undergo frequent follow-up examinations. A biopsy should be performed if a new abnormality is detected at the site of previous excision; therefore, this patient who has a firm bulge on the cheek at the site of a previously excised basal cell carcinoma should initially undergo incisional biopsy. Any treatment should be deferred until the diagnosis is made. In this patient, a recurrent tumor will most likely be ruled out following histologic examination of the biopsy specimen. A fluid collection may be associated with the adenoid cystic variety of basal cell carcinoma. If recurrent basal cell carcinoma is excluded, the most appropriate management would be needle aspiration of the fluid and open drainage and packing of the wound or placement of a drain. If a recurrent carcinoma is found, treatment would involve surgery, radiation therapy, or a combination of both.

Antibiotics should be administered only to patients with proven infection. Massage therapy is useful for management of contracted scar tissue but is not indicated as initial management of a patient in whom a recurrent tumor may be likely.

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143

Which of the following lesions has been shown to result from sun exposure?

- (A) Dermatofibroma
- (B) Ephelides
- (C) Lentigines
- (D) Seborrheic keratoses
- (E) Xanthelasma

The correct response is Option C.

Lentigines are benign pigmented macules that result from increased activity of epidermal melanocytes; these lesions do not fade in the absence of sun exposure. The two primary types of lentigines are simple, which can occur in any area and usually develop during childhood, and solar, also known as senile, which occur in sun-exposed areas such as the face, dorsal aspect of the hands and forearms, and upper trunk.

Dermatofibromas are common benign, fibrous, papular lesions smaller than 1 cm that develop on the trunk and upper or lower extremities in early and middle adulthood. These lesions may be induced by minor trauma and are more common in women than in men. It is important to differentiate them from dermatofibrosarcoma protuberans, which is a malignant tumor. Histologic examination of a biopsy specimen of a dermatofibroma will show localized proliferations of fibrohistiocytes within the dermis.

Ephelides are common pigmented freckles that are not related to sun exposure. They contain a normal quantity of melanocytes, but the amount of melanin within the epidermal cells is increased.

Seborrheic keratoses are benign keratinocytic tumors seen in patients older than age 30 years. They exhibit a classic waxy, greasy, or pressed-on appearance and may have a generalized distribution.

Xanthelasma involves multiple, soft, yellow-orange plaques that occur around the eyes as a result of deposition of lipid-laden macrophages. Approximately 30% of patients with xanthelasma have a disorder of lipid metabolism.

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144

According to the Mathes/Nahai classification of muscle and musculocutaneous flaps, which of the following is a type III flap?

- (A) Gastrocnemius
- (B) Gluteus maximus
- (C) Latissimus dorsi
- (D) Pectoralis major
- (E) Vastus lateralis

The correct response is Option B.

The gluteus maximus and rectus abdominis muscle flaps have a type III vascular pattern consisting of dual dominant pedicles.

Type I muscle flaps have one dominant pedicle; examples include the gastrocnemius, tensor fascia lata, and vastus lateralis flaps. In type II muscle flaps, such as the gracilis and trapezius, there is one dominant pedicle and multiple secondary pedicles. The external oblique and sartorius muscle flaps have a type IV vascular pattern, which is characterized by a segmented blood supply. Type V muscle flaps, such as the latissimus dorsi and pectoralis major, have one dominant pedicle and multiple secondary segmental pedicles.

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145

Which of the following is an absolute contraindication to performing vacuum-assisted closure (VAC) therapy for wound management?

- (A) Bacterial colonization of the wound
- (B) Open fracture of a long bone
- (C) Presence of an enteric fistula
- (D) Presence of exposed blood vessels
- (E) Presence of osteomyelitis

The correct response is Option D.

Vacuum-assisted closure (VAC) is an effective technique for management of open wounds. Advantages include promoting the ingrowth of healthy granulation tissue, decreasing the duration of the wound healing process, simplifying

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dressing changes, and increasing the intervals between dressing changes. However, the presence of exposed arteries or veins is an absolute contraindication to VAC therapy because the vessel may burst and subsequently hemorrhage into the VAC device; this can be potentially fatal.

Although VAC therapy is not contraindicated in open wounds, which by their nature are colonized by bacteria, the presence of gross bacterial infection precludes the use of the VAC device.

VAC therapy is an option for management of open fractures until definitive flap reconstruction can be performed.

The presence of an enteric fistula within the wound is no longer an absolute contraindication to VAC therapy.

The presence of osteomyelitis in the wound bed is not a contraindication to VAC therapy.

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146

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A 45-year-old man has had a painful lesion on the left ear for the past six months. The patient says that he typically sleeps on his left side. Physical examination shows a nodule on the antitragus. Histologic examination of a shave biopsy specimen shows no evidence of malignancy.

Which of the following is the most likely diagnosis?

- for
(A) Acrochordon
(B) Chondrodermatitis nodularis helcis
(C) Dermatofibroma
(D) Sebaceous hyperplasia
(E) Xanthelasma

The correct response is Option B.

The most likely diagnosis is chondrodermatitis nodularis helcis, also known as chondrodermatitis nodularis chronica helcis, a benign lesion of the ear that usually occurs in men older than age 40 years. This is a painful erythematous nodule that typically involves the helix or antihelix and often occurs on the side that the patient prefers to sleep. Although intralesional injection of corticosteroids may be curative, shave excision or direct excision is usually required to exclude the possibility of cutaneous malignancy.

Acrochordons are simple skin tags that occur more frequently with age.

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A dermatofibroma is a common benign, fibrous, papular lesion usually seen on the trunk and upper or lower extremities in early and middle adulthood. This lesion is more common in women than in men.

Patients with sebaceous hyperplasia have small, yellowish lesions that usually occur on or around the face.

Xanthelasma involves multiple soft yellow-orange plaques, typically in the preorbital area, that result from deposition of lipid-laden macrophages. Approximately 30% of affected patients have a disorder of lipid metabolism.

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147

A 37-year-old woman has symptomatic blepharoptosis on the right one week after undergoing injection of 25 units of botulinum toxin (Botox) into the glabellar region for treatment of dynamic rhytides. Which of the following is the most appropriate management?

- (A) Observation
- (B) Use of a patch on the left eye for 48 hours
- (C) Use of alpha-adrenergic agonist eyedrops
- (D) Administration of a beta-adrenergic blocker
- (E) Operative correction of ptosis

The correct response is Option C.

In this 37-year-old woman who has symptomatic blepharoptosis following botulinum toxin injection, the most appropriate management is administration of alpha-adrenergic agonist eyedrops. Botulinum toxin (Botox) is associated with numerous other complications, including diplopia, retrobulbar hemorrhage, perforation of the globe, lagophthalmos, photophobia, epiphora, ectropion, and exposure keratitis. Ecchymoses, eyelid retraction, eyebrow ptosis, and asymmetry have also occurred in some patients.

Blepharoptosis results from migration of the toxin from the area of treatment (the glabellar region in this patient) into the levator muscle. This effect is typically transient, as the dose of migrated toxin diminishes significantly. Patients with mild to moderate symptoms should be reassured that condition is typically self-limiting, and no treatment is recommended. If the blepharoptosis is moderate to severe, ocular decongestants, such as the alpha-adrenergic agonists antazoline and naphazoline, are administered. These eyedrops act to contract Müller's muscle temporarily and thus elevate the upper eyelid margin, relieving the symptoms.

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148

An otherwise healthy 25-year-old man sustains second- and third-degree burns over 60% of total body surface area (TBSA). Which of the following immunologic responses is LEAST likely in this patient?

- (A) Activation of helper T lymphocytes
- (B) Increased circulating immunoglobulin G (IgG) level
- (C) Increased interleukin-7 (IL-7) level
- (D) Redistribution of T lymphocytes in the peripheral blood
- (E) Suppression of circulating T lymphocytes

The correct response is Option B.

One immunologic response anticipated in this 25-year-old man who has sustained a 60% TBSA burn is impairment of cell-mediated immunity resulting from impairment of T-lymphocyte function. This manifests in burn patients as a delay in allograft rejection, suppression of the graft-versus-host response, and development of skin hypersensitivity reactions. Alterations in T-lymphocyte function include overall suppression of circulating T lymphocytes and a redistribution of T lymphocytes within peripheral blood and tissue compartments.

The initial response to significant burn injury is activation of helper T lymphocytes. B lymphocytes undergo functional changes resulting from the profound decrease in immunoglobulin levels following thermal injury. Although all classes of immunoglobulins are decreased, immunoglobulin G (IgG) levels exhibit the greatest decrease. This decrease can be attributed to plasma leakage, increased protein turnover, and decreased synthesis of IgG by B lymphocytes.

Interleukin-7 levels are increased during the first week after injury; this results in a decrease in the proliferative capacity of B lymphocytes.

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149

Which of the following substances is NOT contained in Jessner's solution?

- (A) Ethanol
- (B) Glycolic acid
- (C) Lactic acid
- (D) Resorcinol
- (E) Salicylic acid

The correct response is Option B.

Jessner's solution is incorporated into skin peeling agents to even the depth of the peel and improve exfoliation. This solution, which contains ethanol, lactic acid, resorcinol, and salicylic acid, is often used for treatment of hyperpigmentation. The mechanism of action of Jessner's solution is believed to be destruction of intracellular connections between keratinocytes as well as removal of the epidermis. Its use results in increased epidermal turnover and a decreased quantity of melanin-containing keratinocytes.

Because the depth of penetration of Jessner's solution is limited, the rate of complications is decreased. Mild erythema develops following the first application, which may worsen over time. Additionally, frosting of the skin may be seen with further application.

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150

Histopathologic examination of a proliferating hemangioma is most likely to show each of the following characteristics EXCEPT

- (A) decreased 17-beta estradiol binding sites
- (B) increased collagenase activity
- (C) increased quantity of mast cells
- (D) multilaminate basement membrane
- (E) plump endothelial cells

The correct response is Option A.

Hemangiomas are true benign neoplasms that have plump, rapidly dividing endothelial cells and an increased quantity of mast cells on histopathologic examination. These mast cells produce heparin, which is believed to be the primary stimulus for migration of capillary endothelial cells. The number of mast cells begins to decrease as the hemangioma involutes.

During the proliferation phase of a hemangioma, the levels of circulating 17-beta estradiol are increased. In addition, the number of binding sites for 17-beta estradiol is actually increased, not decreased. Collagenase activity is increased in all enlarging hemangiomas as the endothelial cells destroy the basement membrane to allow for the formation of new capillary tubules. A multilaminate basement membrane is also observed.

In contrast, vascular malformations exhibit flattening of the endothelium, thinning of the basement membrane, and a normal quantity of mast cells.

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HAND AND EXTREMITIES

151

A 12-year-old boy with spastic cerebral palsy and moderate mental retardation is undergoing evaluation of hand function. On physical examination, the arms are held in a reducible posture, with the elbows flexed, the forearms pronated, and the wrists flexed. The ulnar digits are flexed tightly in the palm, and the thumb is held against the index and long fingers. There is ulnar palmar maceration and wounding. Moving two-point discrimination is 12 to 14 mm bilaterally.

Which of the following tendon transfers is most appropriate?

- (A) Flexor carpi ulnaris to extensor carpi radialis brevis
- (B) Flexor carpi ulnaris to flexor digitorum profundus
- (C) Flexor digitorum profundus to extensor digitorum communis
- (D) Flexor digitorum superficialis to flexor digitorum profundus
- (E) Pronator teres to extensor carpi radialis longus

The correct response is Option D.

Patients with cerebral palsy typically have cognitive, developmental, and sensory deficits that affect motor function. Cerebral palsy can be characterized as spastic, with fluctuations in muscle tone, or as a motion disorder, involving ataxia, dyskinesia, and tremors. Although improvement is difficult to achieve in those affected by motion disorders, some children with spastic cerebral palsy have enhanced hand function following surgery.

Important elements included in the preoperative testing of patients with cerebral palsy are evaluation of cognition, hand placement, and sensibility. In patients who fail to meet the minimum criteria in these areas, the primary goal of surgery is improvement of hygiene and not necessarily of hand function.

Cognition is determined by intelligence quotient (IQ) testing; children can be classified as normal (within a standard deviation of the norm), educable (IQ of 50 to 70), and trainable (IQ of 30 to 50).

Hand placement is measured by asking the child to place one hand on the head initially and then on the opposite knee. This maneuver tests range of motion, precision of placement, and time required to complete the task. Typically, only those children who can perform this task within five seconds can be expected to benefit from surgery.

Sensibility testing varies according to the age of the child. Texture discrimination is the recommended test for children 2 to 3 years of age; object identification is appropriate for those from 4 to 5 years of age, and graphesthesia is tested

in children ages 6 to 9 years. In children older than 9 years, sensibility is tested by measuring moving two-point discrimination. Functional improvement following surgery can only be expected in those children who can successfully discriminate texture, identify objects, or exhibit graphesthesia, or those who have moving two-point discrimination of less than 10 mm.

Because this 12-year-old boy with spastic cerebral palsy has both poor cognition and sensibility, improvement of hygiene will be the primary goal of any surgical procedure. Therefore, transfer of the flexor digitorum superficialis tendon to the flexor digitorum profundus tendon is recommended to eliminate the clenched fist deformity and relieve the maceration and disintegration of skin that is typically associated with this deformity. This tendon transfer lengthens yet weakens the finger flexors.

Transferring the flexor carpi ulnaris to the flexor digitorum profundus will only increase the flexion force and aggravate the deformity. Transfer of the flexor digitorum profundus to the extensor digitorum communis will not resolve the clenched fingers. In patients who have a deformity of this severity, arthrodesis of the wrist is recommended instead of tendon transfers to the wrist extensors.

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152

A 28-year-old man has a markedly diminished dorsalis pedis pulse on the right after being stabbed with an ice pick in the right lower leg. In this patient, the most likely finding on physical examination is numbness at which of the following sites?

- (A) Dorsal foot
- (B) First web space
- (C) Lateral foot
- (D) Medial foot
- (E) Plantar foot

The correct response is Option B.

