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American Society of Plastic Surgeons In-Service Examination



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This In-Service Examination has been designed to enhance the participant's clinical knowledge base of plastic surgery and serve as a self-assessment tool. Each participant will become updated on the core curriculum of plastic surgery. Upon completion of questions and thoughtful review of individual scores, participants can establish a benchmark for areas of focus needing further concentrated educational efforts. It is expected that completion of this educational activity will assist participants in obtaining better outcomes in practice.

Material released March 2008.

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Disclosures:

- Kaveh Alizadeh, MD serves as advisor for Klinger Advanced Aesthetics
- Larry Hollier, Jr., MD obtains research support from Synthes/KLS Martin/Stryker
- Lawrence Kurtzman, MD serves as education faculty for Botox Cosmetic
- Joseph Losee, MD receives research funding from AO North American and Synthese funding for educational/fellowship programs
- Babak Mehrara, MD served in the past as consultant to Genzyme Corporation

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Of the 30 credits, 2 have been identified as programming applicable towards the ASPS Patient Safety requirement.

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The American Society of Plastic Surgeons

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for the

In-Service Examination



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Section 1: Comprehensive

1. A 26-year-old man comes to the emergency department because he has a laceration of the anterior aspect of the right lower leg. Physical examination shows a superficial 2-cm full-thickness skin laceration. Sutures are placed. If the wound heals normally, which of the following is the earliest time that the epidermis is likely to be restored?
 - A) 12 Hours
 - B) 24 Hours
 - C) 2 to 3 Days
 - D) 4 to 5 Days
 - E) 6 to 7 Days

The correct response is Option B.

If the basement membrane has been destroyed, epithelial cells and keratinocytes located on wound edges proliferate and send out projections to reestablish a protective barrier against fluid loss and bacterial invasion. The stimuli for epithelial proliferation and chemotaxis are epidermal growth factor and transforming growth factor (TGF)- α produced by activated platelets and macrophages. Fibroblasts do not synthesize TGF- α .

After closing a surgical incision, epithelialization usually occurs within 24 hours, at which point it is no longer necessary to keep the wound dry. Washing to remove dried blood can reduce bacterial proliferation and improve wound healing. This process may take longer in patients in whom wound healing may be compromised, such as elderly patients or patients with diabetes.

Epithelialization occurs early in wound healing. If the basement membrane remains intact, epithelial cells migrate upward in the normal manner. The epithelial progenitor cells remain intact below the wound in skin appendages, and the normal layers of the epidermis are restored in two to three days.

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2. A 26-year-old man is brought to the emergency department 30 minutes after sustaining injuries in a motor vehicle collision. Examination shows full-thickness burns on 28% of the total body surface area, flail chest, pelvic hematoma, and an open fracture of the right ankle. Radiographs show a fracture of the pelvis. He is intubated and mechanically ventilated. A vena cava filter is placed. Open reduction and internal fixation of the ankle fracture is performed followed by debridement of the right lower leg. A free tissue transfer is planned to cover the exposed tibia, patella, and peripatellar tendon. To avoid flap thrombosis, which of the following is the most appropriate time to perform the tissue transfer?
- A) Immediately
 - B) Two days after debridement
 - C) Six days after debridement
 - D) Two weeks after debridement
 - E) Six weeks after debridement

The correct response is Option E.

Assuming that the patient described needs a free flap to provide coverage of the exposed knee structures, the optimal time for free tissue transfer in burn patients, following debridement, is four to six weeks after injury. A recently published series of burn patients who underwent free tissue transfer for limb salvage reported an overall flap loss rate of 12% (5/42). Five of the 14 flaps done between five days and six weeks were lost, compared to a success rate of 100% in 21 flaps performed after six weeks. The proposed mechanism for flap thrombosis was the hypercoagulable state associated with burn injury.

For nonthermal lower-extremity trauma requiring free tissue transfer, most studies support early flap reconstruction within the first week after injury. Both military and civilian injuries benefit from aggressive debridement and immediate or nearly immediate coverage.

Other possible options for reconstruction include subatmospheric sponge dressing, Integra, and staged skin grafting. The scenario described, however, mandates the use of free tissue transfer.

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3. A 78-year-old woman with a history of coronary artery disease and emphysema has a 20-cm-diameter full-thickness defect of the scalp after excision of a large basal cell carcinoma. In addition to burring the outer cortex of the exposed bone and applying a dermal regeneration template (Integra), which of the following is the most appropriate next step to optimize soft-tissue coverage of the defect?
- A) Application of 0.008-inch split-thickness skin graft after four weeks
 - B) Application of 0.018-inch split-thickness skin graft after four weeks
 - C) Application of full-thickness skin graft after two weeks
 - D) Immediate application of 0.008-inch split-thickness skin graft
 - E) Immediate application of 0.018-inch split-thickness skin graft

The correct response is Option A.

Integra dermal regeneration template is a bilayer skin replacement product, composed of a bottom layer of bovine collagen and chondroitin-6-sulfate and a top layer of Silastic membrane, which serves as a temporary epidermal replacement. The product is applied to a fresh, noninfected wound bed. After two to three weeks, the dermal component becomes vascularized. A thin (0.006- to 0.010-inch) split-thickness skin graft (STSG) may then be applied, as the Integra neodermis serves as a scaffold for ingrowth of tissue from the patient's wound bed. The STSG may be applied at two weeks, but graft take may be improved if it is applied after four weeks. Furthermore, thin STSGs are more likely to succeed than thick STSGs. Full-thickness skin grafts are not indicated when using Integra because the product forms a dermal substitute.

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(Please note that this pictorial appears in color in the online examination)

4. An 83-year-old man is undergoing reconstruction of the defect shown with a frontonasal advancement flap. The dominant vascular supply to the flap arises from which of the following arteries?
- A) Angular
 - B) Anterior ethmoidal
 - C) Infraorbital
 - D) Internal maxillary
 - E) Supratrochlear

The correct response is Option A.

The dorsal nasal flap described, also known as a Reiger flap, is a modification of the Gillies bishop's mitre flap. The external nose has a rich blood supply originating from the ophthalmic branch of the internal carotid artery and the facial branch of the external carotid artery. The angular artery is the terminal segment of the facial artery and provides the dominant vascular supply to the flap as it enters near its pivot point at the upper nose-canthus junction. The facial

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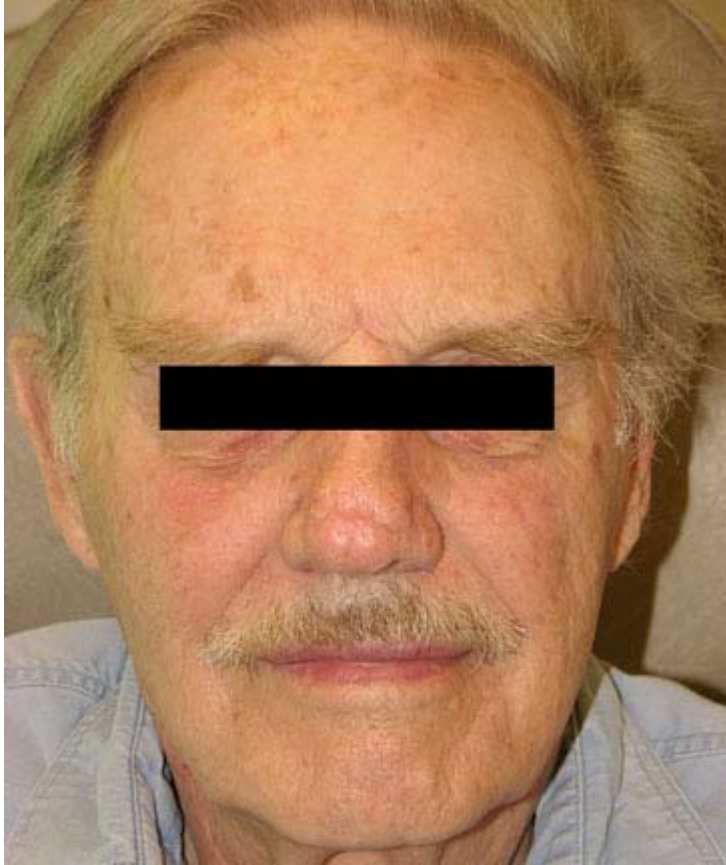
artery originates from the external carotid artery, crosses the base of the mandible, and makes a tortuous course past the anterior aspect of the masseter. It then serves branches to the labial arteries and the columella and nasal tip via the nasal septal artery and the lateral nasal artery. The facial artery then continues along the nasal sidewall to the medial canthal area as the angular artery. Understanding the vascular supply to the skin surface is essential when planning and performing cutaneous flap reconstruction.

The anterior ethmoid branch of the ophthalmic provides a small branch to the anterior nasal skin from the undersurface of the nasal bones after it courses past the anterior ethmoid cells. The external nasal artery is another name for this terminal branch of the anterior ethmoid artery and it would likely be divided in elevating a dorsal nasal flap.

The internal maxillary artery is one of the two terminal branches of the external carotid artery that supplies the structures of the lateral face. It has numerous branches in the pterygomasseteric region and terminates in the infraorbital artery. The infraorbital vessels anastomose with the neighboring angular artery to help supply the lateral nasal skin, although they do not provide the dominant vascular supply to the dorsal nasal flap.

The ophthalmic artery has six branches beyond the orbit, including the dorsal nasal and supratrochlear arteries that serve the glabella and upper nasal region. The glabellar skin is elevated in the dorsal nasal flap and perforating vessels from the supratrochlear and subnasal vessels would be at least partially divided. The supratrochlear vessels perfuse the forehead flap for nasal reconstruction.

A postoperative photograph is shown.



(Please note that this pictorial appears in color in the online examination)

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2. Burget GC, Menick FJ. *Aesthetic Reconstruction of the Nose*. St. Louis: Mosby; 1994:131-133.
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5. A 24-year-old man is brought to the emergency department 30 minutes after sustaining a laceration to the left cheek with a sharp piece of glass. Physical examination shows a 5-cm laceration extending from the left ear to the mid cheek. The patient has motor weakness of his upper lip. The wound is debrided and closed in layers. The patient has increasing swelling over the left cheek over the next five days. Which of the following steps in initial management was overlooked?
- A) Arteriogram
 - B) Cannulation of Stensen duct
 - C) CT
 - D) Duplex ultrasound
 - E) Nerve conduction studies

The correct response is Option B.

The buccal branch of the facial nerve travels with the parotid duct in the cheek. In a deep laceration of the cheek in which either of these structures is injured, it is likely that the other also will be injured. The facial artery and facial vein are lateral to the midfacial region at the mandibular angle. It is recommended that cut nerve branches be repaired immediately. The parotid duct must be explored. If it is injured, it must be repaired immediately. To diagnose an injury, the Stensen duct may be cannulated intraorally. An injection of saline or methylene blue will determine if the duct is intact. If there is no leakage, the duct is intact. If there is leakage, the proximal and distal cut ends of the duct must be repaired over a stent, often a Silastic tube or small feeding tube (see the photographs below). The tube must remain in place for approximately two weeks until the duct heals. If parotid duct injury is left undiagnosed, a sialoceles will develop. Neither the temporalis nor masseter muscle will be injured and result in malocclusion.

Arteriogram, imaging studies (CT and ultrasound), and nerve conduction studies would not be effective in diagnosing an injury to the parotid duct.



(Please note that this pictorial appears in color in the online examination)

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6. A 35-year-old woman comes to the office for removal of the tattoo shown in the photograph. The tattoo was professionally applied. The patient undergoes five treatments with a Q-switched Nd:YAG (1064 nm) laser. After completion of laser therapy, areas of red pigment remain. Additional treatment with which of the following lasers is the most appropriate next step in management?

- A) Erbium: YAG (2940 nm)
- B) Q-switched alexandrite (755 nm)
- C) Q-switched Nd:YAG (532 nm)
- D) Q-switched ruby (694 nm)
- E) Ultrapulsed CO₂ (10,600 nm)

The correct response is Option C.

An estimated seven to 20 million people in the United States have at least one tattoo, and approximately 17% have considered tattoo removal. Compared with amateur tattoos, professional tattoos often contain various densely packed colored pigments at a uniform depth. Quality-switched (Q-switched) lasers enable the deposit of energy very quickly, thus rupturing cells containing pigment and triggering phagocytosis and packaging of tattoo fragments for lymphatic drainage. Because different pigments respond to different wavelengths, it is rare that one laser system can be used alone to remove all combinations of inks.

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The Q-switched Nd:YAG 1064 nm has the deepest penetration and carries the least risk of hypopigmentation but is least effective in removing brightly colored tattoos. In contrast, the Nd:YAG 532 nm is effective for red, orange, and occasionally yellow ink. Because this wavelength is also absorbed by hemoglobin, purpura often occurs after treatment and can last for seven to 10 days.

CO₂ and erbium lasers are preferred for laser resurfacing and are less effective for tattoo removal.

The Q-switched alexandrite and ruby lasers are effective for the treatment of black, blue, and green pigment; however, because their wavelengths are well absorbed by melanin, transient hypopigmentation and even permanent depigmentation can be a problem, particularly in patients with Fitzpatrick type V or VI skin types.