This 28-year-old man has a markedly diminished dorsalis pedis pulse after sustaining a laceration of the anterior tibial artery when he was stabbed in the leg. Therefore, he is most likely to have numbness of the first web space of the foot on physical examination. The first web space is innervated by the deep peroneal nerve; this nerve courses within the anterior compartment of the leg with the anterior tibial artery, which becomes the dorsalis pedis artery in the foot.

The dorsal aspect of the foot (with the exception of the first web space) is innervated by the superficial peroneal nerve. The lateral foot is innervated by the sural nerve, and the medial foot is innervated by the saphenous nerve. None of these nerves travels with an artery.

The plantar surface of the foot is innervated by the tibial nerve, which courses within the deep posterior compartment of the leg with the posterior tibial artery.

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153

A 26-year-old man is brought to the emergency department with significant pain in the forearms 90 minutes after spilling hydrofluoric acid on his forearms at work. Immediately after the accident, the affected areas were copiously irrigated with water.

The most appropriate initial management is topical administration of which of the following agents?

- (A) Calcium gluconate gel
- (B) Mineral oil
- (C) Polyethylene glycol
- (D) Silver nitrate
- (E) Silver sulfadiazine

The correct response is Option A.

This patient has severe pain after sustaining chemical burn injuries from a hydrofluoric acid spill. Hydrofluoric acid is a strong chemical agent used primarily in industries such as electronics manufacturing and glassworks but also found in rust remover and other household items. The mechanism of action of this chemical involves binding of fluoride ions to intracellular calcium and magnesium. The fluoride ions leech calcium and magnesium from the bones, causing cellular death and producing severe pain that may not develop until several hours after initial exposure. In addition, the cellular death leads to the release of potassium, resulting in hypocalcemia, hypomagnesemia, and hyperkalemia. Any patient who has sustained hydrofluoric acid burns should be hospitalized and monitored closely because of the risk for arrhythmia associated with these electrolyte imbalances.

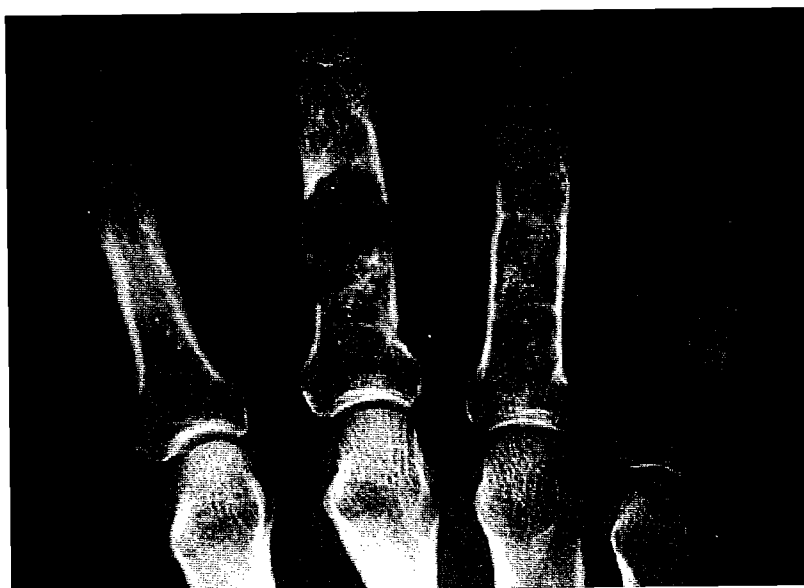
The most appropriate initial management is copious irrigation of the involved areas with water or saline followed by administration of calcium gluconate. This agent, which neutralizes the hydrofluoric acid by binding to the affected fluoride ions, can be applied topically as a gel, infused intra-arterially, or infiltrated beneath the burn eschar. Because relief of pain is a primary goal of treatment, analgesic and anesthetic agents should not be administered, as the patient will be unable to judge the pain-relieving effect of the calcium gluconate.

Application of mineral oil is appropriate for patients with phenol burns. Irrigation with water is contraindicated in these patients because it can dilute the phenol, resulting in deeper penetration and increased tissue damage. Creosol burns should be treated with topical application of polyethylene glycol. Silver sulfadiazine is used in the treatment of thermal burns involving disruption of the skin and soft tissues. Silver nitrate is effective for cauterization of pyogenic granulomas.

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154



A 30-year-old man has pain in the right wrist after falling on his outstretched right hand. Radiographs of the wrist show normal findings; a radiograph of the hand is shown above. Which of the following is the most likely diagnosis?

- (A) Chondromyxoid fibroma
- (B) Enchondroma
- (C) Giant cell tumor
- (D) Osteoid osteoma
- (E) Osteosarcoma

The correct response is Option B.

The most likely diagnosis is enchondroma, a benign cartilaginous tumor that is the most common primary tumor of bone in the hand. Enchondromas typically develop during the second or third decade of life. Although they are often asymptomatic and discovered incidentally on imaging studies, as in this patient, pathologic fractures occurring in the

area of the tumor may lead to diagnosis. Pain in the absence of fracture is suggestive of malignant degeneration. In patients with enchondromas, radiographs show a scalloped, lytic lesion within the medullary canal of the affected bone, occasionally with scattered calcification. Periosteal reaction is rare. Microscopic examination shows benign clusters of hyaline cartilage surrounded by lamellar bone with varying calcification.

Enchondromas that develop on the surface of the bone or within the cortex are known as periosteal or juxtacortical chondromas. Conditions associated with enchondroma include Ollier disease, or multiple enchondromatosis, and Maffucci syndrome, in which patients have multiple enchondromas associated with subcutaneous hemangiomas.

Appropriate management is curettage of the lesion. Bone grafting or use of a bone substitute may be required.

Chondromyxoid fibromas are benign cartilaginous tumors that rarely occur in the upper extremity. Radiographs show a radiolucent lesion with small sclerotic rims that separate the tumor from lamellar bone.

Giant cell tumors of bone are not common in the hand, wrist, or distal forearm. Only 2% to 5% of all giant cell tumors of bone occur in the hand; in contrast, the radius is the third most commonly affected site, with 16% of all giant cell tumors of bone occurring in this region. Management is controversial, as limited resection is associated with high recurrence rates locally, and more aggressive resection is likely to result in significant limitation of function.

Osteoid osteomas are symptomatic lesions. Affected patients have pain, especially at night, that is relieved with administration of nonsteroidal anti-inflammatory agents. Radiographs show a target-like lesion, illustrating the central nidus of the tumor within the bone.

Osteosarcomas are also rare in the hand. These malignant tumors exhibit varying degrees of bone erosion and periosteal reaction.

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155

A construction worker has an abscess of the palm of the nondominant hand after sustaining a puncture wound to the palm. In this patient, the midpalmar space is defined by which of the following boundaries?

- (A) Flexor tendons, abductor pollicis muscle, superficial aponeurosis, and septum from the second metacarpal bone to the flexor digitorum profundus sheath
- (B) Flexor tendons, metacarpal bone and interosseous fascia, septum from the third metacarpal to the flexor digitorum profundus sheath, and hypothenar eminence
- (C) Flexor tendons, superficial palmar aponeurosis, and thenar and hypothenar eminences
- (D) Flexor tendons, thenar eminence, septum from the second metacarpal bone to the flexor digitorum profundus tendon, and superficial aponeurosis
- (E) Septum from the first metacarpal bone to the superficial aponeurosis, septum from the third metacarpal to the flexor tendon sheath, and lateral and medial edges of the abductor pollicis muscle

The correct response is Option B.

The midpalmar space is one potential site of infection of the palm; others include the subcutaneous tissue, tendon sheaths, and thenar and hypothenar eminences. The midpalmar space is located deep to the flexor tendon. It extends dorsally to the fascia over the second and third volar interossei and the third and fourth metacarpals.

The midpalmar space is bordered radially by a fascial septum extending from the third metacarpal to the flexor sheath of the flexor digitorum profundus tendon of the long finger, and ulnarly by the fascia of the hypothenar musculature. The proximal margin of the midpalmar space is a thin layer of fascia that lies just distal to the carpal canal. The distal margin of the midpalmar space is bordered by vertical septa of the palmar fascia, which extend almost to the web spaces.

In patients with infection of the midpalmar space, diagnosis is often delayed. Affected patients typically exhibit swelling of the dorsal aspect of the hand, loss of palmar concavity, and difficulty extending and flexing the fingers. Marked tenderness in the midpalmar area is characteristic, and cellulitis is often associated.

The thenar space is located radial to the vertical septum between the third metacarpal and the flexor digitorum profundus tendon of the long finger; it extends to the radial edge of the abductor pollicis brevis tendon. The hypothenar space contains the hypothenar muscles and is enveloped within the fascia of these muscles. It is bordered radially by a fascial septum extending from the fifth metacarpal bone to the palmar fascia.

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156

In patients with rheumatoid arthritis, which of the following tendons is ruptured most commonly?

- (A) Extensor indicis proprius
- (B) Extensor pollicis longus
- (C) Flexor carpi ulnaris
- (D) Flexor digitorum profundus to the small finger
- (E) Flexor pollicis longus

The correct response is Option B.

Tendon ruptures are a common complication of rheumatoid arthritis because the environment, structure, and vascularity of the tendon are affected abnormally by this condition. Tendon ruptures often occur as the tendon glides over a roughened area of bone, joint, retinaculum, or synovium. In addition, hypertrophic tenosynovium may displace a tendon from its normal position. Tendon ruptures typically manifest as sudden onset of sharp pain or a snapping sensation. However, associated findings may be more subtle in patients who have severe deformities resulting from rheumatoid arthritis.

The extensor tendons are ruptured most commonly, with the extensor pollicis longus (EPL) and extensor digiti quinti (EDQ) tendons being affected most frequently. While rupture of the EPL tendon may manifest as sudden inability

to extend the thumb, it also may be more subtle, because the intrinsic tendons of the thumb may act to extend the thumb. However, if this were to occur, thumb extension would be weak when compared with the contralateral extremity. Options for repair include direct surgical coaptation of the tendon (if the ends have not retracted) or transfer of the extensor pollicis or extensor carpi radialis longus tendon.

Other extensor tendon ruptures typically occur on the ulnar side of the wrist as the tendons glide over the damaged radioulnar joint. These ruptures generally occur in a pattern beginning at the ulnarmost digits and extending to the radial digits (ie, Vaughn-Jackson progression). In this pattern, the EDQ tendon ruptures first, followed by the extensor digitorum communis tendon to the small, the ring, and then the long fingers.

Flexor tendon ruptures are far less frequent and usually involve the radial digits. Rupture of the flexor pollicis longus tendon by a scaphoid spur is typically referred to as a Mannerfelt lesion.

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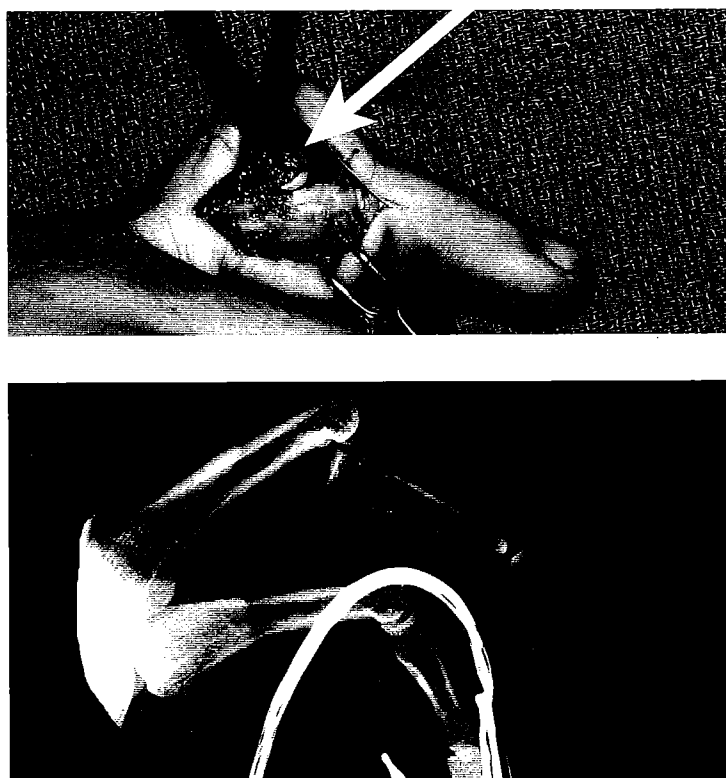
157



An 18-year-old college student sustains an injury to the nondominant small finger when he falls while playing flag football. On physical examination, the finger is swollen slightly and held in a flexed position. Active flexion and extension of the finger are limited by pain. A radiograph is shown above. Closed reduction of the finger in the emergency department is unsuccessful.

The most likely cause is interposition of which of the following structures within the joint?

- (A) Extensor tendon
- (B) Flexor tendon
- (C) Joint capsule
- (D) Neurovascular bundle
- (E) Volar plate



The correct response is Option A.

This 18-year-old college student has sustained a volar dislocation of the proximal interphalangeal (PIP) joint, an injury so named because the middle phalanx is dislocated volar to the proximal phalanx. In volar dislocations, which are far less common than dorsal dislocations, the extensor tendon is torn by the distal condyle of the proximal phalanx, as shown in the intraoperative photograph above. If the condyle has pushed through the extensor tendon, the tendon may tighten and act as a sling to prevent reduction of the dislocation.

Although some physicians may be able to perform closed reduction, operative exploration and repair are recommended because of the possible injury to the extensor tendon. Unsuccessful closed reduction is an absolute indication for operative exploration, as repeat attempts at manipulation will only worsen edema and may contribute to injury. In addition, volar dislocations can be associated with complete avulsion of the central slip, requiring repair.

Although the flexor tendons and volar plate can become interposed within the joint and interfere with closed reduction, this is a rare finding in patients with volar dislocations and is more likely to be associated with irreducible dorsal dislocations. The joint capsule and neurovascular bundle are not involved in volar dislocations of the PIP joint.

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158

Which of the following is the most common primary arterial blood supply to the great toe flap used in toe-to-thumb transfer?

- (A) First dorsal metatarsal artery from the communicating branch between the dorsalis pedis and plantar arteries
- (B) First dorsal metatarsal artery from the dorsalis pedis artery
- (C) First dorsal metatarsal artery from the plantar arch
- (D) Second dorsal metatarsal artery from the dorsalis pedis artery
- (E) Second dorsal metatarsal artery from the plantar arch

The correct response is Option B.

The first dorsal metatarsal artery (FDMA), arising from the dorsalis pedis artery, is the most common primary arterial blood supply to the great toe flap, which is used in toe-to-thumb transfer. Although the vascular anatomy that supplies the great toe flap is somewhat variable, the FDMA typically arises from the dorsalis pedis artery and travels in a relatively dorsal plane. It may travel dorsal or plantar to the interosseous muscle or through the muscle itself.

The FDMA is less likely to arise from the communicating branch between the dorsalis pedis and plantar arteries or from the plantar arch.

The second dorsal metatarsal artery does not contribute to the great toe flap.

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159

A 67-year-old man has a mass overlying the metacarpal of the right index finger that has enlarged rapidly over the past six weeks. He underwent kidney transplantation for polycystic renal disease five years ago. Which of the following is the most appropriate management?

- (A) Observation for spontaneous involution
- (B) Electrodesiccation and curettage
- (C) Interlesional injection of 5-fluorouracil
- (D) Excisional biopsy and primary wound closure
- (E) Excision and sentinel node biopsy

The correct response is Option D.

This 67-year-old man has a keratoacanthoma, a cutaneous lesion that appears similar to squamous cell carcinoma. Although keratoacanthomas had been thought previously to be benign, recent studies have suggested that this lesion

is actually a variant of squamous cell carcinoma. Keratoacanthoma first appears as a red papule on sun-damaged skin and expands rapidly over several weeks. Although most keratoacanthomas regress even without treatment, some can be aggressive and metastasize. Because these lesions have shown an affinity for immunosuppressed patients, an association has been suggested.

Excisional biopsy is most appropriate because the architecture of the lesion is important for accurate diagnosis. In this patient who has a keratoacanthoma affecting the right index finger, the wound can be closed primarily.

Observation for spontaneous involution is obviously inadequate and even dangerous in an immunocompromised patient with a keratoacanthoma because of the risk for aggressive tumor growth and metastasis.

Electrodesiccation and curettage and interlesional injection of 5-fluorouracil are not appropriate therapy in immunocompromised patients.

Sentinel node biopsy is excessive because the risk for lymphatic spread is low.

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160



A 6-month-old boy has the deformities shown in the photograph above. There are no associated syndromes. His parents would like to have more children and inquire about the risk for similar deformities. The risk for development of this deformity in future offspring is closest to

- (A) 0%
- (B) 5%
- (C) 10%
- (D) 25%
- (E) 50%

The correct response is Option A.

This 6-month-old boy has amniotic constriction band syndrome, a congenital hand deformity that manifests as intrauterine amputation of the digits. Amniotic constriction band syndrome has no known genetic transmission and is considered to be an intrauterine accident. Although there are several theories regarding the cause of this condition, it is believed to be related to rupture of the amniotic membrane caused by oligohydramnios; when this occurs, the digits and/or extremities are constricted by amniotic tissue bands created from the edges of the ruptured amniotic sac. Amniotic bands may result in amputations, not only of the fingers (as in this patient) or the extremities, but sometimes other parts of the body. The degree of constriction is variable and is classified according to its severity.

Amniotic constriction band syndrome is the fourth most common congenital anomaly of the hand; only polydactyly, syndactyly, and trigger thumb occur more frequently. Currently, its incidence is estimated at approximately 1 in 5000 to 15,000 births, with variations among different ethnic groups.

Anomalies frequently associated with amniotic constriction band syndrome include club foot, cleft lip and/or palate, craniofacial defects, hemangioma, and meningocele.

In this infant, appropriate management of the hand deformity is deepening of the web space using a standard dorsal flap followed by full-thickness skin grafting.

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161

A 34-year-old man has radial nerve palsy six months after undergoing open reduction and plate fixation of a fracture of the humeral diaphysis. The integrity of the radial nerve was confirmed at the time of the initial injury. Which of the following is the most appropriate next step in management?

- (A) Dynamic extension splinting
- (B) Injection of a corticosteroid
- (C) Tendon transfers
- (D) Interpositional nerve grafting
- (E) Neurolysis

The correct response is Option C.

In patients with high radial nerve palsy, the primary goal is restoration of extension of the wrist, fingers, and thumb. If the nerve was intact at the time of the initial surgery and there is subsequently no return of function six months later, further improvement is unlikely, and tendon transfers are indicated at this time.

Transfer of the pronator teres to the extensor carpi radialis brevis is frequently performed to recover wrist extension. To regain finger extension, the flexor carpi radialis, flexor carpi ulnaris, or flexor digitorum superficialis of the long or ring fingers is transferred into the distal extensor digitorum communis tendons. Transfers to regain thumb extension include the palmaris longus or flexor carpi radialis to the extensor pollicis longus. Additionally, some surgeons advocate end-to-side tendon transfers.

The extensor carpi radialis brevis cannot be transferred to the extensor digitorum communis because it is also affected by the radial nerve palsy. Transfer of the flexor digitorum profundus tendon of the long finger is associated with significant loss of function at the donor site.

Splinting is not indicated in a patient who has persistent radial nerve palsy six months after the initial procedure.

Injection of a corticosteroid is inappropriate treatment of radial nerve palsy.

Because the nerve is shown to be intact, the presence of a neuroma in continuity may be inhibiting the reinnervation process. EMG should be performed to determine the potential for nerve grafting or neurolysis in this patient. However, most nerve grafting procedures in adults provide only limited improvement in motor and sensory functions six months after denervation.

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162

A 25-year-old machinist sustains severe crush injuries to the index and long fingers of the dominant right hand. Physical examination shows avulsion of the volar skin pad of the index finger to the distal interphalangeal joint crease. Bone is exposed, and the nail and nail bed are intact. The dorsal skin of the long finger is avulsed, and the paratenon is exposed.

Which of the following is most appropriate for reconstruction of the index finger?

- (A) Skin graft
- (B) Moberg advancement flap
- (C) Reverse cross-finger flap
- (D) Thenar flap
- (E) Volar V-Y advancement flap

The correct response is Option D.

The thenar flap is most appropriate for reconstruction of this patient's defect. This flap can be used to effectively reconstruct defects of the tips of the index and long fingers, which flex comfortably into the thenar eminence. In contrast, because the ring and small fingers have difficulty reaching the thenar crease, defects of these fingertips can be covered instead using a hypothenar flap from the ulnar side of the hand.

Split-thickness or full-thickness skin grafting is inappropriate over exposed bone, and padding is required for coverage of any fingertip defect.

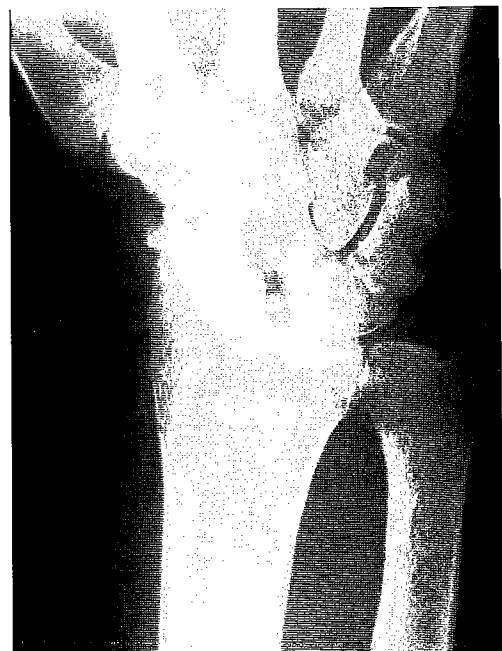
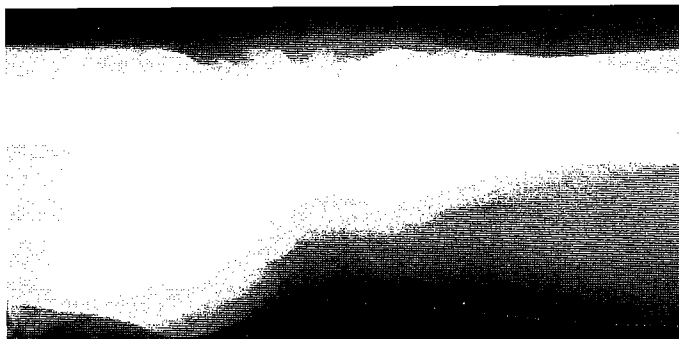
Moberg flaps are recommended for coverage of soft-tissue defects of the volar pad of the thumb. The dorsal circulation of the thumb allows for the extensive soft-tissue mobilization required with this flap. The neurovascular bundles are elevated with the Moberg flap.

A reverse cross-finger flap is used to cover defects of the dorsal aspect of the finger. With this flap, subcutaneous tissue is harvested from the dorsal and not the volar aspect of the finger; therefore, the neurovascular bundles are not disrupted. A cross-finger flap cannot be used in this patient because the dorsal skin of the long finger is avulsed.

Likewise, a volar V-Y advancement flap is not possible because the volar skin pad of the index finger has also been avulsed. Although the dorsal skin is intact, it should not be used for coverage because the patient would like to preserve finger length, and because the risk for development of a hook nail deformity would be increased if the dorsal skin were transferred.

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The radiographs shown on page 140 are from a 45-year-old dock worker who has had worsening pain and loss of motion and strength in the dominant right wrist over the past two years. Which of the following is the most appropriate operative procedure?

- (A) Scapholunate ligament repair
- (B) Radial styloidectomy
- (C) Radial corrective osteotomy
- (D) Ulnar shortening osteotomy
- (E) Four-corner arthrodesis

The correct response is Option E.

This patient has scapholunate advanced collapse of the wrist, also known as SLAC wrist, with radioscaphoid arthrosis and a dorsiflexed intercalated segment instability deformity. This condition is caused by incompetency of the scapholunate ligament, which leads to rotatory subluxation of the scaphoid.

SLAC is the most common cause of degenerative arthritis of the wrist. This condition can be classified according to four stages, as shown in the table below.

Stage I	Radioscaphoid
Stage II	Radial midcarpal
Stage III	Ulnar midcarpal
Stage IV	Pancarpal

Surgical management is aimed at decreasing pain and optimizing wrist function, using two unaffected articular surfaces if possible. In this patient, goals of surgery include eliminating the radioscaphoid articulation and stabilizing carpal kinematics. Therefore, the most appropriate procedure is scaphoid excision and four-corner arthrodesis between the lunate, capitate, hamate, and triquetrum. None of the other procedures addresses all of the problems that are present in this patient's wrist.

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During embryologic development of the hand, which of the following structures is most likely to affect normal differentiation of the limb?

- (A) Apical ectodermal ridge
- (B) Fourth branchial cyst
- (C) Germinal matrix
- (D) Second branchial cleft
- (E) Wolffian ridge

The correct response is Option A.

The apical ectodermal ridge is the critical structure that defines the growth and differentiation of the new limb during embryologic development; if the apical ectodermal ridge were to be surgically removed, the developing limb would be truncated. The apical ectodermal ridge arises from the Wolffian ridge, which protrudes from the main trunk of the embryo. A zone of polarizing activity determines the anterior-posterior morphology of the limb.

The upper extremities begin to develop during the first four weeks of gestation. By the completion of the fifth week, the hand becomes a recognizable structure. As the apical ectodermal ridge becomes flattened, the hand appears initially as a paddle. Each of the phalanges is then formed by a process of physiologic cell death that occurs within the web spaces. The digits become defined by the end of the eighth week, and fingernails can be identified by 17 weeks' gestation.

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165

A 23-year-old man sustained a complete laceration of the ulnar nerve at the level of the elbow four weeks ago when he was stabbed in the nondominant forearm with a knife. After surgical nerve preparation, a 2-cm gap is present. Which of the following is the most appropriate next step in management?

- (A) Use of a vein conduit
- (B) Tendon transfers
- (C) Mobilization of the nerve 15 cm proximally and distally
- (D) Sural nerve grafting
- (E) Ulnar nerve transposition

The correct response is Option E.

In this 23-year-old man who has a 2-cm nerve gap after sustaining a clean laceration of the ulnar nerve at the elbow four weeks ago, the most appropriate next step in management is transposition of the ulnar nerve. Because transposition of this nerve at the elbow provides as much as 4 cm of length, it is recommended in this patient in whom primary coaptation cannot be performed because of nerve retraction.

Ulnar nerve transposition may yield as much as 3 cm of length when performed in the arm, 2 cm of length at the forearm, and 1 to 2 cm of length at the distal forearm and wrist. Transposition is also appropriate for repair of median and high radial nerve injuries.

Vein conduits should only be considered if direct repair and transposition are not options.

Tendon transfers alone do not restore sensory function, and are recommended for late reconstruction only when nerve repair is no longer an option.