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7. An 18-year-old man has pain over the outside of the left thigh two weeks after open harvest of a cancellous bone graft from the left iliac crest for repair of a palatal fistula. Injury to which of the following nerves is the most likely cause of the pain?

- A) Femoral
- B) Ilioinguinal
- C) Lateral femoral cutaneous
- D) Medial superior cluneal
- E) Superior gluteal

The correct response is Option C.

The open method of harvesting iliac crest bone graft is complicated by injury to the lateral femoral cutaneous nerve in 10% of patients. Injury to this nerve, known as meralgia paresthetica, results in numbness, burning, itching, and pain over the lateral thigh. This nerve is avoided by limiting excessive retraction of the iliacus muscle or harvesting bone through a minimally invasive approach.

Femoral nerve injury results in weak hip flexion and knee extension, sensory changes, and pain over the anteromedial thigh. Although injury to the femoral nerve has been reported as a rare complication of iliac crest bone graft harvest, it is more often associated with abdominal and pelvic surgery.

The ilioinguinal nerve provides sensation to the anteromedial thigh and genitalia. Injury to this nerve results in anesthesia to these areas. Excessive medial retraction during harvest of the inner cortex of the iliac crest may injure the nerve because it descends along the iliacus muscle.

Medial superior cluneal nerve injury is a cause of chronic pain complicating bone graft harvesting from the posterior iliac crest. Symptoms include projection of pain into the buttock.

The superior gluteal nerve is a motor nerve and has no sensory distribution. It is unlikely to be injured during harvest of iliac bone graft.

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8. A 35-year-old man with quadriplegia comes to the office because he has a pressure sore over the right elbow. He has limited function of his upper extremities and uses a wheelchair for ambulation. Physical examination shows a 5-cm-diameter ulcer. Culture shows osteomyelitis of the olecranon. After debridement of the wound, coverage with which of the following flaps is the most appropriate next step?
- A) Flexor carpi ulnaris flap
 - B) Lateral arm fasciocutaneous flap
 - C) Latissimus dorsi free flap
 - D) Pedicled latissimus dorsi musculocutaneous flap
 - E) Radial forearm flap

Please note: Question 8 has been deleted from the examination.

The correct response is Option E.

Ulcerations or defects on the lateral or medial aspects of the elbow are common in patients with quadriplegia, often following inflammation of the olecranon bursa. A simple and safe method of reconstruction is achieved using a radial forearm fasciocutaneous flap.

A flexor carpi ulnaris transfer would be suboptimal to cover a wound of this size. A lateral arm fasciocutaneous flap, as commonly designed, would not reach this defect because of its size and location. Free tissue transfer is appropriate for more complex elbow reconstructions and unsalvageable deep burns; however, latissimus dorsi free flap transfer is bulky and would not be the first choice in the scenario described. A pedicled latissimus dorsi musculocutaneous flap is a useful distant flap for coverage of the upper arm and can be used to cover the elbow. Although the functional deficit from this transfer is minimal, it is best preserved in a patient who is a wheelchair ambulator and who has limited muscle function of the upper extremity.

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9. In an acute wound, which of the following structures initiate coagulation, hemostasis, and the inflammatory cascade?

- A) Endothelial cells
- B) Eosinophils
- C) Macrophages
- D) Neutrophils
- E) Platelets

The correct response is Option E.

Initial changes in a wound after injury are vascular in nature. Blood vessels are disrupted and hemorrhage ensues, damaging the epidermal barrier. After vasoconstriction occurs, the coagulation cascade is activated to reduce blood loss. Platelets in the clot are essential for hemostasis and normal inflammatory response. Platelets release adenosine diphosphate (ADP), which, in the presence of calcium, stimulates further platelet aggregation. Alpha granules in the platelets release cytokines such as platelet-derived growth factor (PDGF), transforming growth factor (TGF)- β , TGF- α , basic fibroblast growth factor (bFGF), platelet factor IV, and β -thromboglobulin. These proteins initiate the wound healing cascade by attracting and activating fibroblasts, endothelial cells, and macrophages. Platelets also contain lysosomes and dense bodies in their cytoplasm. Lysosomes include proteases. Dense bodies store vasoactive amines, such as serotonin, which increase microvascular permeability. The extrinsic and intrinsic coagulation pathways are activated, resulting in a fibrin mesh with aggregated platelets embedded in it.

The early inflammatory phase following coagulation activates complement and initiates the classic molecular cascade, which leads to infiltration of the wound with neutrophils within 24 to 48 hours of injury. Neutrophils are attracted to the site of injury via chemical messengers released by damaged tissue, platelets, bacteria, and inflammatory mediators. Neutrophils act as defensive units, phagocytosing bacteria and foreign debris from the wound to prevent infection. Neutrophils are phagocytosed by macrophages and destroyed.

Macrophages are key regulatory cells for repair. When circulating monocytes migrate through the blood vessel wall and into the wound, they transform into macrophages. Between 48 and 72 hours after injury, macrophages are the dominant cells in the wound. They function in phagocytosis of bacteria and dead tissue. Macrophages also secrete collagenases and cytokines responsible for proliferation of fibroblasts, resulting in collagen production, and for proliferation of endothelial cells, resulting in angiogenesis.

Eosinophils do not play a role in acute wound healing.

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10. A 57-year-old man has chest pain in the recovery room after undergoing uneventful septorhinoplasty for repair of a deviated septum and collapsed internal nasal valve. Electrocardiography shows changes consistent with acute myocardial ischemia. He has no history of cardiac disease and takes no medications. Weight is 154 lb (70 kg). Intraoperative anesthesia included 1% lidocaine 20 ml with 1:100,000 epinephrine infiltrated into the nasal tissues, followed by intranasal placement of pledgets soaked in 4 ml of 10% cocaine solution. Infraorbital nerve blocks were performed bilaterally using a total of 10 ml of 0.5% bupivacaine. Which of the following is the most likely mechanism of the myocardial ischemia?
- A) Decreased systolic and diastolic left ventricular function
 - B) Histamine-induced coronary spasm
 - C) Impaired depolarization of the cardiac action potential
 - D) Increased peripheral vascular resistance
 - E) Vasoconstriction of epicardial coronary arteries

The correct response is Option E.

The most likely cause of change in electrocardiography in the patient described is vasoconstriction of the epicardial coronary arteries caused by a toxic dose of cocaine. The maximum safe dose of cocaine is 1.5 mg/kg, or 100 mg in a 70-kg adult. The patient described received a topical dose of 400 mg. With an average 37% mucosal absorption rate, the absorbed dose is still approximately 150 mg. Cocaine increases myocardial oxygen demands via alpha-adrenergic stimulation and decreases myocardial oxygen supply through vasoconstriction of the coronary arteries, resulting in myocardial ischemia.

Adverse cardiovascular reactions are possible after the administration of local anesthetics. At toxic levels, lidocaine and bupivacaine block sodium channels in cardiac tissue, resulting in a depressed rate of depolarization during phase 0 of the cardiac action potential. This manifests as prolonged QRS width, depression of left ventricular function, and ventricular arrhythmias from increased activity in reentrant pathways.

Hypersensitivity reactions to local anesthetics usually result in a shock-type scenario with hypotension, although histamine can cause coronary artery spasm. High doses of epinephrine can cause hypertension through increased peripheral vascular resistance. The doses of lidocaine, epinephrine, and bupivacaine that were administered to the patient described were within the range of maximum recommended doses.

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11. A 65-year-old man comes to the office because he has a painful lesion on the left ear that has been present for the past eight months. Tenderness is noted on palpation of the lesion. A photograph of the ear is shown. Which of the following is the most likely diagnosis?

- A) Actinic keratosis
- B) Chondrodermatitis nodularis helicis
- C) Keratoacanthoma
- D) Seborrheic keratosis
- E) Tricholemmoma

The correct response is Option B.

Chondrodermatitis nodularis helicis is a chronic, inflammatory, painful, nodular lesion located primarily on the helix or antihelix of the ear. These lesions often produce exquisite tenderness that interferes with sleep. Histologically, the underlying cartilage demonstrates focal

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degenerative change and surrounding perichondritis. The cause of this inflammatory process is unknown, but long-term trauma or sun damage may play a role. Surgical excision of the affected cartilage is recommended if conservative therapy with steroid injections is unsuccessful.

This lesion could be actinic keratosis; however, actinic keratosis usually is asymptomatic except for possible pruritus. It is characterized by a discrete, flat, or slightly elevated lesion with surrounding erythema. These lesions are often multiple and appear scaly due to hyperkeratosis and parakeratosis. Twenty to 25% of lesions progress to squamous cell carcinoma. Treatment includes curettage, electrodesiccation, liquid nitrogen, or application of 5-fluorouracil.

A keratoacanthoma is a round, smooth, pink nodule encircling a large keratinous plug. It enlarges rapidly during a period of weeks and can resolve spontaneously. Histologically, it can be difficult to distinguish from squamous cell carcinoma. Although it is classified as benign and self-involuting, the treatment of choice is excision. Seborrheic keratosis is a sharply circumscribed, waxy papillomatous lesion with a friable hyperkeratotic surface and a “stuck on” appearance. It is an asymptomatic benign lesion and excision is elective. Tricholemmoma is a benign tumor often found in the scalp and has a clinical appearance similar to an epidermal inclusion cyst. Treatment is simple excision.

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12. Apligraf is a composite graft composed of cultured living dermis and sequentially cultured epidermis and is derived from which of the following?

- A) Acellular cadaveric dermal matrix
- B) Amniotic membrane
- C) Bovine pericardium
- D) Bovine tendon type I collagen and shark glycosaminoglycan
- E) Neonatal foreskin

The correct response is Option E.

Apligraf is a bioengineered skin substitute derived from neonatal foreskin and consists of cultured living dermis and sequentially cultured epidermis. Apligraf consists of four components: extracellular matrix, viable allogenic dermal fibroblasts, epidermal keratinocytes, and a stratum corneum. The extracellular matrix consists of type I bovine collagen and provides the scaffold for the three-dimensional structure. The dermal fibroblasts provide growth factors to stimulate wound healing. The epidermal keratinocytes form the epidermis and provide growth factors to achieve biologic closure. The stratum corneum provides a natural barrier to mechanical damage, infection, and wound dessication. The dermal fibroblasts and keratinocytes are separated from normally discarded neonatal foreskin.

Apligraf has been shown to be effective in treating diabetic foot ulcers in controlled multicenter prospective randomized clinical trials. The Apligraf group had a significant rate of complete wound closure in 56% of patients, compared with 39% in the control group. Wounds should be aggressively debrided, with no exposure of bone or tendon, before placement of Apligraf. There should also be no evidence of infection.

AlloDerm is an acellular allograft made of cryopreserved cadaveric skin. It consists of a decellularized dermal matrix with a structurally intact dermis and basement membrane.

Amniotic membrane has been used in ophthalmology for ocular surface reconstruction; however, its use as a bioengineered skin substitute is still in the early development phase.

Bovine pericardium has been used as a bioprosthetic for the past 20 years. It is frequently used in cardiac surgery, but not as a skin substitute.

Integra is a bioengineered skin substitute consisting of a dermal matrix of cross-linked bovine tendon type I collagen and shark glycosaminoglycan. The matrix is covered with a temporary epidermal substitute made of silicone. Integra has been shown to be effective in treating burn wounds and its use has been expanding to reconstructive surgery.

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13. A 55-year-old woman is admitted to the hospital for treatment of chronic pancreatitis. She has a 10-year history of severe rheumatoid arthritis managed with corticosteroids. Physical examination performed on admission shows an ulcer of the right ischium with purulent drainage. Results of culture show a polymicrobial infection. Serum albumin level is 1.8 g/dl. Necrotic soft tissue is debrided, resulting in a 6 × 4-cm defect and exposure of the underlying ischium. Which of the following is the most appropriate next step in management?
- A) Enzymatic debridement
 - B) Vacuum-assisted closure (VAC) therapy
 - C) Skin graft
 - D) Gluteus fasciocutaneous flap
 - E) V-Y hamstring advancement flap

The correct response is Option B.

The patient described has a full-thickness wound with exposed bone and will be a good candidate for flap closure once her infection is resolved and her nutrition optimized. Immediate reconstruction in a malnourished patient increases the risk of wound dehiscence and infection. During the interim, a vacuum-assisted closure (VAC) device is the most appropriate coverage for the wound. The VAC device promotes wound healing by facilitating the removal of excess interstitial fluid due to an increased pressure gradient and causes mechanical deformation of the wound resulting in enhanced granulation tissue formation, even over bone.

Enzymatic debridement may be appropriate in some patients with pressure sores but is not required in this patient because she has already undergone surgical debridement. A skin graft will not take to bone and provides insufficient soft-tissue coverage.

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14. Which of the following best describes the benefit of using acellular human dermal matrix compared with alloplastic mesh in complex abdominal wall reconstruction?

- A) Adhesion potential
- B) Cost effectiveness
- C) Definitive scar formation
- D) Rapid absorption
- E) Resistance to infection

The correct response is Option E.

Acellular human dermal matrix, which is commercially available as AlloDerm or FlexHD, has emerged as a versatile material for abdominal wall reconstruction. Because of retained vascular channels, this material revascularizes rapidly and resists infection. In addition, the matrix serves as a soft-tissue scaffold, retaining its original strength and becoming incorporated with minimal scar or adhesion formation.

These materials are more expensive than alloplastic mesh, although a formal cost analysis has not yet been published.

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15. A 4-year-old boy has full-thickness burns on 20% of the total body surface area. Which of the following end points is the most appropriate indicator of adequate fluid resuscitation in this patient?
- A) Cardiac index of 2.0 l/min/m²
 - B) Mean arterial pressure of 60 mmHg
 - C) Positive inspiratory pressure of 25 mmHg
 - D) Pulmonary wedge pressure of 15 mmHg
 - E) Urine output of 1.0 ml/kg/hr

The correct response is Option E.

Since the recognition of the phenomenon of burn shock, significant progress has been made in the survival rates of pediatric and juvenile patients. Currently, patients with all but the largest total body surface area (TBSA) injuries can be expected to survive when treated promptly. There are several very important conceptual factors in the resuscitation of pediatric patients with burns. Intravenous fluid resuscitations usually are required for patients with smaller burns (10%–20%). Venous access in small children may be a difficult issue, and a saphenous vein cutdown or an interosseous line is an acceptable short-term alternative. Children have proportionally larger body surface areas (BSAs) than adults; TBSA burns must be estimated using the pediatric modifications in the Lund-Browder classification, which demonstrates the relatively larger head and small thigh in pediatric patients. This results in higher weight-based calculations for resection volume (nearly 6 ml/kg per percentage burn), leading some to advocate a BSA-based resuscitation in addition to the required maintenance infusion as described by the Galveston Shriners Hospital (Galveston, TX) pediatric formula. Other centers, such as the Shriners Burn Institute in Cincinnati, use the Parkland formula with the addition of a maintenance rate.

Recommended end points are also higher in children, with urine output closer to 1 ml/kg/hr being a more appropriate goal. Children approaching 50 kg are probably better served by adult resuscitation parameters (30-50 ml/hr urine output) and calculations. Another concern with this population is the modest hepatic glycogen reserves, which can be exhausted quickly and sometimes require the change from Ringer's lactate to dextrose 5% in Ringer's lactate to prevent life-threatening hypoglycemia. For this reason, AccuChecks every four to six hours should be routine during the hypermetabolic state, especially for patients with larger burns.

Pediatric resuscitation protocols are based on the following formula (H is height [cm], W is weight [kg]):

$$BSA = [87 (H + W) - 2600]/10,000$$

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Pediatric resuscitation protocols are as follows:

- Shriners Burn Institute (Cincinnati): ml/kg per percentage burn plus 1500 ml/m² BSA
 - First eight hours: Ringer's lactate with 50 mEq sodium bicarbonate per liter
 - Second eight hours: Ringer's lactate
 - Third eight hours: Ringer's lactate solution plus 12.5 g of 25% albumin solution per liter
- Galveston Shriners Hospital: 5000 ml/m² TBSA burn plus 2000 ml/m² BSA, using Ringer's lactate plus 12.5 g 25% albumin per liter plus D5W solution as needed for hypoglycemia

Hourly urine output is a well-established parameter for guiding fluid management. The rate of fluid administration should be titrated to a urine output of 0.5 ml/kg/hr or approximately 30 to 50 ml/hr in most adults and older children (>50 kg). In small children, the goal should be approximately 1 ml/kg/hr. Failure to meet these goals should be addressed with gentle upward corrections in the rate of fluid administration by approximately 25%.

Because of several factors, such as pulmonary vasoconstriction, the same interpretive problems are true for central venous pressure or pulmonary capillary wedge pressure measurements. Again, the overall clinical response and general trends in these numbers are much more useful for adjusting fluid administration or chemotherapy to support cardiac function than are values from isolated measurements. Catheter-based resuscitation tends to deliver higher-based volumes than the traditional methods but has not demonstrated an improvement in morbidity or mortality. Research indicates that increased crystalloid cannot restore cardiac preload to baseline during the period of burn shock.

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16. A 39-year-old woman is referred for consultation regarding reconstruction of the left breast two years after mastectomy for breast cancer. Implantation of a silicone prosthesis and reconstruction with a pedicled latissimus dorsi musculocutaneous flap are planned. This patient will most likely show deficits in which of the following shoulder functions?

- A) Extension and abduction
- B) Extension and adduction
- C) Flexion and abduction
- D) Flexion and adduction
- E) No deficits

The correct response is Option B.

Transfer of the latissimus dorsi musculocutaneous flap is associated with deficits in extension and adduction.

The latissimus muscle acts synergistically with six other muscles in the shoulder. The primary contribution of the muscle is in shoulder extension, adduction, and medial rotation. There are definite biomechanical changes that occur in the shoulder girdle with latissimus muscle transfer. The synergistic action of the teres major muscle compensates for loss of the latissimus muscle. This leads to teres major hypertrophy in the long term. A study in 1986 evaluated a series of patients with latissimus muscle transfer and found a decrease in total shoulder strength up to 34% compared to the contralateral side. When tested specifically for the latissimus muscle function, the average weakness was 18%. Active range of motion at the shoulder with extension and adduction was decreased by 5% and 0%, respectively.

In 1992, one study used isometric, isotonic, and isokinetic strength tests for evaluation after latissimus transfer. The authors concluded that forced extension is weaker only when the arms are in 60 degrees of flexion. There was no loss of range of motion. Another study done in 1995 reexamined change in muscle power and endurance after latissimus transfer. The authors concluded that women who underwent unilateral pedicled latissimus transfer showed a deficit of power and endurance in shoulder extension and adduction. This was seen in three specific work activities: ladder climbing, overhead painting, and pushing up from a chair. A more rapid onset of fatigue during prolonged activities involving these motions, including swimming, is noted.

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17. Capillary malformations at which of the following locations are most likely to respond well to pulsed dye laser treatment?

- A) Hand
- B) Lip
- C) Neck
- D) Nose
- E) Thigh

The correct response is Option C.

Port-wine stains, or capillary malformations, are slow-flowing congenital vascular anomalies characterized by ectatic vessels located at various levels within the dermis. Histologic analysis has identified decreased numbers of neural structures associated with the ectatic vasculature, which may indicate an etiology related to the neural modulation of vascular flow. Unlike hemangiomas, capillary malformations exhibit normal endothelial cell turnover.

The treatment of choice for capillary malformation is pulsed dye laser therapy, which typically uses a wavelength that targets oxyhemoglobin (577, 585, and 595 nm) and results in intravascular coagulation. The response to treatment is variable and most patients do not achieve complete clearing. Lesions located on the central face and limbs tend to be less responsive than lesions found on other parts of the face, neck, and trunk. Biopsy studies and noninvasive assessments have shown that deeper and smaller vessels within a capillary malformation tend to remain untreated after the application of pulsed dye laser treatment.

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18. A 15-year-old boy is referred to the office for management of alopecia areata. Physical examination shows that more than 50% of the scalp is involved. Which of the following is the most appropriate management?
- A) Administration of finasteride
 - B) Construction of a scalp rotation-advancement flap
 - C) Injection of a corticosteroid
 - D) Transplantation of follicular units
 - E) Observation

The correct response is Option C.

Alopecia areata (AA) is a recurrent nonscarring type of hair loss that can affect any hair-bearing area. Clinically, AA can present with many different patterns. Although medically benign, AA can cause tremendous emotional and psychosocial stress in affected patients and their families. The pathophysiology of AA remains unknown. The most widely accepted hypothesis is that AA is a T-cell-mediated autoimmune condition that is most likely to occur in genetically predisposed individuals.

Because AA is believed to be an autoimmune condition, corticosteroids have been used to treat this condition. Few studies are available regarding the efficacy of intralesional corticosteroids, but they are used widely in the treatment of AA. Intralesional corticosteroids are the first-line treatment in localized conditions. In a study including 84 patients, regrowth on treated areas was present in 92% of patients with patchy AA and 61% of patients with alopecia totalis (AT). Regrowth persisted three months after treatment in 71% of patients with patchy AA and 28% of patients with AT. Regrowth usually is seen within four to six weeks in responsive patients. Patients with rapidly progressive, extensive, or long-standing AA responded poorly. Another study showed regrowth in most patients (480) treated with intralesional corticosteroids, except in two patients with alopecia universalis (AU). Hair growth may persist for six to nine months after a single injection. Injections are administered intradermally using a 3-cm³ syringe and a 30-gauge needle. Triamcinolone acetonide (Kenalog) is used most commonly; concentrations vary from 2.5 to 10 mg/cm³. Less than 0.1 cm³ is injected per site, and injections are spread out to cover the affected areas (approximately 1 cm between injection sites). Adverse effects mostly include pain during injection and minimal transient atrophy (10%). The atrophy rarely can be severe or permanent. Injections are administered every four to six weeks.

For patients with extensive AA (>40% hair loss), little data exist on the natural evolution. The rate of spontaneous remission seems to be less than in patients with less than 40% involvement. In one review of 50 patients with extensive AA, 24% experienced spontaneous complete or nearly complete regrowth at some stage during the observation period of 3 to 3.5 years. Without

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therapy, the relapse rate is high in patients with severe forms of AA. Surgery does not have a role in this condition. Finasteride (Propecia) works on alopecia secondary to male pattern baldness by affecting the 5-alpha reductase enzyme.

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(Please note that this pictorial appears in color in the online examination)

19. A 74-year-old man is admitted to the hospital one week after sustaining a full-thickness burn on the left leg during a house fire. A photograph of the leg is shown. After two weeks of medical management, the patient undergoes debridement and reconstruction with a split-thickness skin graft. One week later, the leg becomes erythematous and the graft sloughs. Which of the following is the most likely cause of skin graft failure in this patient?
- A) Advanced age of the patient
 - B) Delay in performing graft procedure
 - C) Depression of the classical complement cascade
 - D) Depth of burn injury
 - E) Flame mechanism of the injury

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The correct response is Option B.

The burn eschar, even when treated with topical antimicrobials, provides an excellent culture medium for microorganisms, with devitalized tissue in a warm and moist environment. Early excision and grafting of burn wounds (in the first 24 hours of burning) has been shown to reduce bacterial loads and gram-negative colonization. Early surgical management is also associated with lower clinical wound infection rates and higher skin graft survival rates. If grafting is performed in the chronic stage, when colonization is probable, debridement must be aggressive to ensure a clean bed.

Extremes of age as well as mechanisms of burn injury have been correlated with outcomes in burn treatment. Advanced age is associated with both increased risk of burn injury and worse clinical outcomes. Complications and higher mortality rates are associated with increasing burn severity, total body surface area, and inhalation injury. The patient described has a limited burn and is less likely to have wound infection and graft loss directly related to his age. Flame mechanism of burn injury is associated with wound infections in pediatric patients; however, it is more likely that delayed excision and grafting resulted in wound infection and graft loss in the scenario described.

Immunosuppression following a significant burn is a result of impairment of both the innate and adaptive immune system responses. The innate system includes the immediate cellular response of neutrophils and macrophages and activation of the complement cascade. Burn injuries directly impair the cellular response and depress the alternative pathway of the complement cascade but do not affect the classical pathway of the complement cascade. The adaptive immune system, or humoral response, is suppressed in thermal injuries primarily by alteration in the balance between T suppressor lymphocytes and T helper lymphocytes.

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20. Under optimal conditions, the peak tensile strength of a skin incision is achieved at approximately how many days after injury and reaches what percentage of the tensile strength of unwounded skin?

	Days	Percentage
A)	30	75
B)	60	80
C)	90	85
D)	120	90
E)	150	95

The correct response is Option B.

The peak tensile strength of skin is achieved at approximately 60 days after injury and reaches approximately 80% of the original unwounded tensile strength.

Several factors can influence wound healing, including ischemia, anemia, steroids, malnutrition, smoking, age, denervation, foreign bodies, infection, radiation, and other systemic conditions (eg, diabetes, cancer, renal failure).

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21. A 33-year-old man comes to the office because he has had an abscess and surrounding cellulitis on the right arm for the past three days. He believes it is the result of a spider bite but did not see the spider. The patient is otherwise healthy. He is afebrile. Other vital signs are stable. His two roommates have had similar episodes during the past two weeks. Community-acquired methicillin-resistant *Staphylococcus aureus* is suspected. In addition to surgical drainage of the abscess, administration of which of the following antibiotics is the most appropriate management?
- A) Ciprofloxacin
 - B) Linezolid
 - C) Rifampin
 - D) Trimethoprim-sulfamethoxazole
 - E) Vancomycin

The correct response is Option D.

One of the proper antibiotics for treating cellulitis associated with community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is trimethoprim-sulfamethoxazole. The spectrum of disease in the community caused by CA-MRSA appears to be similar to that of methicillin-susceptible *S. aureus*. Skin and soft-tissue infections—specifically follicles, boils, carbuncles, and abscesses—are the most frequently reported. MRSA skin lesions are frequently confused with spider bites by patients and clinicians. The spontaneous appearance of a raised red lesion might lead to this supposition among patients, whereas the tendency for lesions to develop necrotic areas might confuse clinicians. The role of MRSA in cellulitis without abscess or purulent drainage is less clear because cultures are rarely obtained. Anecdotal reports suggest that recurrent MRSA skin infections and clustering of infections within a household are relatively common occurrences.