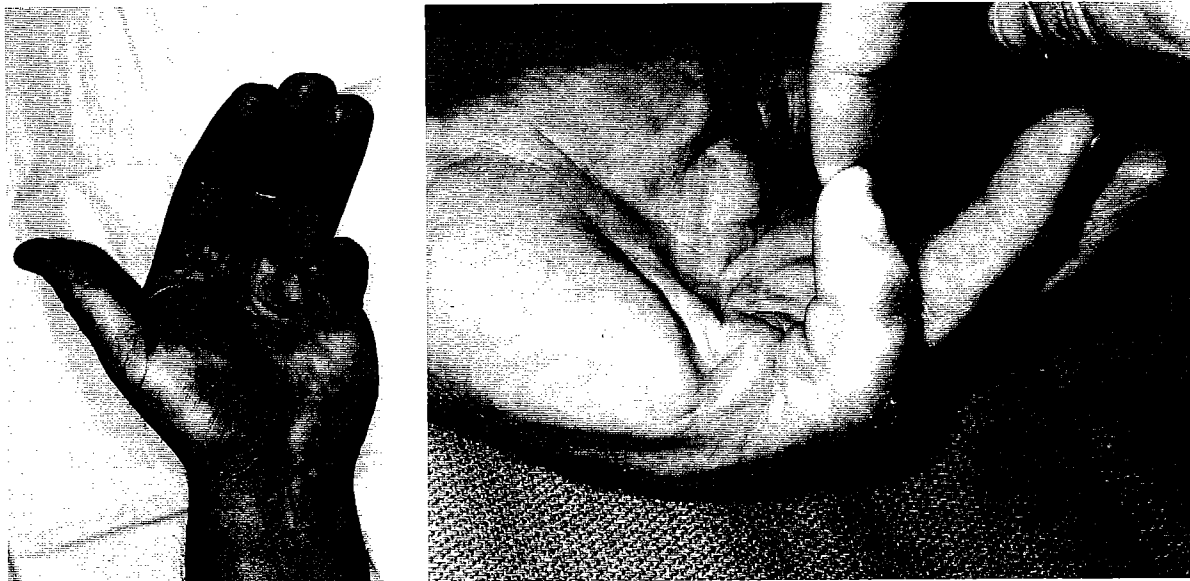
Extensive mobilization of the ulnar nerve into the mid forearm may cause devascularization and injury to distal nerve branches and ultimately worsen functional outcome.

Sural nerve grafting may be considered if transposition of the ulnar nerve results in tension following nerve coaptation.

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166



A 63-year-old man has the deformity of the left small finger shown in the photographs above. It has worsened over the past two years, and he has limited passive and active extension of the proximal interphalangeal (PIP) joint of the finger. The most likely cause is contracture of which of the following cords?

- (A) Central and lateral
- (B) Central and pretendinous
- (C) Natatory and lateral
- (D) Natatory and pretendinous
- (E) Natatory and spiral

The correct response is Option A.

In this 63-year-old man who has limited extension of the proximal interphalangeal (PIP) joint of the left small finger that has occurred as a result of a Dupuytren contracture, the central and lateral cords are the most likely cause. Diseased cords evolve from the normal fascial bands of the hand in patients with Dupuytren disease, leading to flexion deformities of the affected joints. Fascial structures of the hand that may contribute to Dupuytren contracture include Grayson's and Cleland's ligaments, the lateral digital sheath, the natatory ligament, the pretendinous and spiral bands, and the superficial transverse ligament.

The central, lateral, and spiral cords cause flexion contractures of the PIP joint. The central cord arises from the pretendinous band, and the lateral cord is formed from the central digital sheath. The spiral cord is composed of the pretendinous and spiral bands, lateral digital sheath, and Grayson's ligament. Contraction of the spiral cord results in medial and superficial displacement of the neurovascular bundle.

In addition to the contracture of the PIP joint caused by the central and lateral cords, this patient's hand posture results from contracture of the metacarpophalangeal joint caused by the action of the pretendinous cord. The pretendinous cord does not contribute to contractures of the PIP joint.

The natatory cord is formed from the natatory ligament as it passes transversely across the palm at the level of the web spaces. It causes adduction, not flexion, contractures of the digits.

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167

A 47-year-old woman has a low-grade fever, chills, and pain and swelling of the proximal interphalangeal joint of the index finger. On examination, active and passive motion of the joint produces pain. There is no lymphangitis or lymphadenopathy. Which of the following is the most likely causative organism?

- (A) *Eikenella corrodens*
- (B) *Neisseria gonorrhoeae*
- (C) *Serratia marcescens*
- (D) *Staphylococcus aureus*
- (E) *Viridans streptococcus*

The correct response is Option D.

In this patient who has septic arthritis affecting the proximal interphalangeal joint of the index finger, the most likely cause is infection with *Staphylococcus aureus* organisms. *Staphylococcus aureus* is an anaerobic gram-positive coccus that is present on the skin and is a frequent cause of skin and soft-tissue infections. It is the most common cause of septic arthritis of the hand and wrist.

Eikenella corrodens, an anaerobic gram-negative rod, is present in the human mouth and is more likely to be cultured from a human bite wound.

Septic arthritis resulting from *Neisseria gonorrhoeae* is more likely to occur in young men who are sexually active. Affected patients typically have a history of migratory polyarthralgia.

Serratia species are a frequent cause of infection in persons who abuse intravenous drugs as well as patients with diabetes mellitus or immune system compromise.

Streptococcus species, including viridans streptococcus, are the second most common causative organism in patients with septic arthritis of the hand.

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168

A 77-year-old man has a 4 × 3-cm defect of skin and soft tissue over the distal third of the tibia after he had a stroke and fell. He has a history of myocardial infarction and chronic obstructive pulmonary disease. Physical examination of the lower leg shows exposed bone and desiccated periosteum; there is no fracture.

Which of the following is most appropriate for reconstruction of the defect?

- (A) Full-thickness skin graft
- (B) Cross-leg flap
- (C) Fasciocutaneous flap
- (D) Gastrocnemius flap
- (E) Free tissue transfer

The correct response is Option C.

The most appropriate management is coverage of the defect with a fasciocutaneous flap. This flap is ideal for reconstruction of lower extremity wounds in patients with severe illness or multiple trauma, or in patients with small wounds that cannot be covered with a skin graft alone. The fasciocutaneous flap can be based either proximally or distally on various septocutaneous perforators, including those of the medial leg (which lie approximately 3 cm posterior to the tibia), the posterolateral septum, and the anterolateral leg.

Skin grafting should not be performed over bone that is exposed and lacks periosteum. Some surgeons have recently described a technique for grafting over exposed bone, in which holes are drilled into the bone to allow for granulation and grafting is then performed. However, this process is not the best option in an elderly patient with multiple medical problems.

The gastrocnemius flap is appropriate for defects of the upper and sometimes middle third of the leg, but lacks the adequate reach for defects of the distal leg.

Cross-leg flaps are rarely used now because of the availability of free tissue transfer. This flap is more appropriate in children than elderly patients, in whom stiffness is a factor.

Free tissue transfer is not an option in a patient who has had serious medical conditions, including stroke, myocardial infarction, and pulmonary disease.

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169



A 50-year-old man has had the fingernail deformity shown in the photograph above for the past year. There is no history of trauma to the finger. Which of the following is the most appropriate management?

- (A) Topical administration of neomycin ointment twice daily
- (B) Oral administration of ciprofloxacin 400 mg twice daily
- (C) Oral administration of terbinafine 250 mg daily
- (D) Resection of the involved sterile matrix and grafting from the matrix of the great toe
- (E) Surgical removal of the nail plate and stenting of the eponychial fold with nonadherent gauze

The correct response is Option C.

This patient has a dystrophic nail resulting from a fungal infection (onychomycosis). The diagnosis of onychomycosis can be confirmed by positive findings on fungal culture. Fungal infections are the underlying cause of dystrophic nails

in approximately 50% of affected patients; the remaining 50% are caused by other factors, including psoriasis, lichen planus, and trauma. Although they are more common in the foot, fungal infections can cause functional and aesthetic deformities in the fingernails.

In the past, long-term administration of antifungal agents was recommended; however, this treatment course was associated with significant toxicity, requiring monitoring of hepatic function, and often disappointing results. More recently, terbinafine and itraconazole have offered new treatment options. These agents are administered for six weeks, and hepatic function is monitored only in those patients who have a history of hepatitis, liver disease, or heavy alcohol use. However, adverse effects associated with terbinafine use include Stevens-Johnson syndrome, neutropenia, hepatotoxicity, hepatic failure, erythema multiforme, toxic epidermal necrolysis, and anaphylaxis. In addition, terbinafine is far more costly than previously used antifungal agents.

Topical or oral administration of antibiotics would not be expected to improve this fungal infection. In addition, topical antibiotics may aggravate the nail matrix. Resection of the sterile matrix and replacement with a graft is associated with a high incidence of recurrence and morbidity. Removal of the nail would not eliminate the fungal infection within the underlying matrix.

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170

Six months after sustaining a traumatic amputation of the right index finger at the level of the distal interphalangeal joint, a 27-year-old machinist has extension of the proximal interphalangeal joint of the index finger when he attempts to make a fist. Revision amputation and primary closure were performed at the time of the initial injury, and the patient has undergone occupational therapy for the past six months.

Which of the following is the most appropriate management?

- (A) Osteotomy of the middle phalanx
- (B) Release of the sagittal bands
- (C) Sectioning of the lumbrical muscle
- (D) Tenolysis of the profundus tendon
- (E) Transfer of the interosseous muscle

The correct response is Option C.

In this 27-year-old machinist who has a lumbrical-plus deformity secondary to release of the flexor digitorum profundus tendon to the index finger, the most appropriate management is sectioning or division of the lumbrical muscle. Because the profundus tendon to the index finger is independent, proximal retraction causes proximal retraction of lumbrical tendon, leading to increased tension. With attempted flexion of the proximal interphalangeal (PIP) joint (ie, to make a full fist), the lumbrical muscle migrates more proximally, exerting tension on the extensor mechanism through the lateral band. Paradoxical extension of the interphalangeal joints results. Sectioning of the muscle can be performed as an outpatient procedure using a local anesthetic.

Osteotomy of the middle phalanx will not correct the muscle-tendon imbalance. Release of the sagittal bands is most likely to result in subluxation of the extensor tendons across the metacarpophalangeal joint. Tenolysis of the profundus tendon is appropriate for management of flexion contractures with adhesions, and transfer of the interosseous muscle is performed for correction of ulnar drift in patients with rheumatoid arthritis.

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171

A 6-year-old girl has camptodactyly of the small finger of the right hand. The deformity has not improved with splinting and passive stretching exercises. On physical examination, there is loss of 20 degrees of terminal extension of the proximal interphalangeal (PIP) joint that is unaffected by flexion of the metacarpophalangeal joint.

Which of the following is the most appropriate management?

- (A) Observation
- (B) Injection of a corticosteroid into the PIP joint
- (C) Release of the lumbrical tendon
- (D) Release of the superficialis tendon
- (E) Zancolli-lasso procedure

The correct response is Option A.

In this 6-year-old girl with camptodactyly who has a loss of 20 degrees of extension of the proximal interphalangeal (PIP) joint, observation is most appropriate. Surgical correction is rarely required in patients who have lost less than 30 degrees of extension. Minimal extension deficits that require operative management can be corrected by transferring the lumbrical tendon into the central slip.

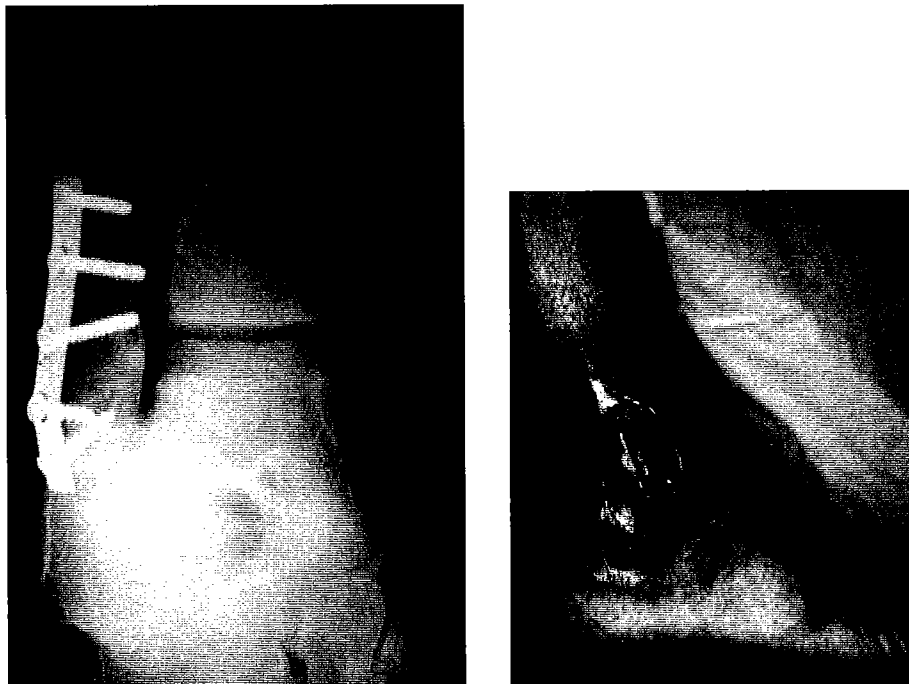
In patients who have a terminal extension deficit of 30 degrees or more, surgical release of the abnormal lumbrical and superficialis tendons is most likely to improve the deformity. Release of the attachment of the accessory collateral ligaments to the volar plate may also be necessary. Full-thickness skin grafts or local skin flaps can be used to cover the resultant volar skin deficits. However, the patient should be informed of the likelihood for a residual flexion deformity, especially if there are abnormalities of the articular joint surfaces on preoperative radiographs.

Corticosteroids should not be injected into the affected joints of patients with camptodactyly. In the Zancolli-lasso procedure, slips of the flexor digitorum superficialis tendon are looped through the A2 pulley. This technique is appropriate for correction of digital clawing associated with ulnar palsy in a patient who demonstrates improved extension of the PIP joint with flexion of the metacarpophalangeal joint.

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172



A 50-year-old man has noninfected wound dehiscence with exposure of the hardware two weeks after undergoing open reduction and internal fixation of an ankle fracture. A photograph and radiograph are shown above. Following debridement of the wound, which of the following is the most appropriate management?

- (A) Skin grafting
- (B) Coverage with a free flap
- (C) Application of an external fixator and skin grafting
- (D) Removal of the hardware and skin grafting
- (E) Removal of the hardware and coverage with a free flap

The correct response is Option B.