Treatment of uncomplicated soft-tissue infections includes drainage of the infection and antibiotics if significant cellulitis is present. Appropriate antibiotics include trimethoprim-sulfamethoxazole, clindamycin (which requires the microbiology laboratory to run a “D-zone test” to check for resistance), and doxycycline. Ciprofloxacin (and other fluoroquinolones) is not a good choice because of the high resistance of MRSA. Linezolid is effective against MRSA but is costly and should be reserved for severe cases due to potential of emergence of resistance. Rifampin should not be used because of rapid resistance when used as a single agent. Vancomycin is effective but should be reserved for more serious infections.

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22. A 45-year-old woman comes to the office because she developed several painful vesicles on the lips since undergoing a trichloroacetic acid peel for rejuvenation of the perioral area five days ago. Medical history includes a similar outbreak two years ago. Which of the following is the most appropriate management?
- A) Oral prednisone
 - B) Oral valacyclovir
 - C) Topical bacitracin
 - D) Topical hydrocortisone
 - E) Reassurance and observation

The correct response is Option B.

Patients with a history of facial herpetic infections are at high risk for recurrence following chemical peel or laser resurfacing for facial rejuvenation and should receive antiviral prophylaxis with acyclovir or valacyclovir. The patient described likely has such an infection and should receive aggressive treatment to shorten the course of the infection.

Corticosteroids and bacitracin will not provide definitive therapy but may lessen symptoms.

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23. Maffucci syndrome is characterized by which of the following vascular anomalies?

- A) Arteriovenous malformation
- B) Capillary malformation
- C) Hemangioma
- D) Lymphatic malformation
- E) Venous malformation

The correct response is Option E.

Venous malformations are the most common type of vascular malformation. They are present at birth, slowly increase in size as the child grows, and are prone to thrombosis. Maffucci syndrome includes exophytic cutaneous venous malformations, bony exostoses, and enchondromas. There is also a risk for malignant transformation.

Arteriovenous malformations are a combination of arterial and venous channels. MRI best documents the extent of involvement. The mainstay of management is embolization and surgical excision.

Capillary malformations are slow-flow vascular malformations that classically were referred to as “port-wine stains.” Facial capillary malformations often occur in a dermatomal distribution. In Sturge-Weber syndrome, the capillary malformation may involve V1, V2, and/or V3 dermatomes, with ipsilateral ocular and leptomeningeal vascular anomalies.

Hemangiomas are vascular tumors, not malformations. They grow rapidly, often within the first year of life, and regress slowly, often involuting by 5 years of age. Hemangiomas typically are observed and not treated unless they cause visual interference, auditory canal obstruction, airway blockage, or ulceration and bleeding. Treatment regimens include corticosteroids or interferon.

Lymphatic malformations are characterized as microcystic, macrocystic, or combined. Lymphatic malformations most commonly occur in the cervicofacial region, axilla/chest, mediastinum, retroperitoneum, buttocks, and perineum, and were classically referred to as “cystic hygromas.” Lymphatic malformations in the floor of the mouth and tongue present as macroglossia, vesicles, and intermittent swelling. Lymphatic malformations may enlarge with infection.

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24. A 48-year-old woman comes to the office because she has painful lesions on the upper lip and medial aspect of the cheek three days after undergoing dermabrasion for treatment of fine rhytides and acne scarring. Physical examination shows red, blotchy, and weeping areas over the treatment sites. Which of the following is the most likely causative organism?

- A) *Candida albicans*
- B) Herpes simplex type 1
- C) *Staphylococcus aureus*
- D) *Streptococcus pyogenes*
- E) Varicella zoster

The correct response is Option B.

Outbreaks of herpes simplex virus (HSV) type 1 may occur after any dermal resurfacing procedure, including dermabrasion, chemical peels, and laser treatments. Reactivation of the virus is reported to occur in up to 50% of patients known to have a history of HSV and undergo resurfacing without prophylaxis treatment. Outbreaks occurred in 6.6% of patients without a known history of HSV; therefore, it is important that all patients undergoing a resurfacing procedure receive prophylaxis with antiherpetic medication (acyclovir, valacyclovir, or famciclovir) starting one to two days before the procedure and continuing until reepithelialization is complete.

Bacterial or candidal infections also can occur, although they are not as common as HSV infection. Perioperative antibiotics, careful antibacterial facial prepping, and frequent post-procedure handwashing are also important aspects of care.

Varicella zoster is not commonly associated with dermabrasion.

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25. A 50-year-old man is scheduled to undergo repair of a Gustilo grade IIIB open fracture of the tibia and fibula, resulting in an 8-cm segmental defect of the tibia. Which of the following is an advantage of a vascularized fibula graft over a nonvascularized autograft for this patient?

- A) Greater bone resorption
- B) Greater osteocyte viability
- C) Incorporation by creeping substitution
- D) Remodeling
- E) Replacement of necrotic bone

The correct response is Option B.

Compared with a conventional nonvascularized autograft, a vascularized fibula graft has increased osteocyte viability. In one study, osteocyte counts in the cortex of vascularized grafts were 89% of those observed in normal control subjects. There were substantially fewer surviving osteocytes in conventional grafts.

Nonvascularized bone autograft incorporation occurs by creeping substitution, which involves gradual vascular ingrowth, resorption, and replacement of necrotic bone. The revascularization process that occurs causes significant mechanical weakening due to bone resorption at six to 12 months.

Vascularized bone grafts allow living bone tissue to be transplanted to an adjacent or remote location. They have been used in segmental bone defects larger than 6 cm due to tumor, trauma, osteomyelitis, or infected nonunion. Other indications include avascular necrosis of bone, composite tissue loss requiring complex reconstruction, and longitudinal growth with physeal transfer.

The transfer of vascularized bone grafts increases cell survival and as a result the process of bone graft incorporation by creeping substitution is obviated. Significant osteopenia is not seen and bone mass is maintained after transfer. The result is improved strength, healing, and stress response. Cell survival results in less remodeling during revascularization.

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26. An otherwise healthy 65-year-old woman comes to the office because she noticed a well-circumscribed 2-cm dark brown lesion with a waxy surface on her back two years ago. On excision of the lesion, which of the following is the most likely pathologic diagnosis?

- A) Actinic keratosis
- B) Congenital nevus
- C) Cutaneous horn
- D) Keratoacanthoma
- E) Seborrheic keratosis

The correct response is Option E.

Seborrheic keratosis is commonly excised to prevent potential confusion with malignant melanoma. These lesions are often seen in large numbers on middle-aged and older patients. They are sharply circumscribed, waxy, and friable with a “stuck on” appearance. Pigmentation ranges from tan to deep black. Treatment options include shave excision, electrodesiccation, freezing with liquid nitrogen, or simple excision. These lesions do not undergo malignant degeneration and are not easily confused with squamous cell carcinoma.

Actinic keratoses are premalignant lesions. These dry, scaly, rough patches range in color from yellow to dark brown and can progress to squamous cell carcinoma. A congenital nevus is seen in childhood and does not develop in later life. A cutaneous horn has significant keratotic growth and does not have a waxy appearance. Keratoacanthoses are rapidly growing lesions and do not have the appearance described.

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27. A 26-year-old man is brought to the emergency department 90 minutes after sustaining injuries in a house fire. The patient says he has a headache. Physical examination shows second-degree burns to the face and anterior chest equaling 10% of the total body surface area, singed nasal vibrissae, and carbonaceous sputum. Ventilation with 100% oxygen is started; SaO_2 is 95%. Which of the following is the most appropriate next step in diagnosis?
- A) Fiberoptic bronchoscopy
 - B) Measurement of carboxyhemoglobin level
 - C) Radiograph of the chest
 - D) Spiral CT
 - E) Ventilation-perfusion lung scan

The correct response is Option A.

Inhalation injury is the most frequent cause of death in burn patients. Smoke inhalation in combination with cutaneous burns is fatal in 30% to 90% of patients. Prompt diagnosis and aggressive early therapy are paramount in reducing the morbidity and mortality associated with this injury.

The clinical diagnosis of inhalation injury has traditionally rested on a group of clinical observations including facial burns, singed nasal hair, and a history of injury within an enclosed space. As a group, they underestimate the true incidence of inhalation injury.

The current standard for diagnosis of inhalation injury in most major burn centers is fiberoptic bronchoscopy. Findings include the presence of soot, charring, mucosal necrosis, airway edema, and inflammation. Widespread use of this technique has led to a two-fold increase in the diagnosis of inhalation injury.

Patients with inhalation injury also have carbon monoxide poisoning levels greater than 10%. Levels greater than 30% can cause headache, nausea, and behavioral disturbances. Levels greater than 40% cause a pathognomonic cherry-red skin discoloration. Carbon monoxide levels in the patient described would be a poor indicator of injury because the patient received 100% oxygen for the past two hours. It takes one hour for levels to fall by one half while patients breathe 100% oxygen.

Clinical findings of hypoxia, crackles, wheezing, and rhonchi, and initial findings on radiographs of the chest are poor indicators of inhalation injury. It usually takes five to 10 days before findings of focal infiltrates or diffuse pulmonary edema are evident on radiographs.

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A spiral CT is useful in determining the presence of a pulmonary embolism but plays no role in the acute diagnosis of inhalation injury.

A xenon ventilation-perfusion lung scan is the most definitive study for diagnosis of inhalation injury. It demonstrates areas of decreased alveolar gas washout, which identifies sites of small airway obstruction caused by edema or fibrin cast formation; however, the study is time-consuming. It requires transport of the patient from the emergency department or burn unit to the radiology department and is therefore less practical.

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28. Which of the following treatments for basal cell carcinoma has the lowest recurrence rate?

- A) Cryotherapy
- B) Electrodesiccation and curettage
- C) 5-Fluorouracil
- D) Mohs surgery
- E) Radiation therapy

The correct response is Option D.

Mohs surgery yields the most favorable recurrence rate of 3.4% to 7.9%, establishing it as the treatment of choice for recurrent skin tumors. For lesions in cosmetically or functionally important areas such as the nose, eyes, and lips, Mohs surgery is an excellent treatment choice because of the tissue-sparing advantage.

Recurrent tumors may have ill-defined margins due to fibrosis from previous treatments. Other treatment modalities, including cryotherapy, electrodesiccation and curettage, radiation therapy, and surgical excision may have subclinical extension when they recur. Recurrence rates of previously treated tumors is 12% with cryotherapy, 40% with electrodesiccation and curettage, 10% with radiation therapy, and 18% with excision. 5-Fluorouracil is used for treating multifocal lesions.

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29. A 65-year-old woman is scheduled for a brow lift procedure. She has a 10-year history of osteopenia. Her brow is approximately 8 mm inferior to the supraorbital rim on the right and 6 mm inferior to the supraorbital rim on the left. Scalp thickness is 4 mm. Which of the following techniques for rejuvenation of the forehead is contraindicated in this patient?

- A) Endoscopic brow lift fixed with cortical tunnels
- B) Endoscopic brow lift fixed with an Endotine 3.5 forehead device
- C) Endoscopic brow lift fixed with Mitek anchors
- D) Open brow lift using a coronal approach
- E) Open brow lift using an anterior hairline approach

The correct response is Option B.

The Endotine 3.5 forehead device, which was recently approved by the United States Food and Drug Administration for endoscopic brow lifts, consists of a 1-mm-thick polylactic acid platform with tines that project 3.5 mm from the platform. A second-generation device consisting of a 0.5-mm L-lactide/glycolide rapidly absorbing copolymer with variably projecting tines was introduced in 2003. Endotine fixation provides rapid and secure multipoint fixation and is designed to minimize complications such as alopecia and pain. Although the older device was designed to resorb over a period of 12 months, the newer devices resorb at a faster rate, decreasing complaints of postoperative palpability.

Contraindications to the use of Endotine forehead fixation include thin cranial bones (the post extends 3.95 mm) and a thin, atrophic scalp. Endotine forehead fixation also should not be used when internal fixation is otherwise contraindicated (eg, infection) and in patients with a known allergy or foreign-body sensitivity to plastic biomaterials.

The patient described has a thin scalp (less than 5 mm) and potentially thin cranial bones secondary to osteopenia. Endotine 3.5 fixation is contraindicated.

In a recent cadaveric study comparing various methods of forehead fixation, neither cortical tunnels at 45-degree angles nor Mitek anchor screws penetrated the inner table, whereas the Endotine 3.5 post and titanium miniscrews both penetrated regions of the skull that were found to be thin (lateral and posterior to the coronal suture).

Open techniques of brow lifting with direct skin excision are still widely accepted and present a reasonable alternative when more invasive methods of fixation are contraindicated.

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30. A 30-year-old man is scheduled to undergo rhinoplasty using autogenous rib cartilage. Which of the following interventions is most likely to prevent postoperative warping of the graft?
- A) Balanced cross-sectional carving
 - B) Electrocautery to harvest the graft
 - C) Implantation immediately after harvest
 - D) Irradiation
 - E) Removal of all perichondrium

The correct response is Option A.

Although cartilage grafting has many advantages, including the ease of carving and shaping and a generally abundant donor supply, it has a distinct tendency to warp. Studies have recommended several techniques to help minimize this tendency, including harvesting straight rib segments, delaying implantation for at least 30 minutes after harvest to allow sufficient time for natural deformities to appear before implantation and performing balanced cross-sectional carving and using fixation techniques such as threaded Kirschner wires or fibrin glue.

Removing all perichondrium and using electrocautery to harvest the rib graft have not been shown to decrease warping. Irradiated cartilage has been shown to warp more over time than nonirradiated cartilage.

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31. A 34-year-old man sustained deep burns to the entire body surface area above the level of the waist one year ago. Initial management of the burns included excision and split-thickness skin grafting. During his recovery, release of burn scar contractures will most likely be needed in which of the following anatomic regions?

- A) Axilla
- B) Elbow
- C) Hand
- D) Neck
- E) Trunk

The correct response is Option D.

According to multicenter study data, neck contracture release is performed 24% of the time, followed by axilla (20%), elbow (11%), trunk (11%), knee (10%), and hand (9%). Release procedures are often performed in more than one site. The most common factors prompting contracture release are decreased range of motion or impaired function, unsatisfactory cosmetic appearance, pain, and pruritus.

Neck contractures produce significant tightening of the lower face and mechanical disability. At times, the contracture is so severe that intubation may be difficult. In such cases, the neck must be released under local anesthesia with sedation before intubation and general anesthesia. Release of scar, which must be complete and often involves the platysma, may involve Z-plasty, skin grafting, or tissue-expanded skin in adjacent, unburned skin. Postoperatively, the patient is fitted with a neck splint to extend the neck to prevent contraction and provide pressure necessary for optimal scarring.

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32. A 55-year-old man has complete excision of squamous cell carcinoma of the scalp resulting in a 6 × 8-cm occipital defect with exposed calvaria. Reconstruction with a lower third trapezius island flap is performed. Which of the following arteries is the major blood supply for the flap?

- A) Dorsal scapular
- B) Occipital
- C) Superficial cervical
- D) Thoracoacromial
- E) Thoracodorsal

The correct response is Option A.

The predominant blood supply of the inferior portion of the trapezius myocutaneous flap is the dorsal scapular artery. The dorsal scapular artery is a separate branch of the subclavian artery or forms a common trunk with the superficial cervical artery. When a common trunk is present, it is referred to as the transverse cervical artery, the superficial cervical artery as the superficial branch of the transverse cervical artery, and the dorsal scapular artery as the deep branch of the transverse cervical artery.

The superior or descending part of the trapezius is supplied by branches of the occipital artery. The middle or transverse part is supplied by the superficial cervical artery. The thoracoacromial artery supplies the pectoralis major muscle flap and the thoracodorsal artery supplies the latissimus dorsi muscle flap.

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33. A 20-year-old woman underwent subgaleal placement of two rectangular tissue expanders for an 8-cm area of burn alopecia at the vertex of the scalp. During the expansion, the skin over both expanders became red and mottled. The patient is afebrile and leukocyte count is within normal limits. Which of the following is the most appropriate next step?

- A) Collect aspirate from expanders for culture
- B) Continue the expansion procedure
- C) Deflate both expanders
- D) Initiate intravenous antibiotic therapy
- E) Remove both expanders

The correct response is Option B.

In a patient undergoing tissue expansion, redness and mottling of the skin over the implant is common. The next step in management is to do nothing and continue expansion.

Tissue expansion of the scalp is well tolerated and provides hair-bearing tissue to cover defects. Approximately 50% of the scalp can be reconstructed with expanded scalp tissue. A frequent complication from an expander is a superficial infection. Redness and mottling of the skin over an implant is cause for concern when the patient has a fever, spreading erythema, or frank pus. Any combinations of these factors may warrant aspiration of the expander fluid, initiation of intravenous antibiotics, or operative removal of the expander.

If infection is not suspected, expansion can proceed normally. There is no need to deflate the expander prematurely.

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34. A 45-year-old man with T4 paraplegia has an ulcer of the right ischium that extends to the underlying bone. Which of the following stages best describes the wound?
- A) I
 - B) II
 - C) III
 - D) IV

The correct response is Option D.

This wound is described as a stage IV pressure ulcer because the depth of involvement extends down into muscle.

The most widely accepted classification system for decubitus ulcers is that of the National Pressure Ulcer Advisory Panel (NPUAP), which is a modification of Shea's classification. The four-stage classification is designed only to describe the depth of a visible ulcer at the time of examination. It is not designed to follow progression or regression of the wound or to document healing.

Stage I describes pressure ulcers with intact skin with signs of impending ulceration: blanching and/or nonblanching erythema, warmth, and induration. These are reversible and can improve with pressure reduction.

Stage II describes shallow pressure ulcers with pigmentation changes that may appear as an abrasion, blister, or superficial ulcer. These are also reversible.

Stage III describes pressure ulcers with a full-thickness loss of skin with extension through the subcutaneous tissue but no penetration of the underlying fascia.

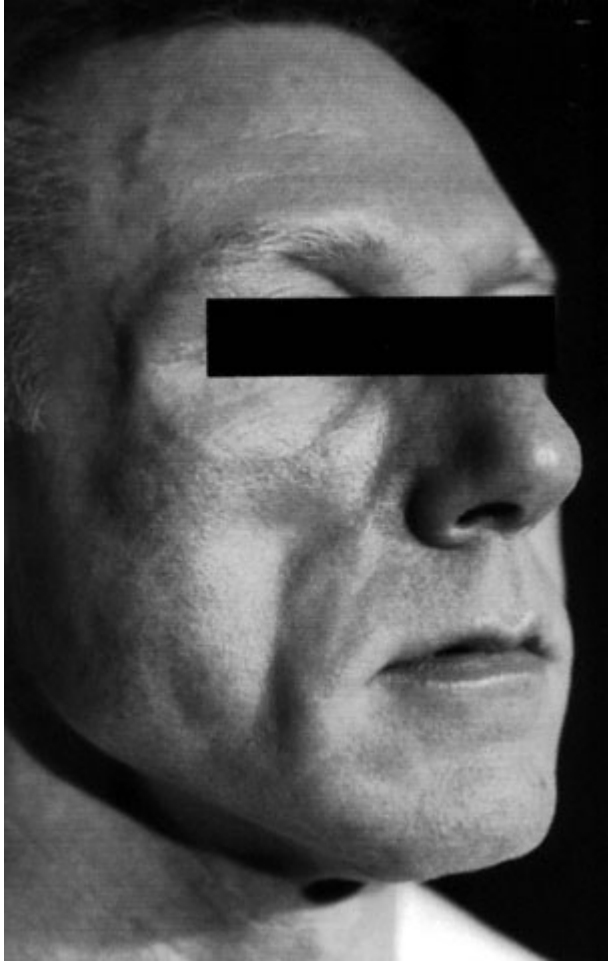
Stage IV describes pressure ulcers with full-thickness loss of skin with penetration into the deep fascia, resulting in muscle, bone, tendon, or joint involvement. Osteomyelitis and severe undermining of adjacent tissue are often present.

Stages III and IV describe pressure sores that usually require surgical intervention.

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35. A 53-year-old man who is HIV positive comes to the office for management of facial lipoatrophy. A photograph of the face is shown. Injection of which of the following fillers is the most appropriate treatment?
- A) Calcium hydroxyapatite
 - B) Human-based collagen
 - C) Hyaluronic acid
 - D) Liquid silicone
 - E) Poly-L-lactic acid

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The correct response is Option E.

Facial lipoatrophy can affect as many as 50% of individuals infected with HIV. With more than 42 million people living with HIV worldwide, the demand for an effective, safe treatment of this stigmatizing deformity is increasing.

Many treatments for HIV-associated facial lipoatrophy have been explored. The ideal filler would be completely nonallergenic, produce an excellent aesthetic result, and have a long duration of effect but not be so permanent that errors in treatment could not be corrected.

Poly-L-lactic acid (Sculptra) is currently the only soft-tissue filler specifically approved by the United States Food and Drug Administration (FDA) for soft-tissue augmentation in HIV-associated lipoatrophy. Several recent studies in the United States have found that the use of Sculptra results in a significant and prolonged improvement in facial atrophy associated with HIV. The effect can last up to two years in some patients. There have been no reported cases of serious adverse reactions, and the treatment is well tolerated.

Although calcium hydroxyapatite (Radiesse), human-based collagen (CosmoPlast), and hyaluronic acid (Restylane) all have been used effectively in the treatment of this problem, none are as long-lasting as Sculptra. Moreover, placement of Radiesse in a more superficial plane can result in palpable nodularities that may require surgical excision.

The use of FDA-approved forms of liquid injectable silicone are currently being tested for the treatment of HIV-associated facial atrophy. Early results are promising, but longer follow-up of treated patients is required to adequately assess the efficacy, durability, and long-term safety of liquid injectable silicone for treatment of this disease.

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36. Hyperbaric oxygen therapy has the greatest utility in the treatment of which of the following wounds?

- A) Diabetic foot ulcer with osteomyelitis
- B) Extravasation injuries
- C) Grade 4 pressure sore of the ischium
- D) Pyoderma gangrenosum
- E) Superficial partial-thickness burn

The correct response is Option A.

The effect of hyperbaric oxygen (HBO) therapy on wound healing has been shown in several clinical trials. There is proven utility in conditions such as osteomyelitis, necrotizing infections, and ischemia reperfusion injury. The use of HBO in the treatment of diabetic lower extremity wounds has shown improved healing rates and decreased amputations. This would be particularly valuable when conventional therapy has failed and underlying bone and tendons are exposed. HBO has no proven utility in the treatment of extravasation injury, pressure sores, or pyoderma gangrenosum. There is insufficient evidence to recommend HBO in the treatment of burn wounds, although there may be numerous theoretical advantages.

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37. A 25-year-old man has shortness of breath one day after undergoing radical resection of dermatofibrosarcoma protuberans of the scalp. Surgical margins are clear, and the 15-cm-diameter defect was covered with a free latissimus flap. Heparin 2500 U was administered immediately after completion of microvascular anastomosis. The patient has been receiving Ringer's lactate 70 ml/hr, low-molecular-weight dextran 20 ml/hr, and aspirin 81 mg daily since the procedure. Temperature is 38°C (100.4°F). Pulse rate is 105 bpm. Respirations are 28/min. Blood pressure is 105/70 mmHg. Crackles are heard on auscultation of the chest. Radiographs of the chest show bilateral diffuse infiltrates. Which of the following is the most likely cause of the respiratory distress in this patient?

- A) Atelectasis
- B) Bacterial pneumonia
- C) Drug reaction
- D) Postoperative fluid overload
- E) Pulmonary metastasis

The correct response is Option C.

Systemic use of dextran, even in a low-molecular-weight form, has been shown to result in complications. The most serious of these is adult respiratory distress syndrome. This has been seen even in young patients and appears to be related to dose; however, it may occur even after a test dose. The etiology of this reaction and its specific mechanism are not understood completely, although this specific complication from systemic administration has been shown multiple times in the literature.

Atelectasis, despite being prevalent in the immediate postoperative period, usually presents in a bilateral basilar fashion rather than diffusely throughout the lung fields. Bacterial pneumonia usually does not present early or with bilateral diffuse pulmonary infiltrates. Postoperative fluid overload in an otherwise healthy 25-year-old patient receiving 70 ml/hr of intravenous fluids is extremely unlikely. Sarcomas usually do not metastasize.

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38. A 54-year-old woman comes to the office for follow-up examination of a painful open wound on the right ankle after falling down a subway stairwell three weeks ago. Physical examination two weeks ago showed necrotizing fasciitis on the lateral aspect of the right ankle. Culture was positive for group B streptococcus. The wound was debrided. Vacuum-assisted closure (VAC) therapy was started and clindamycin was administered intravenously for two weeks. She has a 12-month history of transient ischemic attacks controlled with aspirin 81 mg daily. Leukocyte count is within the reference range. Closure with a split-thickness skin graft is planned. Which of the following interventions is most likely to improve survival of the graft in this patient?
- A) Administration of intravenous clindamycin for six weeks before graft placement
 - B) Application of tie-over bolster dressing after graft placement
 - C) Application of VAC dressing after graft placement
 - D) Discontinuation of aspirin seven days before graft placement
 - E) Further debridement to superficial fascia before graft placement

The correct response is Option C.

The most common causes of autologous skin graft failure are hematoma, infection, fluid accumulation beneath the graft, and shearing. Several recent studies have found that application of negative pressure dressings significantly improves the qualitative appearance and diminishes the area of loss of split-thickness skin grafts as compared with standard bolster dressings. The mechanism is likely multifactorial. The VAC dressing provides a means of immobilization of the graft and improves the contact of the graft with the recipient bed, particularly in circumferential or uneven wounds. As a result, plasmatic imbibition and neovascularization are improved. Moreover, removal of interstitial fluid, bacteria, and small amounts of blood that may otherwise be trapped under the graft after debridement is facilitated by the application of negative pressure.

Treatment of group B streptococcal infection with clindamycin for a period of two weeks is adequate in the patient described. Prolonged antibiotic therapy after debridement is complete and the patient's clinical condition has stabilized is inappropriate and may result in the development of secondary infections with drug-resistant organisms.

Hematoma formation after debridement is self-limited and would respond well to negative pressure therapy. Discontinuation of low-dose aspirin is unnecessary and may aggravate the patient's neurologic condition.