This patient has early wound dehiscence after undergoing open reduction and internal fixation of a lateral malleolus fracture. Appropriate management involves early coverage of the exposed bone and hardware to promote bony union while preventing bacterial colonization of the hardware, which may lead to the development of osteomyelitis. Because this patient underwent open reduction and internal fixation only two weeks ago, fixation is still required to maintain rigid fracture stabilization. Instead, coverage with a free flap is recommended to provide stability and vascularity and to enhance function once bony union is obtained.

Skin grafting will not provide stable, well vascularized coverage in this patient. External fixation is problematic because of the location of the fracture. Removal of the hardware two weeks after fracture is indicated only for established hardware failure.

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173

A 34-year-old man has had pain and swelling of the long and ring fingers for the past three days. On physical examination, there is a sausage-like appearance of the fingers. The patient has pain on passive stretch of the fingers, and there is tenderness over the flexor tendon sheaths. Radiographs show swelling of the soft tissues.

In addition to intravenous administration of antibiotics, which of the following is the most appropriate management?

- (A) Needle aspiration of the flexor tendon sheaths
- (B) Incision into the fingers
- (C) Incision into the joints
- (D) Incision into the palm
- (E) Opening and irrigation of the flexor digital sheath

The correct response is Option E.

This 34-year-old man has findings consistent with advanced flexor tenosynovitis. The diagnosis can be made by the presence of one or more of Kanavel's four signs (fusiform swelling, partial flexed posturing of the finger, tenderness over the flexor tendon sheath, and pain with passive extension of the finger). This patient exhibits three of the diagnostic signs, indicating an advanced disease course. In addition to intravenous administration of antibiotics, the most appropriate management is opening and irrigation of the flexor tendon sheath. The surgeon should make an incision into the palm that is sufficiently wide to allow for access to and visualization of the proximal aspect of the A1 pulley. Another incision is made distally to allow access to the A4 and A5 pulleys. If necessary, the incisions can be extended distally and/or proximally to treat infected, necrotic tissue.

In patients with advanced flexor tenosynovitis, the flexor digital sheath is typically distended with purulent material. A plastic irrigation catheter is inserted at the level of the A1 pulley and threaded distally into the sheath to allow for irrigation beyond the A5 pulley. This technique will facilitate complete decompression of the sheath without sacrificing

the pulleys. Irrigation can be provided via the catheter continuously for as long as 24 hours, depending on the severity of infection.

Needle aspiration is useful in establishing a diagnosis of or treating early tenosynovitis (characterized by the presence of only one or two of Kanavel's signs) or as initial treatment during pregnancy. Simple incision into the finger, joint, or palm will not address the infection of the flexor tendon sheath.

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174



A 10-month-old infant with simple, complete syndactyly involving the third web space of the left hand undergoes reconstruction using a dorsal flap and multiple full-thickness skin grafts. A postoperative photograph is shown above. Which of the following is the most appropriate next step in management?

- (A) Wound cleansing using dilute peroxide and application of antibiotic ointment daily
- (B) Application of soft dressings and an elastic wrap
- (C) Application of a short arm splint
- (D) Application of a short arm cast
- (E) Application of a long arm cast



The correct response is Option E.

In infants and children who undergo reconstructive procedures for correction of syndactyly, the most appropriate management postoperatively is application of a long arm cast. The success of the procedure depends on adequate immobilization of the entire upper extremity following surgery. When applying the cast, the elbow must be flexed before padding and fiberglass material are applied in order to prevent restriction or pressure in the antecubital region. Flexion of the cast at the elbow will prevent the dressings around the skin grafts and flaps from becoming loosened.

The photograph above shows the properly applied above-elbow cast of a patient who has undergone syndactyly reconstruction. All of the fingertips are visible, but the fingers are immobilized securely. This infant previously underwent two reconstructive attempts that were unsuccessful because of improper postoperative immobilization. The third procedure, involving release of severe contractures of the digits followed by repeat full-thickness skin grafting, was successful because the arm was immobilized correctly.

If the arm is not immobilized, the skin grafts and flaps will ultimately fail, and significant wound problems will occur. Soft dressings do not provide the needed immobilization. Short arm splints and casts frequently become dislodged in infants in children because of their high level of activity and the problems associated with fitting a short arm device to the cone-shaped forearm of a young child.

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Repair of flexor tendon injuries in which of the following zones is most commonly associated with a good prognosis?

- (A) Zone 1
- (B) Zone 2
- (C) Zone 3
- (D) Zone 4
- (E) Zone 5

The correct response is Option E.

Flexor tendon injuries in zone 5 have the best prognosis following repair. This zone, one of five in the flexor tendon system, lies proximal to the carpal tunnel. The generous space found proximal to the wrist allows for better tendon gliding following repair.

In contrast, zone 2 is an especially tight region that contains both flexor tendons within the fibro-osseous tunnel. There is an increased risk for development of adhesions when flexor tendons are repaired in this zone.

Repair of flexor tendon injuries in zones 1, 3, and 4 typically results in intermediate outcomes because of tendon vascularity and gliding potential in these zones.

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176

A 5-year-old girl sustains a stellate laceration of the sterile matrix of the nail bed of the left long finger when she closes a door on the finger. Which of the following is the most appropriate management?

- (A) Allowing the nail bed to heal by second intention
- (B) Primary repair of the nail bed
- (C) Debridement of the nail bed and split-thickness skin grafting
- (D) Debridement of the nail bed and split germinal matrix nail grafting
- (E) Coverage of the nail bed with a free flap from the great toe

The correct response is Option B.

In this patient who has sustained a stellate laceration of the nail bed of the long finger, the most appropriate management is primary repair of the nail bed. Lacerations of the nail bed are common injuries that most frequently occur in the long finger, as it is typically the last digit to be moved during a situation of potential trauma to the hand. Injury to the nail bed can be classified as simple laceration, stellate laceration, avulsion, crush injury, or amputation.

The most appropriate management of simple and stellate lacerations of the sterile matrix is primary repair. These injuries are associated with the best prognosis; the nail typically has a normal appearance after healing.

In patients with avulsion and crush injuries, the outcome is often variable, as fracture of the distal phalanx may be associated. Any fracture that occurs must be reduced initially to eliminate irregular bone contours, which often result in a nail deformity. If there is contamination of the nail bed, the necrotic tissue is debrided. Split matrix grafting, using sterile grafts obtained from an adjacent portion of uninjured nail bed, can be performed for reconstruction. A split nail bed graft can be harvested also from the great toe.

Healing by second intention would result in deformity of the nail bed.

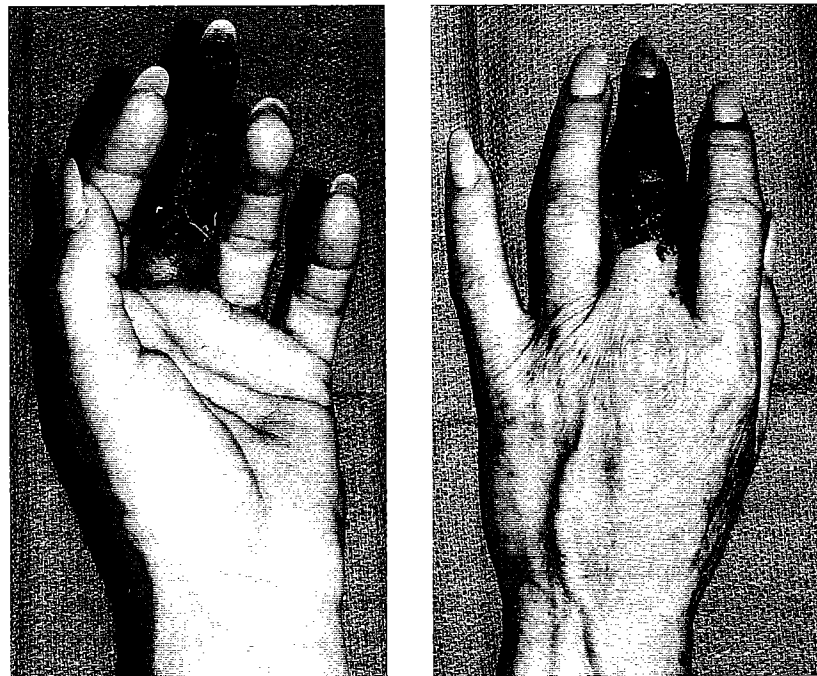
Germinal matrix grafts are appropriate for repair of trauma to the germinal matrix of the nail. These are full-thickness grafts that leave a deformity at the donor site following harvest.

Reconstruction of the nail bed with a free flap is reserved for management of chronic deformities of the nail and is not considered in patients with acute injuries.

References

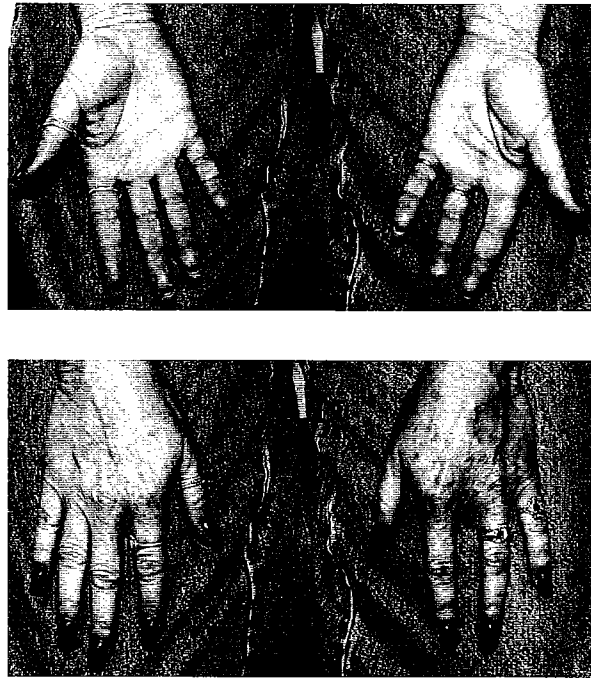
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177



A 46-year-old woman sustains a ring avulsion injury to the long finger when the finger becomes caught in a machine. Emergent revascularization is performed; on examination 10 days later, the patient has the findings shown in the photographs above. Which of the following techniques is most likely to provide optimal function?

- (A) Resection of all nonviable soft tissue and coverage with a full-thickness skin graft
- (B) Resection of all nonviable soft tissue and coverage with a neurovascular island flap from the ring finger
- (C) Resection of all nonviable soft tissue and reconstruction with a toe-to-hand transfer
- (D) Revision amputation at the level of the mid proximal phalanx, with trimming of the bone to a level at which it can be covered primarily by viable skin
- (E) Ray amputation of the long finger, leaving the base of the metacarpal in place



The correct response is Option E.

Ring avulsion injuries are typically associated with the highest failure rates following replantation, most likely because of the mechanism of injury, which involves destruction of the intimal layer of the supporting vasculature. In this patient, revascularization has failed, leaving a necrotic digit.

The most appropriate next step in management of this patient is ray amputation, which involves removal of the entire digit and most or all of the metacarpal. Completely removing the digit eliminates the segmental loss and greatly improves both function and aesthetic appearance, as shown in the photographs above.

Resection of nonviable soft tissue results in exposure of the phalanges and tendons. A full-thickness skin graft will not take over these exposed structures.

The Littler neurovascular island flap is based on the digital neurovascular bundle of either the long or ring finger. This flap provides sensate coverage of smaller digital defects, particularly the thumb, but would not cover the entire defect in this patient.

Replacing the long finger with a toe-to-hand transfer is impractical, as the transferred digit would be significantly shorter than the adjacent digits and would ultimately impair their function. This technique is appropriate for patients who have sustained amputations of the thumb or of multiple digits.

Simple revision amputation is the easiest method of skin closure but leaves a large gap between the long and small fingers, allowing an area through which small objects can fall, and thus limiting hand function.

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178

An otherwise healthy 48-year-old nurse is brought to the emergency department because she has intense pain in the right lower extremity after sustaining a minor abrasion of the right knee. She has undergone evaluation twice within the past 48 hours for pain disproportionate to the level of injury. Temperature is 38.8 C (102 F) and blood pressure is 70/50 mmHg. On examination, the extremity is warm, swollen, and erythematous. There is a bluish blister at the site of injury. Laboratory studies show an increased leukocyte count, decreased platelet count, increased serum creatinine level, and increased international normalized ratio (INR). Radiographs show no abnormalities.

Which of the following is the most likely diagnosis?

- (A) *Clostridium* necrotizing fasciitis
- (B) Cutaneous anthrax
- (C) *Pseudomonas* ecthyma gangrenosum
- (D) Staphylococcal cellulitis
- (E) Streptococcal toxic shock syndrome

The correct response is Option E.

This 48-year-old nurse has findings consistent with streptococcal toxic shock syndrome caused by invasive infection with *Streptococcus* organisms. This condition is characterized by pain disproportionate to the level of injury. Affected patients typically have other minor symptoms, in addition to pain, and have been known to seek treatment frequently before the correct diagnosis is established. Streptococcal toxic shock syndrome is confirmed by the presence of coagulation difficulties and hepatic and renal abnormalities.

Clostridial necrotizing fasciitis has symptoms similar to streptococcal toxic shock syndrome but is differentiated by subcutaneous emphysema and air in the tissues on radiographs.

With anthrax contamination, primary routes of inoculation are cutaneous and inhalational. Cutaneous anthrax is characterized by a single lesion that initially resembles an insect bite but then becomes ulcerated. Skin trauma is not associated.