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Debridement of the tissue must effectively remove all of the infected skin. After the infection is stabilized, further debridement to a deeper layer will not improve graft take and may compromise recipient bed vascularity.

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39. An Er:YAG laser targets which of the following chromophores?

- A) Blue dye
- B) Collagen
- C) Hemoglobin
- D) Melanin
- E) Water

The correct response is Option E.

Lasers generate heat in the target tissue that dissipates by conduction. The amount of heat generated is a function of the wavelength of the laser and the duration of exposure. Selective tissue injury is caused by the choice of a wavelength of energy that is specific for a particular target chromophore within the skin.

The Er:YAG laser is an ablative laser with a wavelength of 2940 nm and a target chromophore of water. There is less thermal diffusion to the surrounding tissues with an Er:YAG laser than with a CO₂ laser, although both have the same target chromophore.

Fractional photothermolysis uses a blue dye template, which also serves as the target chromophore, and divides the skin into microscopic thermal zones. The Nd:YAG laser affects blood vessels, red blood cells, collagen, and melanin. Intense pulsed light targets water, hemoglobin, and superficial or deeper pigment, depending on the wavelength.

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40. A 6-month-old male infant is brought to the office because he has a hemangioma on the face that has been gradually enlarging since birth. Oral prednisone 3 mg/kg daily is initiated. The parents should be advised that the patient is at greatest risk of developing which of the following complications?

- A) Cushingoid facies
- B) Diminished height gain
- C) Fungal infection
- D) Gastric irritation
- E) Personality changes

The correct response is Option A.

Well-localized cutaneous hemangiomas respond well to intralesional injections of corticosteroids. Large or endangering hemangiomas may require a course of oral corticosteroids for four to six weeks with tapering over several months. Although there is a high success rate with this treatment, the most common complication is the short-term development of cushingoid facies. One study found that 71% of patients developed this feature. Other short-term complications include personality changes (29%), gastric irritation (21%), oral or perineal fungal infections (6%), and a reversible diminished gain of height (35%) and weight (42%). Bacterial infections did not appear to be more common in this group of patients. Systemic corticosteroids can be given safely at doses of 2 to 3 mg/kg per day to treat appropriate hemangiomas, but minor and transient complications should be expected. Serious long-term complications are rare.

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41. A 37-year-old woman who has Fitzpatrick type I skin requests intense pulsed-light therapy for reduction of blond hairs over the upper lip. Compared with a person with darker hair, which of the following best describes the outcome of this procedure?
- A) Decreased risk for permanent scar
 - B) Decreased risk for prolonged erythema
 - C) Increased risk for hyperpigmentation
 - D) Increased risk for malignant transformation
 - E) Less effective hair reduction

The correct response is Option E.

Melanin is the target chromophore for laser and intense pulsed-light (IPL) hair reduction. Melanin pigment is responsible for skin and hair color and absorbs energy at wavelengths of 250 to 1200 nm. Thermal injury to the melanin-containing cells of the bulb and matrix results in destruction of the hair follicle. Patients with greater melanin content have darker hair and are more likely to have effective laser or IPL hair reduction. In very fair-haired individuals, the limited melanin content makes hair reduction less effective. At higher energy levels, fair-skinned patients can have prolonged erythema. In patients with darker pigmentation, surrounding skin can absorb energy, resulting in blistering or pigment changes.

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42. A poorly nourished 70-year-old woman is brought to the emergency department after sustaining burns in a house fire. Examination shows partial-thickness burns on 10% of the total body surface area. Nutritional supplementation is planned. Which of the following best describes the role of vitamin C in wound healing?
- A) Acts as a cofactor in the hydroxylation of proline and lysine for procollagen formation
 - B) Alters prostaglandin production by inhibiting phospholipase A2 activity
 - C) Inhibits leukocyte migration into the wound
 - D) Promotes epithelialization and fibroblast proliferation through its effect on metalloenzymes
 - E) Promotes formation of oxygen free radicals

The correct response is Option A.

Vitamin C plays a pivotal role in collagen synthesis, being an essential cofactor in the hydroxylation of proline and lysine for procollagen formation. Procollagen residues are then altered intracellularly to form collagen. Vitamin C deficiency therefore results in scars of poorer tensile strength and abnormal capillary formation.

In addition, vitamin C has an antioxidant function, neutralizing the effects of oxygen free radicals and can increase resistance to infection by facilitating leukocyte migration into the wound. Alteration of prostaglandin production, by inhibition of phospholipase A2 activity, is a function of vitamin A. Zinc promotes epithelialization and fibroblast proliferation through its effect on metalloenzymes.

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43. A 32-year-old man comes to the emergency department because he has a 2-cm laceration of the forehead. He developed urticaria after receiving a local anesthetic during suturing of a laceration of the leg two years ago. Which of the following local anesthetics is most likely to cause hypersensitivity in this patient?

- A) Bupivacaine
- B) Etidocaine
- C) Lidocaine
- D) Mepivacaine
- E) Procaine

The correct answer is Option E.

Actual hypersensitivity is rare and accounts for less than 1% of all reactions to local anesthetics. Allergic reactions may be attributed to other factors such as acute toxicity (eg, high plasma levels caused by inadvertent intramuscular injection), psychomotor reactions (eg, patient anxiety or apprehension), pharmacologic properties of local anesthetics, concurrent drug therapy (eg, epinephrine-induced tachycardia), or preservatives such as paraben or sulfites, which may be present in multidose vials.

Local anesthetics with a para-aminobenzoic acid (PABA) ester-type structure seem to cause most anesthesia-related allergic reactions. Documented cross-sensitivity has been exhibited within the ester-based family of local anesthetics and structurally related compounds (eg, paraben preservatives). PABA is structurally similar to methylparaben. Amide local anesthetics do not metabolize to PABA; therefore, hypersensitivity to amide local anesthetics is rare. Because of possible hypersensitivity, many manufacturers have reformulated some of their products to eliminate methylparaben. Some of these products include Nesacaine-MPF (methylparaben-free), Xylocaine MPF, Polocaine MPF, and Sensorcaine MPF. A ruling by the United States Food and Drug Administration mandated the removal of methylparaben from all local anesthetic dental cartridges. Antioxidants (sodium bisulfite, metabisulfite) are added to local anesthetic products that contain vasoconstrictors (epinephrine, levonordefrin) to prevent biodegradation by oxygen.

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44. A patient with a complex defect that requires replacement of skin, muscle, and bone is scheduled to have reconstruction with a single free flap from the subscapular system. Which of the following would NOT be used as part of this reconstruction?

- A) Parascapular fasciocutaneous tissue
- B) Serratus anterior muscle
- C) Trapezius muscle
- D) Vascularized rib
- E) Vascularized scapular bone

The correct response is Option C.

Unlike the other tissues, the trapezius muscle is based on the transverse cervical artery (based on the thyrocervical trunk in 80% of cases or the subclavian artery in 20% of cases). The subscapular system allows for the creation of chimeric flaps that can include bone, muscle, fascia, fat, and skin. Flaps that have been used include the serratus anterior muscle and fascia, latissimus dorsi muscle and fascia, scapular and parascapular fascia and overlying skin, and scapular and rib bone. Such combinations allow for versatility in reconstructing complex three-dimensional defects that are often encountered in the face.

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45. A 3-year-old boy is brought to the office by his parents because he has a mass over the left upper arm. His parents say that they first noticed the mass when their son was 6 months of age and that it has been enlarging since then. During the past year, he has had three episodes of redness, swelling, and tenderness over the mass that required hospitalization for intravenous antibiotic therapy. He is now asymptomatic. Examination shows a 15-cm-diameter, soft, multilobulated mass that extends from the left elbow to the mid upper arm. Color of the skin is normal, and left hand and forearm function are normal. CT shows a multicystic, fluid-filled mass. Which of the following is the most appropriate next step in management?
- A) Amputation at the mid humerus
 - B) Compression therapy garment
 - C) Hypertonic saline sclerotherapy
 - D) Nd:YAG laser ablation
 - E) Surgical resection

The correct response is Option E.

Lymphatic malformations develop early in embryogenesis and result in deforming, enlarged lymphatic chambers that can occur throughout the face, trunk, or extremities. They can be associated with bony overgrowth. The overlying skin may be normal or contain multiple small, fluid-filled vesicles. Diagnosis of large lesions can often be made during prenatal ultrasonography. Lymphatic malformations of the neck have previously been called “cystic hygromas.” “Lymphangioma” is another misused term because it implies a tumor proliferation, whereas the pathology involves dilated, aberrantly formed lymphatic channels.

Although some lesions are noted early in life, others may present in later childhood or early adulthood. Cervicofacial lesions can cause early airway obstruction and occasionally necessitate tracheotomy. Treatment focuses on symptom management, contour, and function improvement. Malformations are prone to infection, and cellulitis can rapidly progress to sepsis. Early antibiotic administration is essential, and parents should have prescriptions on hand to start treatment at the first sign of symptoms.

Surgical resection is a mainstay of treatment, although dissection of the malformation from vital structures can be difficult. When complete clearance of the mass is not feasible, some degree of recurrence is likely. Complete removal can result in dramatic contour and functional benefit. Surgery should be deferred until after infancy, if possible, to facilitate dissection around delicate neurovascular structures. Diffuse or large lesions can be removed in stages. Postoperative compression and drainage are important for managing fluid accumulation.

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Limb amputation is not indicated in the patient described. Compression therapy alone will have no long-term effect on this malformation and will not prevent future infection. Sclerotherapy with hypertonic saline, sugar, and oil solutions have not been successful. Intralesional treatment with bleomycin or OK-432 has been shown to shrink isolated masses and may be useful in recurrent lesions. Laser treatment has limited temporizing benefit for oral mucosal lesions, although it has no effect on the deeper portion of the mass.

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46. A 52-year-old woman has a subtotal nasal defect resulting from recurrent basal cell carcinoma. A paramedian forehead flap is used for coverage. Which of the following is the most appropriate time to perform the next stage of reconstruction?

- A) 1 to 2 Weeks
- B) 3 to 4 Weeks
- C) 5 to 6 Weeks
- D) 7 to 8 Weeks
- E) 9 to 10 Weeks

The correct response is Option B.

The ideal timing for secondary procedures in nasal reconstruction is three to four weeks after transfer of donor tissue such as the lining, substructure, and cover flap. This time frame provides a balance between the enhanced vascularity induced by the delay phenomenon and the wound tensile strength that is adequate to permit surgical revision.

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47. A 21-year-old man sustains a flame burn to the distal aspect of the left forearm, resulting in a hypertrophic scar. Silicone gel sheeting is applied to the scar. Which of the following is the most likely mechanism of action that the silicone gel sheeting will have on the scar?

- A) Alteration of cytokine levels
- B) Direct chemical effect
- C) Hydration
- D) Increased oxygen tension
- E) Pressure

The correct response is Option C.

Although the exact mechanism of action of silicone gel sheeting is unknown, the most widely accepted hypothesis is that there is an increase in hydration resulting from occlusion, which is supported by in vitro data. Other studies have either ruled out, or not supported, alteration of cytokine levels, direct chemical effects, increased oxygen tension, or pressure.

It is generally thought that for silicone gel sheeting to be effective it must be worn for at least 12 hours a day for three months or longer.

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48. Which of the following arteries is the major blood supply to the flap most often used in the reconstruction of open-knee defects?

- A) Anterior tibial
- B) Medial circumflex femoral
- C) Peroneal
- D) Posterior tibial
- E) Sural

The correct response is Option E.

The medial and lateral sural arteries supply circulation to the gastrocnemius muscle, which, when released and rotated proximally, provides the best coverage for complex knee wounds. The gastrocnemius muscle may be harvested with overlying skin or may be skin-grafted.

The medial circumflex femoral artery and profunda femoris vessels supply the gracilis muscle, which provides coverage for medial thigh and groin defects. It cannot be rotated distally.

The posterior tibial artery provides some blood supply to the soleus muscle, which is the preferred muscle coverage to wounds to the middle one third of the lower extremity. The posterior tibial, peroneal, and anterior tibial arteries provide perforators for fasciocutaneous flaps in the lower extremity, which are limited in their applicability and are too distal for coverage of the wound.

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49. A 9-month-old female infant has an 11-cm congenital melanocytic nevus. The patient is at greatest risk for malignant transformation of which of the following systems?

- A) Central nervous
- B) Endocrine
- C) Gastrointestinal
- D) Skeletal
- E) Urologic

The correct response is Option A.

Although it is difficult to assign a risk, there is an increased risk of malignant transformation in giant congenital melanocytic nevi. Studies show rates of up to 20%; however, a recent systematic review of eight large studies showed a transformation rate of 2.8% of 432 affected patients. Other estimates are between 4% and 5%.

In addition to melanoma, patients with large, congenital melanocytic nevi are at increased risk for developing neurocutaneous melanocytosis, in which collections of melanocytes are present in the leptomeninges. Malignant transformation also can occur in neurocutaneous melanosis and result in primary central nervous system (CNS) melanoma. Even without malignant transformation, neurocutaneous melanosis can carry significant morbidity and mortality, often from seizures, hydrocephalus, and other signs of CNS irritation. MRI screening of the CNS early in life is recommended for those patients who are at high risk for malignant transformation, particularly when the presentation includes a large nevus in the posterior midline and/or multiple satellite nevi. The incidence of rhabdomyosarcoma is also increased in patients with large, congenital melanocytic nevi.

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50. A 45-year-old woman with Fitzpatrick type II skin comes to the office because she has a nonhealing lesion on the left alar crease that has been present for the past two months. Physical examination shows few rhytides and minimal laxity. Results of excisional biopsy show basal cell carcinoma. Reexcision is performed. Surgical margins are clear. The resulting 2.5 × 1.5-cm defect extends through the alar perichondrium and involves the ala and sidewall. Which of the following is the most appropriate method of reconstruction?
- A) Bilobed flap
 - B) Dorsal nasal flap
 - C) Full-thickness skin graft
 - D) Nasolabial flap
 - E) Rhomboid flap

The correct response is Option D.

A superiorly based nasolabial flap is the most appropriate choice because of the size, depth, and location of the defect. These flaps are most useful for reconstructing deep central and lateral nasal dorsal defects and defects of the nasal ala and tip. They work best for defects less than 2.5 to 3 cm in width. These flaps can be thinned but require maintenance of the dermal-subdermal plexus. Adjunct resurfacing at the wound margins reduces contour irregularities.

A bilobed flap works well for defects involving the lower third of the nose; however, the best results are obtained in defects no greater than 1.5 cm. This patient also has very little laxity or extra skin, thus less adjacent tissue is available for recruitment.

A dorsal nasal flap will not reach this defect.

A full-thickness skin graft could be performed if the perichondrium was intact; however, clinicians should be aware of contour deformities and the possibility of secondary contracture.

A rhomboid flap is difficult to fashion in the lower third of the nose without tension and often produces distortion to the nasal tip.

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Section 2: Cosmetic

51. A 28-year-old woman is scheduled to undergo release of severe cicatricial contraction six months after removal of an infected breast prosthesis. Preoperative physical examination shows that soft tissue is required in the inframammary area. Closure with a submammary flap is planned. Which of the following vessels is most likely to supply blood to this flap?
- A) Internal mammary perforators
 - B) Lateral thoracic artery
 - C) Superficial inferior epigastric artery
 - D) Thoracoacromial perforators
 - E) Thoracodorsal perforators

The correct response is Option A.

The sequelae of infection in breast augmentation can be severe cicatricial contraction of the inferior pole of the breast. Reoperation can be considered after an appropriate interval of six months, which allows for resolution of inflammation and scar maturation. If additional soft tissue is required, submammary flaps (with good color and texture match) can be used from the medial or lateral base of the breast. The blood supply is based medially on perforators of the internal mammary or superior epigastric arteries and laterally from perforators of the intercostal vessels.

The lateral thoracic artery is the blood supply for a lateral chest flap, which would not be able to contribute any meaningful amount of soft tissue to the submammary area.

The superficial inferior epigastric artery is the basis of lower abdominal flaps and has no role as a local flap for breast surgery.

The thoracoacromial perforators are associated with extended cheek/neck flaps for head and neck reconstruction.

Thoracodorsal perforators are the basis of thoracodorsal perforator flaps and would not be able to contribute soft tissue to the submammary area.

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52. A 59-year-old woman comes to the office for consultation regarding rejuvenation of the periorbital region. She is most concerned with bulging of orbital fat in the upper and lower eyelids. She says she wants "it all removed." Which of the following is the most likely long-term outcome of excessive fat removal in this area?

- A) Cadaveric appearance
- B) Ectropion
- C) Enophthalmos
- D) Negative vector deformity
- E) Tear trough deformity

The correct response is Option A.

Removal of excessive fat from the eyelids may improve the convexity of the periorbital region temporarily, but it can cause a cadaveric appearance over the long term. Correction of the tone of the lower eyelid with tightening of the muscle and canthal tendon, combined with correction of the tear trough deformity by fat repositioning over the orbital rim, will lead to a smooth lower eyelid-cheek junction.

Ectropion may be caused by involutional or cicatricial changes but is not caused by the absence of fat.

Enophthalmos may be caused by an enlarged bony orbit or orbital fat atrophy but is not caused by a lack of preaponeurotic fat.

A negative vector is assessed by noting the position of the most anterior projection of the globe as compared to the malar eminence on lateral view of the patient. Patients with negative vectors are predisposed to eyelid malpositioning after blepharoplasty and may require variations in technique, such as conservative skin and muscle resection, lateral canthoplasties, and horizontal eyelid-tightening procedures.

A tear trough deformity is the depressed and discolored groove at the junction of the cheek and lower eyelid.

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53. An open rhinoplasty that includes Weir resection for alar flare and tip modification is planned. Which of the following will decrease the risk of columellar flap necrosis?

- A) Limited lateral dissection above the alar groove
- B) Minimal dissection of the septal cartilage
- C) Minimal superior dissection of the osseocartilaginous framework
- D) No use of epinephrine in local anesthetic
- E) Use of only bipolar cautery during dissection

The correct response is Option A.

Limited dissection above the alar groove will spare injury to the lateral branch of the angular artery, which is one of five vessels contributing to the blood supply for the nasal tip and columella. However, it is the one source that could contribute to tissue loss if injured.

Caudal septal dissection has no influence on columellar flap blood supply in the scenario described.

Limiting superior dissection of the nasal region and sparing injury to the external nasal artery will not significantly affect the blood supply to the columella.

Routine use of epinephrine has no impact on the survival of distal tissue such as the fingertip, nasal tip, or penis. This has been substantiated in numerous studies.

Use of bipolar cautery is not necessary in open rhinoplasty as long as soft-tissue debulking of the nasal tip area is not performed.

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54. A 20-year-old man is scheduled for gynecomastia reduction by the use of ultrasound-assisted lipoplasty. In planning this procedure, which of the following liposuction techniques has the highest risk of thermal injury to the skin?

- A) Dry
- B) Wet
- C) Superwet
- D) Tumescence

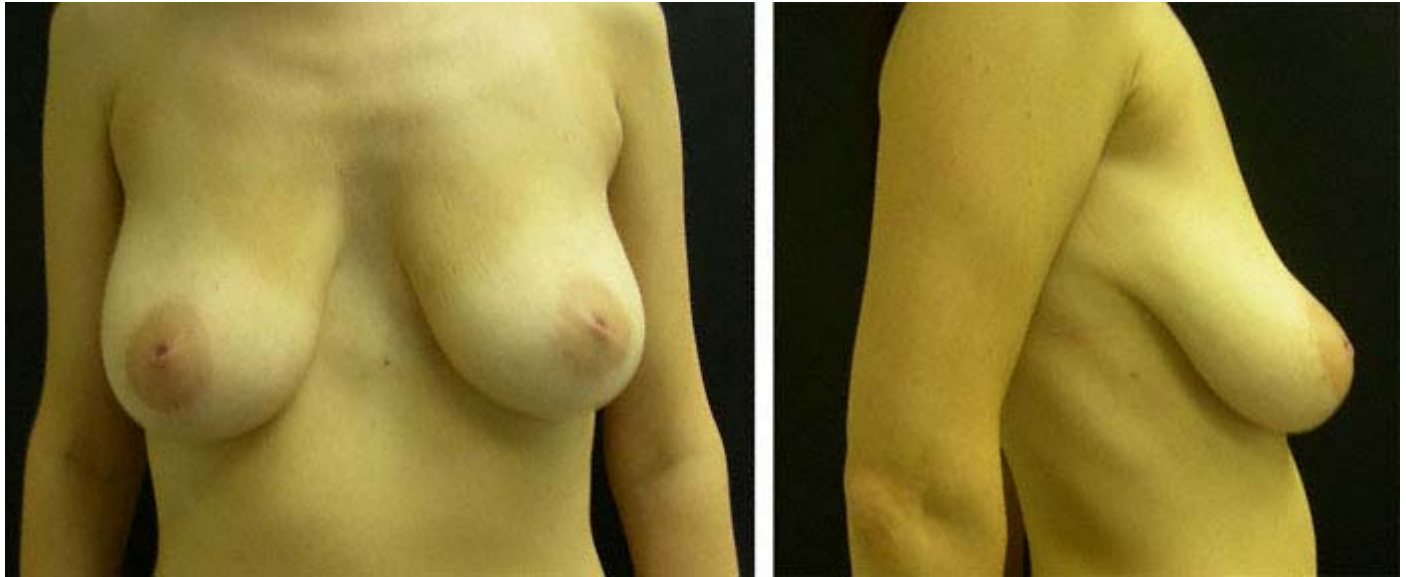
The correct response is Option A.

Ultrasound-assisted liposuction in a dry environment increases the risk of thermal injury and overlying skin necrosis. The introduction of subcutaneous fluid in the wet, superwet, and tumescent techniques helps cool the probe and decreases the risk of injury. Additionally, avoidance of end hits, strict continuous movement of the probe, continuous cold saline irrigation, and use of a probe sheath and a wet towel as a skin guard also protect against thermal injury when ultrasound energy is delivered to the tissues.

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(Please note that this pictorial appears in color in the online examination)

55. A 36-year-old woman comes to the office for consultation regarding mastopexy. She will not consider use of prostheses and is concerned about the length of the scars. Photographs of the breasts are shown. Which of the following types of mastopexy is most appropriate for this patient?

- A) Circumareolar
- B) Crescent
- C) Vertical
- D) Wise-pattern

The correct response is Option C.

The most appropriate management for the patient described, who has grade 2 ptosis of the breasts, is a vertical mastopexy. The procedure will leave periareolar and vertical scars but will give the patient a longer-lasting result than a periareolar procedure.

Ptosis is graded on a scale of 1 to 3, depending on nipple position changes from above or below the level of the inframammary crease. In pseudoptosis, the nipple is above or at the level of the crease, but the majority of breast parenchyma has descended and is distributed below the inframammary fold. In grade 1 ptosis, the nipple position is within 1 cm of the level of the inframammary fold. In grade 2 (moderate ptosis), the nipple is clearly below the fold (1 to 3 cm) but above the lowest part of the breast. In grade 3 ptosis, the nipple is greater than 3 cm below the inframammary fold and below the lower contour of the gland.

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In grade 1 ptosis, subglandular augmentation is often adequate. Alternatively, if the patient does not desire implants, a dermal or crescent mastopexy, which involves excision of a crescent-shaped area of skin above the areola, may be necessary. Circumareolar mastopexy, which involves concentric excision of skin and leaves no vertical scar beneath the areola, is also adequate for grade 1 ptosis. Periareolar resections without implant placement tend to flatten the shape of the breast.

A vertical or infraareolar mastopexy is ideal for grade 2 or moderate ptosis.

Wise-pattern mastopexy is appropriate for grade 3 ptosis with large amounts of skin excess, but the procedure will leave an inverted T-shaped scar.

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56. A 9-month-old girl is referred to the office for evaluation of a deformity of the left ear. Physical examination shows absence of the auriculocephalic sulcus. The superior helix is noted underneath the temporal skin. Which of the following is the most appropriate management?

- A) Anterior cartilage scoring and placement of Mustarde sutures at 6 years of age
- B) Immediate molding of the ear with impression material
- C) Immediate taping of the helix to the cranium
- D) Placement of conchomastoid sutures at 6 years of age
- E) Release of the helix and placement of a skin graft at 6 years of age

The correct response is Option E.

Cryptotia is a deformity of the ear in which the superior portion of the helix is buried under the temporal skin and the auriculocephalic sulcus is absent. This condition can be managed nonsurgically until the patient is approximately 6 months of age when the cartilage is still malleable. A splint fabricated from material such as dental compound is placed on the anterolateral surface of the ear to shape the auricle. The mold is then held in place with tape or an elastic band.

After the patient is 6 months of age, management is typically delayed until 5 or 6 years of age. At this point, the ear is close to its adult size, and the child is about to begin attending school. Treatment consists of release of the auricle from the temporal skin and management of the posterior skin deficiency with either a skin graft, Z-plasty, or rotational flap.

Anterior scoring with placement of Mustarde sutures, taping of the helix to the cranium, and conchomastoid sutures are not appropriate because they are techniques used to correct the prominent ear.

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57. When performing a delayed autologous breast reconstruction, which of the following is the most appropriate placement of the skin paddle on the chest wall for optimal aesthetic appearance?

- A) Inferior and lateral
- B) Inferior and medial
- C) Superior and lateral
- D) Superior and medial

The correct response is Option A.

The most advantageous orientation of a skin paddle in the scenario described is inferior and lateral. This placement creates a natural ptotic breast shape. Placement of the skin paddle in the medial or superior position results in an unaesthetic pattern with scars that may be difficult to hide in clothing. Placement of the skin paddle centrally, within the old mastectomy scar, also results in a less aesthetic contour.

When considering aesthetic subunits of the breast during reconstruction, the ideal skin paddle placement and shape is areolar or expanded areolar for an immediate reconstruction. For delayed reconstruction, the ideal aesthetic subunits are lower outer crescent, lower half of the breast, inferolateral crescent, or entire breast.

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58. A 54-year-old woman comes to the office for consultation regarding rejuvenation of the upper face. She has ptosis of the brow, laxity of the lower eyelids, and zygomatic hypoplasia. A deep temporal lift and augmentation with a subperiosteal pocket to contain hydroxyapatite granules are planned. To spare the frontal branch of the facial nerve, the dissection should be performed in which of the following planes?
- A) Just under the deep layer of the deep temporal fascia
 - B) Deep to the superficial layer of the deep temporal fascia
 - C) Superficial to the temporoparietal fascia
 - D) Deep to the temporoparietal fascia
 - E) Within the temporalis muscle

The correct response is Option B.