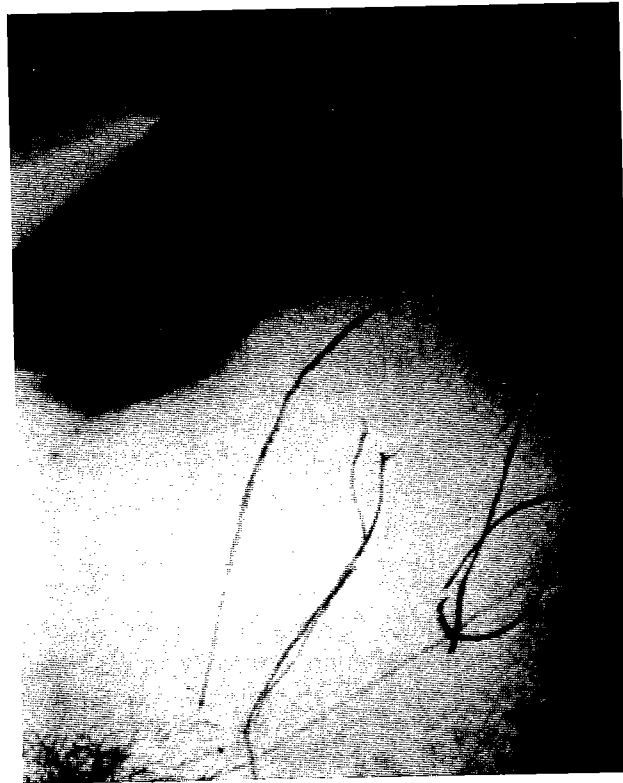
Pseudomonas ecthyma gangrenosum is an infection that demonstrates rapid progression and is frequently fatal. It occurs in patients with febrile neutropenia, and is often a complication of chemotherapy administered for lymphoreticular malignancies.

Although staphylococcal cellulitis is not associated with systemic manifestations, patients with staphylococcal toxic shock syndrome can have failure of multiple organ systems.

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179



A 20-year-old woman is undergoing evaluation eight months after sustaining a severe degloving injury, including multiple injuries to skin and tendons, to the dorsal aspect of the left hand. At the time of injury, extensive wound care was followed by full-thickness skin grafting from the left side of the groin. On current physical examination, the patient has severe contractures and clawing of the metacarpophalangeal joints. The photograph above shows an outline of the flap that is to be used to resurface the dorsal aspect of the hand.

This flap derives its axial blood supply from which of the following arteries?

- (A) Deep inferior epigastric artery
- (B) Medial femoral circumflex artery
- (C) Superficial circumflex iliac artery
- (D) Superficial external pudendal artery
- (E) Superficial inferior epigastric artery



The correct response is Option E.

The flap depicted in the photograph is the superficial inferior epigastric artery (SIEA) flap, also known as the Shaw flap. This flap derives its axial blood supply from the superficial inferior epigastric (SIE) artery, one of three cutaneous arteries supplied by the common femoral artery. The SIE artery arises from the intersection of the inguinal ligament and the femoral artery, then courses superiorly and laterally toward the anterior axillary line.

The SIEA flap is typically transferred as a pedicled flap, but fasciocutaneous free tissue transfer has also been described. This flap is recommended for coverage of wounds of the hand and forearm because it lies in a relatively higher position on the torso than the groin flap; this allows for improved mobility of the shoulder while placing the elbow in a comfortable, flexed position while the flap matures. To confirm the pedicle pattern, Doppler ultrasonography can be performed prior to elevation of the flap. A photograph of the inset of the flap is shown above.

The superficial circumflex iliac artery provides the axial blood supply to the groin flap. This artery also originates from the femoral artery and travels parallel to the inguinal ligament, approximately 1 cm deep to the ligament.

Although the deep inferior epigastric artery supplies the rectus muscle on its deep surface, it does not supply the skin of the abdomen directly; instead, perforators emerge from the deep inferior epigastric artery and course through the rectus muscle to supply blood to the skin of the abdomen. This vascularity allows the skin and muscle to be harvested for free flap transfer.

The superficial external pudendal artery provides vascularity to the pubic region.

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180

A 39-year-old assembly line worker has chronic disabling pain of the trapeziometacarpal joint of the dominant right hand that is exacerbated when he uses his tools. Radiographs show significant degenerative arthritis that is limited to the trapeziometacarpal joint.

Which of the following is the most appropriate operative management?

- (A) Reconstruction of the palmar oblique (beak) ligament
- (B) Trapeziectomy only
- (C) Trapeziectomy with tendon interposition arthroplasty
- (D) Trapeziectomy with Silastic interposition arthroplasty
- (E) Trapeziometacarpal arthrodesis

The correct response is Option E.

In this 39-year-old assembly line worker who has significant degenerative arthritis of the trapeziometacarpal joint (ie, carpometacarpal joint of the thumb) of the dominant hand, the most appropriate management is trapeziometacarpal arthrodesis. Arthrodesis is recommended for younger patients who have arthritis that is limited to the trapeziometacarpal joint and who require strong grip and pinch. This procedure may increase stresses across the peritrapezial joints, leading to pain, laxity, and subsequent arthritis. In addition, some range of motion of the thumb is sacrificed, but this may improve over time. Other potential options include partial trapeziectomy and interposition of the palmaris longus, which is a new arthroscopic technique that has demonstrated promising results but is not yet used widely.

Trapeziectomy, with or without soft-tissue interposition arthroplasty, is most commonly used to treat trapeziometacarpal arthritis because it provides relief of pain and increased mobility. However, this technique results in a decrease of pinch and grip strength to approximately 75% of normal. Silastic arthroplasty is performed only in low-demand patients who have adequate bone stock.

Reconstruction of the palmar oblique (beak) ligament is indicated for treatment of prearthritic, painful instability of the trapeziometacarpal joint, and may prevent the development of arthritis. However, this procedure will not alleviate pain once significant arthritic changes have occurred.

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181



A 45-year-old roofer has pain and swelling of the right wrist after falling off a roof and landing on his outstretched right hand. Radiographs are shown above. This patient most likely has which of the following types of fracture-dislocation?

- (A) Carpometacarpal joint-hamate
- (B) Radial styloid
- (C) Scaphocapitate
- (D) Scaphoid-perilunate
- (E) Scaphotrapeziotrapezoid

The correct response is Option D.

This patient has a scaphoid-perilunate fracture-dislocation, also known as a scaphoid-dorsal perilunate fracture-dislocation. Wrist dislocations can range from simple injuries to extended fractures associated with dislocation of one or more carpal bones. This patient has sustained one of the most severe forms of wrist dislocation, as shown in the radiographs.

Fracture-dislocations of the wrist are identified according to the carpal bone(s) involved and the type of lunate dislocation (ie, incomplete or complete). Lunate dislocations are subdivided into midcarpal lunocapitate, complete lunate, and perilunate injuries. A complete lunate injury can be differentiated from a perilunate injury by the presence of a concomitant dislocation of the radiolunate joint. Greater arc injuries are typically caused by high-energy trauma. The radial styloid, scaphoid, capitate, hamate, triquetrum, and/or ulnar styloid may be fractured. Lesser arc dislocations involve injury to the scapholunate, lunocapitate, and/or lunotriquetral intervals; these injuries are rated as type I to type IV according to Mayfield's classification.

The radiographs do not depict a carpometacarpal joint-hamate fracture-dislocation. A fracture-dislocation of the radial styloid would occur more proximally. The scaphocapitate and scaphotrapeziotrapezoid lie distal to the level of injury.

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182

Immediately after undergoing reconstruction of a wound of the dorsal aspect of the hand using a reverse radial forearm flap, a patient has marked venous congestion of the flap. There is no hematoma visible under the flap. Which of the following is the most appropriate management?

- (A) Increasing the temperature of the hand
- (B) Elevation of the hand
- (C) Intravenous infusion of heparin
- (D) Application of leeches to the flap
- (E) Anastomosis of an outflow vein

The correct response is Option E.

When harvesting a reverse island flap such as the reverse radial forearm flap, the surgeon should always attempt to preserve an outflow vein, which will be necessary for drainage of the flap if the reverse flow venous system does not function adequately. Most patients exhibit only mild venous congestion, and leeches can be applied to drain the flap sufficiently and thus preserve it. However, any patient who has immediate onset of marked venous congestion in which the cause is not obvious (ie, kinking of the pedicle or hematoma under the flap) should undergo immediate anastomosis of an outflow vein to decompress the flap.

Conservative measures such as increasing the temperature of the hand, elevating the extremity, or infusing heparin intravenously will ultimately fail in a patient with marked venous congestion requiring immediate operative treatment.

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183

A 40-year-old man has a painful, fluctuant abscess over the dorsal aspect of the left hand at the level of the metacarpophalangeal joints. On physical examination, the index finger is abducted away from the long finger. This abscess most likely courses through which of the following anatomic sites?

- (A) Extensor tendon sheath
- (B) Flexor tendon sheath
- (C) Palmar bursa
- (D) Palmar fascia
- (E) Parona's space

The correct response is Option D.

This patient has a collar button abscess, which communicates from the volar web space to the dorsal aspect of the hand via the palmar fascia or lumbrical canal. Finger abduction is a characteristic finding. Appropriate management is drainage of the abscess using a combined volar and dorsal approach.

The extensor tendons do not lie within sheaths on the dorsal aspect of the hand.

Infection of the flexor tendon sheath is known as flexor tenosynovitis. This condition is diagnosed by the presence of one or more of Kanavel's signs, including fusiform swelling, partial flexed posturing of the finger, tenderness over the flexor tendon sheath, and pain with passive extension of the finger. Finger abduction is not associated.

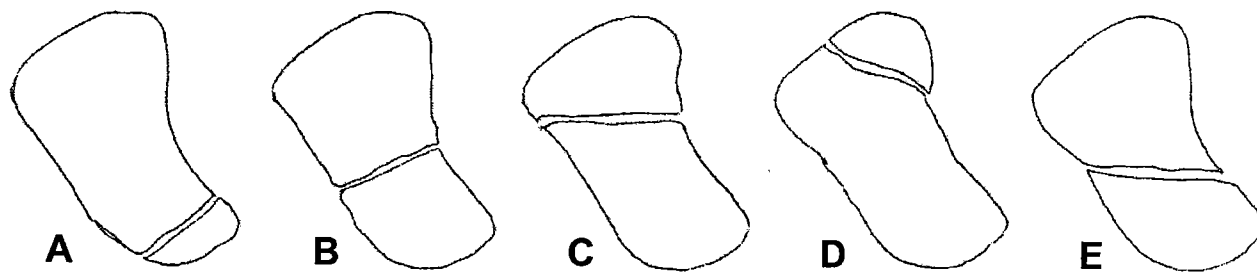
Patients with infection of the palmar bursa have a painful prominence in the palm without finger abduction.

Parona's space lies between the pronator quadratus and flexor digitorum profundus tendons. It communicates with the flexor tendon sheaths to the thumb and small finger (radial and ulnar palmar bursa) and the midpalmar space. Infection within this space is characterized by painful swelling over the volar aspect of the wrist that occurs proximal to the flexion crease of the distal wrist.

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184



Which of the following scaphoid fracture patterns illustrated above has the highest incidence of avascular necrosis?

- (A) A
- (B) B
- (C) C
- (D) D
- (E) E

The correct response is Option A.

Fractures of the scaphoid comprise as many as 60% of all carpal bone fractures; most of these fractures are caused by a fall onto a dorsally flexed wrist. Scaphoid fractures can be displaced or nondisplaced. In patients with nondisplaced fractures, application of a cast followed by mobilization results in a rate of union as high as 95%. A long arm thumb spica cast is typically applied first, then replaced with a short arm thumb spica cast.

In contrast, displaced fractures are often associated with an unacceptably high rate of nonunion if treated conservatively and a high incidence of avascular necrosis. This complication has been reported to occur in 13% to 40% of patients with scaphoid fractures; its incidence is dependent on the presence or absence of displacement and the anatomic location of the fracture. Because perforators to the scaphoid enter distally and proceed proximally, fractures that occur more proximally are more likely to interrupt the blood supply to the scaphoid.

The distal pole of the scaphoid has a good, protective blood supply; as a result, the risk for avascular necrosis is low. In contrast, fractures of the scaphoid waist are associated with an incidence of avascular necrosis of approximately 30%, and fractures of the proximal pole of the scaphoid have a rate of avascular necrosis that may be as high as 100%. Therefore, internal fixation is generally advocated for treatment of fractures of the proximal pole of the scaphoid. With rigid fixation of the bone, revascularization of the scaphoid occurs almost uniformly.

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185

In a patient with established Volkmann's ischemic contracture, reconstruction via free transfer of the gracilis involves decompression of which of the following nerves?

- (A) Anterior interosseous
- (B) Median
- (C) Posterior interosseous
- (D) Radial
- (E) Ulnar

The correct response is Option B.

In a patient with Volkmann's ischemic contracture of the forearm, the median nerve is most likely compressed, and is thus most likely to require decompression, because it traverses the center of the scarred muscles. After muscle infarction occurs, peripheral nerves can become compressed within a constricting scar at a specific anatomic location. Because improvement in nerve function is related to the severity and duration of compression, early decompression is required to minimize further dysfunction. As a result, the median nerve should be decompressed as soon as the patient's condition permits. In order to be successful, operative exploration is necessary at all points of compression.

In patients with compartment syndrome, high interstitial pressures are typically measured in the deepest compartments of the forearm, especially those compartments that lie adjacent to bone. The flexor digitorum profundus and flexor pollicis longus muscles are affected most often; in more severe cases, the flexor digitorum superficialis, flexor carpi radialis, and flexor carpi ulnaris are involved also. The median nerve often lies at the center of the a constricting scar in the forearm and is thus at risk for compression at the lacertus fibrosus, the two heads of the pronator teres, and the proximal arch of the flexor digitorum superficialis, as well as within the carpal tunnel.

The anterior interosseous nerve is a branch of the median nerve and thus is not involved in Volkmann's ischemic contracture of the forearm. The posterior interosseous nerve and the radial nerve are rarely involved. The ulnar nerve is implicated less frequently than the median nerve and is often compressed at or just distal to the elbow.

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186

A 3-year-old boy has total absence of the long and ring fingers of both hands. This finding is most consistent with which of the following conditions?

- (A) Camptodactyly
- (B) Clinodactyly
- (C) Ectrodactyly
- (D) Macroductyly
- (E) Polysyndactyly

The correct response is Option C.

This 3-year-old boy has ectrodactyly, a partial or total absence of the fingers that suggests a central hand deficiency. Central hand deficiencies can be classified as typical or atypical. Patients with typical central hand deficiencies have absence of the third ray (infrequently the second ray, rarely the fourth ray). The finding is often bilateral. Other anomalies, including cleft lip and palate, congenital heart disease, and significant deformities of the upper and lower extremities, can be associated. Syndactyly and foot involvement are common. The inheritance is familial.

In contrast, a patient with atypical central hand deficiency usually has several deficient rays unilaterally. This deficiency is commonly known as symbrachydactyly and is the opposite of true cleft hand. Inheritance is nonfamilial. Other anomalies, such as syndactyly and foot involvement, are uncommon. Affected patients typically have digital nubbins that are best removed at birth. Functional hand grasp can be increased through surgical manipulation of the web space or osteotomies.

Camptodactyly is a nontraumatic flexion deformity of the proximal interphalangeal joint, usually bilateral and involving the small finger.

Patients with clinodactyly have either radial or ulnar angulation of the digit, usually the small finger, at the distal interphalangeal joint. In severe clinodactyly, a delta phalanx is common.

Macrodactyly involves overgrowth of one digit or hand segment. Overgrowth appears to be under neurotrophic control. Correction is either reduction or ablation.

Polysyndactyly is a type of complicated syndactyly, in which polydactyly and syndactyly are seen in association.

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187

A 38-year-old man has a pulsatile mass on the volar aspect of the distoradial forearm three weeks after sustaining a stab wound to the forearm. At the time of injury, he controlled the bleeding successfully by applying pressure to the wound and did not seek treatment. Which of the following is the most likely diagnosis?

- (A) Aneurysm
- (B) Arteriovenous fistula
- (C) Pseudoaneurysm
- (D) Ulnar artery thrombosis
- (E) Vascular malformation

The correct response is Option C.

The most likely diagnosis is pseudoaneurysm, which has occurred secondary to trauma in the area of the radial artery. This patient sustained a stab wound to the forearm that immediately began to bleed. Although he controlled the bleeding at the time of injury, a pulsatile mass developed subsequently. Because obtaining a biopsy specimen can result in significant hemorrhage in these patients, it is important to carefully review preceding history, which is consistent with pseudoaneurysm in this situation.

This patient's history is not consistent with a true aneurysm, and examination findings rule out an arteriovenous fistula.

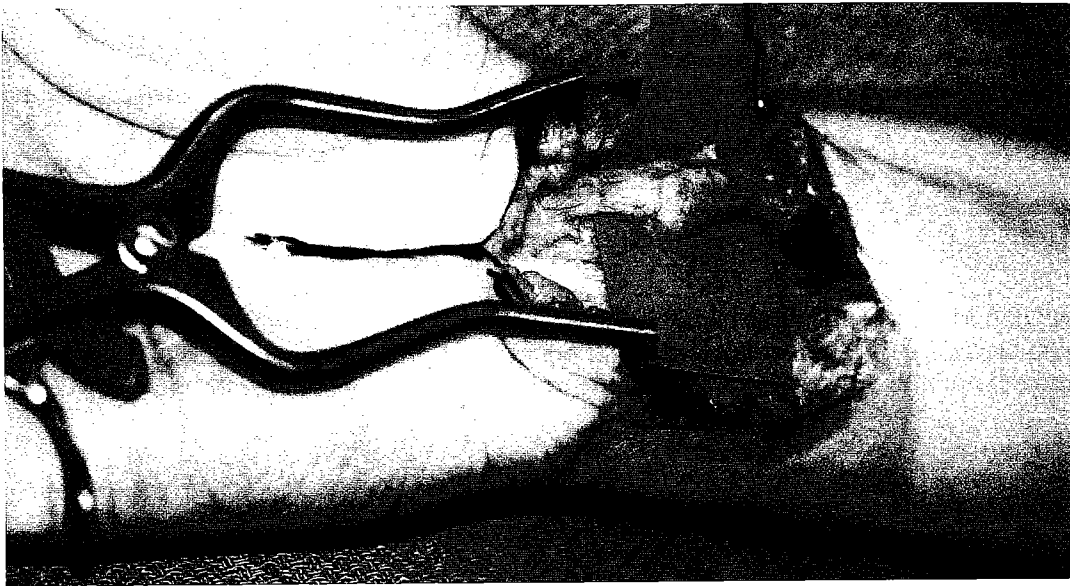
Ulnar artery thrombosis is also known as hypothenar hammer syndrome because it occurs secondary to localized trauma in construction workers or other persons who strike objects with their hands. Typical symptoms include pain, paresthesia, decreased temperature, color changes, pallor, and numbness of the ulnar most digits.

Vascular malformations are usually present at birth, but may develop and enlarge over time. A thrill or bruit is frequently associated, and color changes may occur.

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188



A 15-year-old girl has absence of sensation of the long finger and radial side of the ring finger 18 months after undergoing operative repair of a partial injury to the median nerve in the wrist. Sensation is normal in the thumb, index, and small fingers and in the ulnar side of the ring finger. An intraoperative photograph is shown above.

Which of the following is the most appropriate management?

- (A) Internal neurolysis of the median nerve
- (B) Excision of the neuroma only
- (C) Excision of the neuroma and epineural repair
- (D) Excision of the neuroma and sural nerve grafting
- (E) Resection of the median nerve and epineural repair

The correct response is Option D.

In this patient who has a neuroma in-continuity, the most appropriate management is excision followed by sural nerve grafting. Neuroma in-continuity is often difficult to diagnose and treat. Serial clinical examination and electrodiagnostic testing are essential for diagnosis. Although operative exploration can improve hand function and result in a good outcome, the functional fascicles that lie adjacent to the neuroma are at risk for injury. Nerve conduction velocity studies should be performed intraoperatively to identify the nonfunctioning fascicles that lead into

and out of the neuroma. The surgeon should take great care during excision of the neuroma to avoid damaging the functional fascicles. Following excision, autogenous grafting with a donor nerve such as the sural nerve should be performed.

Internal neurolysis would not re-establish the continuity of the involved fascicles. Simple excision of the neuroma will result in recurrence. Excision and epineural repair would place excessive tension on the neurorrhaphy and potentially lead to the development of another neuroma. Resection of the median nerve is an excessive procedure that would eliminate the functional portion of the nerve.

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189

A 60-year-old mechanic is brought to the emergency department 12 hours after sustaining an amputation of the nondominant left thumb at the level of the metacarpophalangeal joint. At the time of injury, the amputated part was immediately placed in a plastic bag over an ice slush. He underwent arthroplasty of the carpometacarpal joint of the left hand five years ago.

Which of the following factors is most likely to influence the success of replantation in this patient?

- (A) Age of the patient
- (B) Hematocrit of the patient
- (C) Length of ischemia time
- (D) Mechanism of injury
- (E) Previous hand surgery

The correct response is Option D.

In addition to the experience of the surgeon, the mechanism of injury is most likely to influence the success of replantation in any patient who has sustained an amputation of a digit. Because the vessels of the amputated part are damaged in patients who sustain avulsion and crush amputations, perfusion will be impeded, decreasing the likelihood of successful replantation. In addition, cooling of the amputated part contributes to the success of the replantation, as the amputated part can be replanted as late as 24 hours after injury if it is well preserved.

The age of the patient does not affect the success rate of replantation in the absence of other comorbid conditions or a history of cigarette smoking. Likewise, hematocrit and a history of hand surgery generally do not influence the outcome of replantation significantly. Because digits do not contain muscle, the length of ischemia time is not an influential factor.

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190



A 9-month-old infant has the deformity shown in the photograph above. The pregnancy and delivery were uncomplicated; the infant's development is otherwise normal. Which of the following is the most likely diagnosis?

- (A) Brachysyndactyly
- (B) Camptodactyly
- (C) Clinodactyly
- (D) Ectrodactyly
- (E) Syndactyly

The correct response is Option E.

Syndactyly is a common congenital hand anomaly, occurring in one of every 2500 neonates. Familial inheritance ranges from 10% to 40%, and boys are twice as likely as girls to be affected. Syndactyly can be simple or complex and complete or incomplete. Patients with simple syndactyly have fusion of the skin of adjacent digits. In complex syndactyly, the skin and bones are fused. Complete syndactyly encompasses the entire web space. In patients with incomplete syndactyly, only part of the web space is fused.

Based on the clinical photograph alone, incomplete syndactyly can be diagnosed in this infant because the entire web space is not involved. However, because there are no additional radiographs, a diagnosis of simple or complex syndactyly cannot be determined.

Although most infants with syndactyly undergo release before 18 months of age, some surgeons have performed surgery as early as 6 weeks of age.

Infants with brachydactyly have short, fused digits. Camptodactyly is characterized by curvature of a digit in its plane of flexion; in contrast, clinodactyly describes deviation of the digit in the plane of the hand. Patients with ectrodactyly have partial or total absence of the digits.

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191

A 4-year-old boy has a 4 × 8-cm compressible mass of the soft tissue of the volar forearm that has enlarged over the past year. He also has worsening pain in the forearm. Physical examination shows intact skin over the forearm; a thrill can be palpated over the mass. The mass does not decompress fully with elevation of the arm.

Which of the following is the most appropriate diagnostic study?

- (A) Plain radiographs
- (B) Bone scan
- (C) Contrast-enhanced CT scan
- (D) MR angiography
- (E) Contrast angiography

The correct response is Option D.

In this 4-year-old boy who has a high-flow vascular malformation of the volar forearm, the most appropriate diagnostic study is magnetic resonance imaging with intravenous gadolinium, also known as magnetic resonance angiography (MRA). Noninvasive imaging studies are most appropriate in young patients with suspected vascular malformations. MRA delineates baseline tissue involvement and is used to distinguish between low-flow and high-flow lesions.

Plain radiographs are appropriate for detecting skeletal alterations resulting from vascular malformations, but would not be diagnostic. Duplex ultrasonography is a simple noninvasive technique that can define flow characteristics, but is cumbersome in young patients and cannot be used to accurately assess the degree of involvement of other soft-tissue structures. Contrast-enhanced CT scans do not provide the necessary resolution for evaluation of vascular malformations. Because contrast angiography is invasive, it is reserved for more extensive evaluation of high-flow malformations, preoperative planning, and/or superselective embolization.

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192

A 50-year-old man is undergoing evaluation because he has had weakness of grip in the right hand for the past two months that is affecting his golf swing. Physical examination shows limited abduction and adduction of the fingers of the right hand. He has difficulty crossing the fingers. Sensation is diminished over the volar aspect of the small finger and volar-ulnar aspect of the ring finger. Sensation is normal over the radial digits and dorsal aspect of the hand.

This patient most likely has an nerve lesion at which of the following sites?

- (A) Arcade of Frohse
- (B) Arcade of Struthers
- (C) Guyon's canal
- (D) Origin of the flexor carpi ulnaris
- (E) Vascular leash of Henry

The correct response is Option C.

This patient has symptoms consistent with ulnar nerve compression, including weakness of the intrinsic muscles of the hand innervated by the ulnar nerve (which manifests as a loss of finger adduction and abduction) and evidence of muscle atrophy. There is also decreased sensation in the distribution of the ulnar nerve. The ulnar nerve is compressed most commonly in the region of the cubital tunnel; the second most common site of compression is at Guyon's canal in the wrist. Sensation over the dorsoulnar hand, which is supplied by the dorsal branches from the ulnar nerve arising proximal to Guyon's canal, is tested to determine the location of compression. If sensation is altered dorsally, the lesion lies proximal to the distal forearm, and is most likely to involve the cubital tunnel. However, if sensation in the dorsoulnar hand is normal, the lesion lies distal to the distal forearm, and most likely involves Guyon's canal, as in this patient.

Other, less common sites of compression of the ulnar nerve include the arcade of Struthers, which is a thin aponeurotic band extending from medial head of the triceps to the medial intermuscular septum, located approximately 8 cm proximal to the medial epicondyle, and occasionally the origin of the flexor carpi ulnaris. The arcade of Frohse and vascular leash of Henry are potential sites of compression of the radial nerve.

When compressed, peripheral nerves typically cause pain and specific nerve deficits of sensation and strength. Some sensory branches divide from the nerve proximal to the wrist or at the level of the carpal canal. The dorsal sensory branch of the ulnar nerve divides approximately 6 cm proximal to the wrist. The motor branches of the median and ulnar nerves can be separated into extrinsic and intrinsic function.

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193



A 22-year-old woman has the split nail deformity shown in the photograph above. On physical examination, the deformity involves the sterile and germinal matrices. The patient does not want to lose the nail. Which of the following is the most appropriate management?

- (A) Excision of the scar and primary closure of the nail bed
- (B) Split nail grafting from the same nail bed
- (C) Split nail grafting from the toe
- (D) Full-thickness nail grafting from the finger
- (E) Full-thickness nail grafting from the toe

The correct response is Option E.

In this patient who has a split nail deformity, the most appropriate management is full-thickness nail grafting from the toe. This deformity is caused by injury to the nail bed, leading to scarring of the bed. The nail plate does not grow in the scarred area, resulting in a split in the nail plate.

Because the deformity involves both the sterile and germinal matrices, only a full-thickness nail will provide the sterile and germinal matrix components required for reconstruction. Harvest of a full-thickness nail produces a significant cosmetic defect at the donor site; therefore, a graft from the second toe is thought to provide the least unsightly result.

In patients who have a small scar affecting the sterile matrix only, appropriate management may include excision of the scar and re-approximation of the sterile matrix; however, the sterile matrix is not usually mobilized and re-approximated unless the affected area is narrow. In addition, the germinal matrix cannot tolerate re-approximation.

As mentioned above, a split nail graft from either the same nail bed or another nail bed will not provide the components needed for reconstruction of this defect. In addition, using another finger as a donor will result in an unsightly donor defect in the hand.

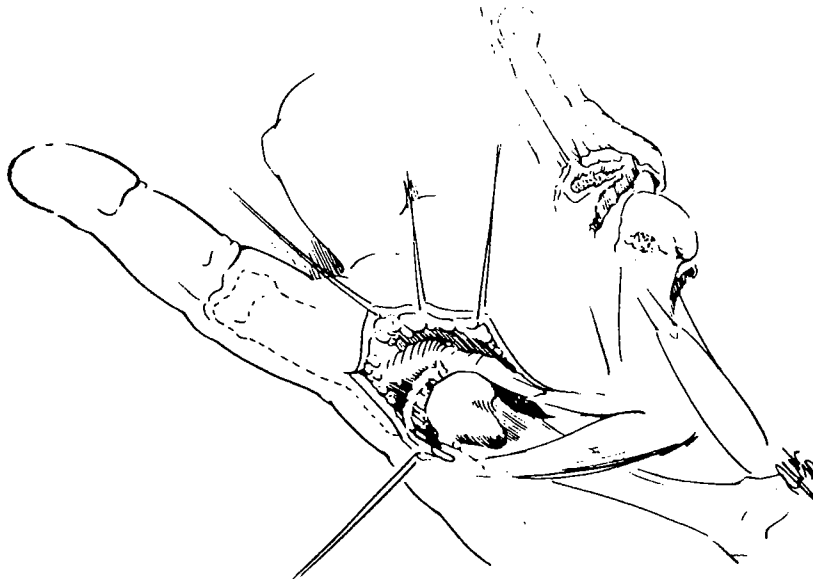
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194

A 20-year-old college basketball player sustains a dorsal dislocation of the metacarpophalangeal joint of the dominant index finger. Repeat attempts at closed reduction are unsuccessful. Which of the following structures are the most likely cause of the unsuccessful closed reduction?

- (A) Extensor indices, lumbrical muscle, and flexor digitorum profundus
- (B) Flexor digitorum profundus, volar plate, and sagittal bands
- (C) Lumbrical muscle, volar plate, and flexor digitorum profundus
- (D) Sagittal bands, extensor indices, and lumbrical muscle
- (E) Volar plate, sagittal bands, and extensor indices



Pathology of irreducible (complex) dislocations of the index metacarpophalangeal joint. The metacarpal head protrudes volarly between the lumbrical (radially) and the flexor tendons (ulnarily). The proximal phalanx and volar plate displace dorsal to the metacarpal head, and the plate is folded and impinged within the previously congruous articular surfaces. The flexor tendons remaining in the fibrous sheath attached to the volar plate are kept taut by this displacement and thus maintain the tight tendon-lumbrical encirclement around the narrow metacarpal neck. Traction applied to attempt reduction further tightens this entrapment and makes closed reduction impossible.

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The correct response is Option C.

The lumbrical muscle, volar plate, and flexor digitorum profundus tendons are most likely interfering with reduction of the index finger dislocation. Dorsal dislocations are uncommon injuries that occur as a result of forced hyperextension. The membranous proximal portion of the volar plate ruptures and becomes interposed dorsally between the base of the proximal phalanx and the dorsal metacarpal head. Reduction can be accomplished by flexing the wrist, which loosens the flexor tendons, and then applying pressure, directed distally and volarly, to the base of the proximal phalanx. In patients with complex dislocations, open reduction is required because the volar plate lies in the joint space, blocking a successful closed reduction. With dislocations of the metacarpophalangeal joint, the flexor digitorum profundus tendon lies ulnar to the joint and the lumbrical muscle lies radial to the joint. The sagittal bands and extensor indices are dorsal structures that are not involved.

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195

A 27-year-old woman has intense, burning pain in the right arm 10 days after sustaining a fracture of the right radius. Conservative treatment of the pain with oral administration of narcotic agents has not been effective. At the time of injury, a long arm cast was applied in the emergency department.

Which of the following is the most appropriate diagnostic test?

- (A) Three-view radiographs of the wrist
- (B) Stellate ganglion block
- (C) Thermography of the upper extremity
- (D) Triple-phase bone scan
- (E) MRI of the wrist

The correct response is Option A.

This patient has symptoms consistent with complex regional pain syndrome type I, or reflex sympathetic dystrophy (RSD), a complex alteration of the pain response following trauma. In contrast, patients with complex regional pain syndrome type II, or causalgia, have posttraumatic pain resulting from an identifiable nerve injury. While its exact cause is unknown, RSD is characterized by pain, stiffness, limited function, atrophic changes, and vasomotor instability. Early diagnosis and treatment are essential for optimal functional outcome; the surgeon must also differentiate RSD from other, treatable conditions.

Although fractures of the distal radius are a common precipitating factor for RSD, the pain may actually be caused by fracture nonunion or an excessively tight cast. Therefore, appropriate initial management involves removing the cast and obtaining three-view radiographs of the wrist to determine the adequacy of fracture reduction. This should be performed before any of the other diagnostic tests listed.

Stellate ganglion blocks are used in the treatment of RSD and can be performed diagnostically, but simple radiographs should be obtained first. Thermography has been advocated for diagnosis of this condition but has low sensitivity and specificity. Triple-phase bone scans are important for evaluation and have a relatively high specificity for diagnosis, but should not be performed initially. MRI is ineffective in diagnosis and management of RSD.

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196



A 17-year-old boy has tenderness over the metacarpal shafts of the ring and small finger four weeks after undergoing closed reduction of a hand injury followed by use of a hand-based splint. On physical examination, there is no rotational deformity of the involved digits. Current radiographs are shown above.

Which of the following is the most appropriate management?

- (A) Repeat closed reduction followed by application of a long arm cast
- (B) Closed reduction and transcutaneous fixation with Kirschner wires
- (C) Closed reduction and external fixation
- (D) Open reduction and lag screw fixation
- (E) Open reduction and miniplate fixation

The correct response is Option E.

This 17-year-old boy has displaced, angulated transverse fractures of the metacarpal shafts of the ring and small fingers. Closed reduction of the fractures and use of a hand-based splint for four weeks has not resulted in healing. Therefore, operative treatment is the most appropriate next step. This includes exploration to debride any material surrounding the fragments and open reduction of the fractures. In addition, miniplate fixation is indicated for transverse metacarpal fractures.

Repeat closed reduction and application of a long arm cast are unlikely to result in a successful reduction or lead to fracture healing.

Closed reduction and transcutaneous fixation with Kirschner wires may have been considered at the time of injury but are not appropriate four weeks later.

Closed reduction and external fixation are indicated in patients with highly comminuted fractures with or without bone loss or fractures associated with soft-tissue loss.

Lag screw fixation is appropriate for treatment of spiral and oblique metacarpal fractures in which the length of the fracture is at least twice the diameter of the bone. This technique is advantageous because it minimizes periosteal stripping.

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197



A 7-month-old infant has the deformity shown in the photographs above. Which of the following is the most likely mode of inheritance of this deformity?

- (A) Autosomal dominant
- (B) Autosomal recessive
- (C) Sporadic
- (D) X-linked dominant
- (E) X-linked recessive

The correct response is Option A.

This 7-month-old infant has a typical, or true, cleft hand deformity, which is most commonly inherited as an autosomal dominant condition. However, cleft hand may also occur as a spontaneous mutation, as it did in this patient whose family members were unaffected.

Typical cleft hand deformity is classified as a longitudinal deficiency because it involves dysplasia of the central portion of the hand. This anomaly is stratified into five categories, based on the degree of ray absence and hypoplasia of the thumb space. Characteristics include a V-shaped cleft, suppression of the central digit, and sometimes minor syndactyly of the ulnar border digits.

In contrast, atypical cleft hand is sporadic and is included in the teratologic sequence of symbrachydactyly. Affected patients have a broad, flat cleft hand with finger nubbins containing nail remnants.

Because typical cleft hand may be associated with several syndromes, any infant who exhibits this anomaly should be evaluated for cardiac, pulmonary, musculoskeletal, ocular, and renal defects. EEC syndrome, involving ectrodactyly, ectodermal dysplasia, and cleft lip/palate, is most frequently associated. Many patients with typical cleft hand deformity also have clefting of the feet (as does this patient), which results from localization of the split hand foot gene (SHFM1) to chromosome 7q21.

The degree of deformity of typical cleft hand varies greatly. Although most patients adapt and ultimately function quite well, surgical reconstruction is often recommended for functional as well as cosmetic reasons. The Snow-Littler procedure, which involves transposition of a palmar-based cleft flap with the index ray to close the cleft and create a useful first web space, is an appropriate reconstructive option.

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198

Which of the following is the most likely cause of swan-neck deformities in patients with advanced rheumatoid arthritis?

- (A) Hyperextension injuries of the proximal interphalangeal joints
- (B) Ruptures of the extensor digitorum communis tendons
- (C) Ruptures of the flexor digitorum superficialis tendons
- (D) Tightness of the extrinsic tendons
- (E) Tightness of the intrinsic tendons

The correct response is Option E.

Patients with advanced rheumatoid arthritis have profound tenosynovial hypertrophy of the metacarpophalangeal (MP) joints, resulting in subluxation of the joints. They also exhibit ulnar drift of all fingers and swan-neck deformities of the ulnarmost three fingers. The swan-neck deformity is characterized by flexion contractures of the MP joints and

hyperextension deformities of the proximal interphalangeal (PIP) joints. This hand posture results from tightness of the intrinsic tendons, which is caused by both intrinsic rheumatoid myositis and increased tension within the intrinsic system of the hand resulting from the aforementioned joint subluxation.

Recommended procedures for correction of swan-neck deformities include arthroplasties of the MP joints of the fingers, comprehensive soft-tissue and intrinsic releases, centralization of the extrinsic extensor tendons over the MP joints, and spiral oblique retinacular ligament or Zancolli-flexor digitorum superficialis lasso reconstruction of the ulnarmost three digits.

Hyperextension or volar plate injuries of the PIP joints can result in swan-neck deformities, but are unlikely to occur in patients with advanced rheumatoid arthritis.

Although ruptures of the extensor digitorum communis (EDC) tendons are common in patients with rheumatoid arthritis of the hand, they do not cause swan-neck deformities. Ruptures of the EDC tendons generally occur at the level of the distal ulna, impairing extension of the MP joints. These ruptures must be differentiated from subluxations of the EDC tendons at the level of the MP joints before surgery is performed. Rupture is characterized by a lack of continuity of the extensor tendons. In patients with subluxation, the tendons fall between the MP joints.

Ruptures of the flexor digitorum superficialis tendons can result in swan-neck deformities in patients with rheumatoid arthritis, but occur less frequently than ruptures of the EDC and profundus flexor tendons and thus are much less common than intrinsic tendon tightness.

Tightness of the extrinsic tendons may contribute to a swan-neck deformity but is not the sole cause in the absence of other deforming conditions. Extrinsic tendon tightness usually results from scarring and adhesions of the extensor tendons over the metacarpals. Neuromuscular and central hand disorders can also cause extrinsic tightness. Affected patients are unable to flex the PIP joints when the MP joints are flexed fully.

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199

A 35-year-old woman has an open fracture of the index finger metacarpal after sustaining a gunshot wound to the hand. Physical examination shows a 2.5-cm defect of the skin; radiographs show a 2-cm segmental defect of the metacarpal. The patient is to undergo single-stage reconstruction using a distally based posterior interosseous flap with vascularized bone.

Harvest of the flap with a cuff of which of the following muscles will maintain the blood supply to the bone?

- (A) Extensor carpi radialis brevis
- (B) Extensor carpi ulnaris
- (C) Extensor digiti minimi
- (D) Extensor pollicis longus
- (E) Supinator

The correct response is Option D.

The vascular supply of the ulna can be maintained by harvesting the distally based posterior interosseous flap with a cuff of the extensor pollicis longus muscle. In this patient who has a 2-cm segmental defect of the metacarpal, vascularized bone from the ulna is appropriate for single-stage reconstruction. Other reconstructive options include the radius, scapula, fibula, humerus, and iliac crest. The radial forearm flap may also be harvested as an osteocutaneous flap for reconstruction of the metacarpal.

To determine the cutaneous portion of the posterior interosseous flap, a line is drawn from the lateral epicondyle of the humerus to the ulnar head with the forearm in full pronation. The cutaneous branch of the posterior interosseous nerve, which must be incorporated in the flap, lies 1 cm distal to the midpoint of this line. The posterior interosseous artery lies deep to the deep fascia, and the septum passes between the extensor carpi ulnaris and extensor digiti minimi. After the artery has been identified, the surgeon dissects distally to the supinator, taking care to identify and preserve the posterior interosseous nerve. A 5- to 7-cm segment of bone can be harvested by dissecting through of a portion of the extensor pollicis longus while leaving a cuff of muscle attached to the bone.

Although free iliac crest corticocancellous grafts can be used to reconstruct metacarpal defects, vascularized bone graft is often preferred instead if the defect is large or the soft-tissue envelope has poor quality.

The extensor carpi radialis brevis and supinator muscles do not supply perforators to the ulna.

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A 57-year-old man has a flexion contracture involving the ring and small fingers of the left hand. A photograph is shown on page 178. During partial fasciectomy in this patient, the neurovascular bundle to these fingers is at risk for injury. Each of the following structures is a normal component of the fascia surrounding the neurovascular bundle EXCEPT

- (A) Cleland's ligament
- (B) Grayson's ligament
- (C) lateral digital sheet
- (D) pretendinous band
- (E) retrovascular band

The correct response is Option D.

Fascial structures that encase the neurovascular bundles include Cleland's and Grayson's ligaments, the lateral digital sheet, and the retrovascular band. Cleland's ligament is a thick fascial structure that lies deep to the neurovascular bundle; it arises from the side of the phalanges and courses obliquely toward the skin. Grayson's ligament is thinner and more sheet-like than Cleland's ligament, and is positioned superficial to the neurovascular bundle; it arises from the tendon sheath and extends to the skin. The lateral digital sheet is comprised of superficial fascia on either side of the phalanges. It receives fibers from the natatory ligament and the spiral band, and is found lateral to the neurovascular bundle. The retrovascular band is a longitudinal structure situated dorsomedial to the neurovascular bundle.

The pretendinous cord is a pathologic component of Dupuytren disease. It is an extension of the pretendinous band in the midline of the phalanges. The pretendinous band is not a component of the fascia surrounding the neurovascular bundles.

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