The temporal branch is among the most vulnerable of the facial nerve branches during surgical procedures on the upper and mid face. This vulnerability has been attributed to the following: (a) the temporal branch is significantly more superficial than the remaining branches of the facial nerve anterior to the parotid edge, (b) the dense fusion of the deep fascial layers as the nerve crosses over the zygomatic arch, and (c) the lack of interconnection between the temporal branch and the remaining branches of the facial nerve, increasing the gravity of inadvertent temporal branch injury. With the recent advent of deeper planes of dissection during rhytidectomy, including deep-plane and subperiosteal techniques, frontal branch injury has been reported to be as high as 20% in selected groups of patients. The aesthetic rejuvenation of the upper third of the face is important in restoring a youthful look. The deep temporal lift is based on safe anatomic planes of dissection. Within the temporal region there are three fascial layers: superficial temporal fascia (also known as temporoparietal fascia) and superficial and deep layers of deep temporal fascia. The superficial temporal fascia lies superficial to the zygomatic arch and represents an extension of the galea cephalad. On its undersurface, it contains the frontal branch of the facial nerve and superficial temporal vessels (see the photograph below). The investing deep temporal fascia splits into a superficial and deep layer at the supraorbital rim, and the two layers are separated by the superficial temporal fat pad. Incision through this superficial temporal fascia allows dissection to the arch through the temporal fat. Access is then gained to the arch in a subperiosteal plane by incising the periosteum along the superior border, thereby protecting the temporal branch by a layer of periosteum and the superficial layer of the deep temporal fascia. To facilitate exposure, the intact periosteum along the inferior border of the zygomatic arch is released medial to the course of the nerve.

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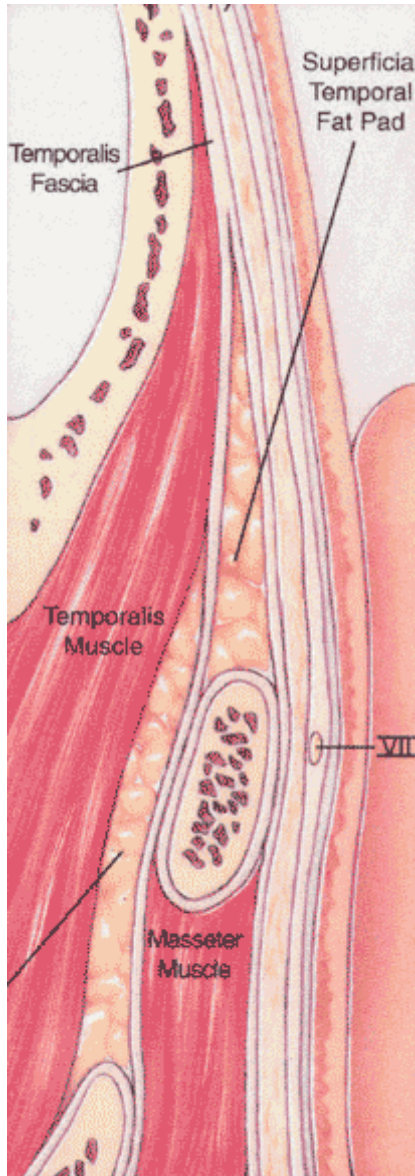


Figure adapted with permission from
Ellis E, Zide MF. *Surgical Approaches
to the Facial Skeleton*. Baltimore:
Williams & Wilkins; 1995:66, Fig.6-1.

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59. A 17-year-old girl comes to the office for consultation regarding breast asymmetry. She wears a size 34B brassiere, which fits the right breast but is too large for the left breast. On examination of the left side of the chest, there is no palpable breast parenchyma and no nipple-areola complex. No abnormalities of the muscles and ribs are noted. Development of the right breast is Tanner stage 4. Which of the following is the most likely diagnosis?

- A) Amastia
- B) Amazia
- C) Athelia
- D) Pectus excavatum
- E) Poland syndrome

The correct response is Option A.

The patient described has amastia, a congenital condition that involves absence of the nipple-areola complex and glandular tissue.

Amazia is the absence of glandular tissue only. Athelia is the absence of the nipple alone.

Pectus excavatum is a congenital defect of the thoracic wall, consisting of a concave deformity of the mid thorax. Reconstruction is indicated for aesthetic reasons or, in severe cases, for relief of cardiorespiratory dysfunction.

Poland syndrome is characterized by absent sternal head of the pectoralis major, hypoplasia of the breast or nipple, deficiency of subcutaneous fat and axillary hair, absence of the pectoralis minor, syndactyly or hypoplasia of the ipsilateral extremity, and shortening of the forearm.

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60. A 56-year-old woman comes to the office for consultation regarding aesthetic improvement of her abdomen. She says she is unhappy about the excess abdominal fat and skin, an unattractive abdominal contour from a previous surgery, and the size and ptosis of the mons area. A fleur-de-lis abdominoplasty is planned. To achieve optimal aesthetic improvement of the mons area, the lower incision should be made at which of the following locations?
- A) 2.5 cm above the vulvar commissure
 - B) 5 cm above the vulvar commissure
 - C) Panniculus crease
 - D) Pubic hairline
 - E) Vulvar commissure

The correct response is Option B.

To maximize the lift in the mons area without incurring an abnormal contour, the incision should be placed 5 to 7 cm above the vulvar commissure and within the hairline. If there is excessive fat within the mons area, it can be treated with suction lipectomy or defatting. Undermining and deep fat excision should be avoided because they may cause injury to the sensory nerves and untoward lymphedema. Liposuction to the area may assist in an improved contour. The superficial fascial system of the mons is then fixed to the rectus fascia with care to match the thickness of the upper and lower flaps.

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61. A 22-year-old woman undergoes an open tip septorhinoplasty. Which of the following arteries is the terminal blood supply to the skin envelope?

- A) Angular
- B) Columellar
- C) Facial
- D) Lateral nasal
- E) Superior labial

The correct response is Option D.

The lateral nasal artery, which is a branch of the angular artery, supplies the vascular arcade that keeps the nasal tip viable during an open tip septorhinoplasty.

The angular artery branches from the facial artery to supply portions of the cheek and nasal sidewall. The facial artery is a branch of the external carotid artery. The superior labial artery supplies the upper lip, and the columellar artery is a branch of the superior labial artery, which supplies the columella. It is divided during open tip rhinoplasty, and the skin must survive on the lateral nasal artery circulation.

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62. A 47-year-old woman comes to the office for consultation regarding rejuvenation of the upper periorbital area. Physical examination shows excess skin on the upper eyelids with no fat herniation. Brow contour is normal. Upper blepharoplasty is planned. Which of the following best represents the postoperative distance between the eyelid margin and fold necessary to achieve the ideal cosmetic result?

- A) 0 to 1 mm
- B) 2 to 5 mm
- C) 6 to 10 mm
- D) 11 to 15 mm

Please note: Question 62 has been deleted from the examination.

The correct response is Option B.

The ideal youthful eyelid appearance can be seen in models and movie stars by a study of their periorbita. Ideal eyelids are full, not hollow, with a crisp tarsal upper eyelid crease and elastic support of the upper eyelid tissue, creating smooth and taut pretarsal and preseptal upper eyelid skin. The pretarsal eyelid show is often only 2 to 3 mm in the aesthetically attractive eye. Current methods of periorbital rejuvenation are more conservative in the resection of soft tissue from the eyelids, avoiding the harsh overresected look that greater pretarsal eyelid show causes, which accelerates the apparent aging process.

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63. Which of the following findings is most indicative of Poland syndrome?

- A) Abnormalities of the chest wall
- B) Absence of the nipple
- C) Absence of the sternal head of the pectoralis major muscle
- D) Brachysyndactyly
- E) Hypoplasia of the latissimus dorsi muscle

The correct response is Option C.

For the definitive diagnosis of Poland syndrome, patients must have absence or hypoplasia of the sternal head of the pectoralis major muscle on the affected side. Other chest wall abnormalities can occur along with the absence of, or hypoplasia of, the ipsilateral breast. These include the latissimus dorsi and serratus anterior muscles. Brachysyndactyly of the ipsilateral upper extremity can be present as well.

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64. A 15-year-old girl is brought to the office because she has a hematoma of the right ear 24 hours after she sustained blunt trauma to the ear during practice with her high school wrestling team. Which of the following is the most appropriate management?
- A) Application of a pressure dressing
 - B) Aspiration of the hematoma only
 - C) Aspiration of the hematoma and placement of a subcutaneous drain
 - D) Incision and drainage of the hematoma and placement of a bolster dressing
 - E) Injection of hyaluronidase into the hematoma and placement of a subcutaneous drain

The correct response is Option D.

A hematoma of the ear caused by blunt trauma will result in a cauliflower ear deformity if not treated early. The hematoma most commonly forms between the perichondrium and cartilage of the ear on the anterior surface. Cauliflower ear deformity, also known as “wrestler’s ear,” forms when the hematoma organizes, becomes fibrotic tissue, and occasionally causes necrosis of part of the auricular cartilage. This results in a convex distortion of the normally concave conchal bowl, scapha, and/or triangular fossa and obliteration of portions of the antihelix. An auricular hematoma should be treated early by aspiration or drainage, and a bolster dressing should be placed to prevent reaccumulation of the hematoma.

Application of a pressure dressing alone is not adequate in the patient described because the hematoma is still present.

Aspiration alone often results in reaccumulation of the hematoma. A subcutaneous drain is difficult to place, is difficult to secure, and has not been shown to effectively prevent reaccumulation of the hematoma.

Hyaluronidase has not been shown to be effective for treating an auricular hematoma.

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65. A 50-year-old woman comes to the office for rhytidectomy. Height is 5 ft 1 in and weight is 110 lb (50 kg). Diazepam 10 mg and oxycodone 5 mg is administered with a sip of water approximately 30 minutes before the procedure is scheduled to begin. Forty-five minutes after 50 ml of 0.5% bupivacaine and 10 ml of 0.5% lidocaine with 1:100,000 epinephrine is injected into the patient's face, she becomes confused and disoriented. The ECG monitor shows heart block and wide-complex arrhythmia. Which of the following is the most likely cause of the ECG reading?
- A) Benzodiazepine toxicity
 - B) Bupivacaine toxicity
 - C) Lidocaine toxicity
 - D) Opioid toxicity
 - E) Primary undiscovered coronary artery disease

The correct response is Option B.

In the scenario described, a medication error has apparently occurred. A staff member has probably misread the surgeon's formula for local anesthetic and used bupivacaine in place of lidocaine. Surgeons should be encouraged to prepare their own solutions and read all labels on the medications they use, but in practice, nurses often prepare wetting solutions and injection solutions, and, even in the best of facilities, errors may occur. The accepted maximum dose of bupivacaine is 2.5 mg/kg, and thus anything over 150 mg is considered toxic in a 50-kg patient. The patient described was given 50 ml of a 0.5% solution, which contains 5 mg/ml of medication. Therefore, she was given 250 mg of the medication, well into the toxic range. On the other hand, had she been given lidocaine 0.5% with epinephrine, the maximum dosage would have been 7 mg/kg, or 350 mg of lidocaine. The amount of lidocaine in 50 ml of a 0.5% solution is 250 mg, within the safe zone for this patient. If the solution had been mixed as intended, the patient described would have received 250 mg of lidocaine and 25 mg of bupivacaine, and the resulting total amount would have been within the safe zone and well below the toxic range.

Large doses of bupivacaine can cause irreversible, nonrecoverable heart block (a recent case in Australia involved placing the patient on cardiac bypass until the toxicity was resolved [Soltesz, et al. 2003]). Recent literature has indicated that intralipid (1 ml/kg of a 20% solution IV recommended by Weinberg) is important in reducing mortality (Weinberg, et al. 1998, 2003, 2006; Rosenblatt, et al. 2006). Discussion at recent anesthesiology meetings has resulted in the recommendation that all facilities using bupivacaine also be stocked with intralipid (Dr. P. Schneider, anesthesiologist, personal communication). It is essential to realize that transfer to a hospital center for further treatment is urgent and mandatory in bupivacaine overdose and that immediate transfer without delay offers the best chance of survival, as further absorption from injected tissues is to be expected during this critical period (Mather, et al. 2005).

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The dosages of benzodiazepine, lidocaine, and opiates are all appropriate in the scenario described. The ECG changes are consistent with bupivacaine toxicity, not heart ischemia.

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66. A 26-year-old woman is undergoing subglandular implantation of saline breast prostheses. Pinch test of the superior pole shows a thickness of 1 cm. This patient is most at risk for which of the following complications?

- A) Capsular contracture
- B) Double-bubble deformity
- C) Infection
- D) Numbness
- E) Wrinkling

The correct response is Option E.

The subglandular placement of breast prostheses has both advantages and disadvantages. Because the prostheses are closer to the skin, the patient's native skin and subcutaneous fat layer are the only coverage and must be carefully evaluated. Subglandular implants are less painful than other methods, and they age well with the breast.

When evaluating the superior pole of the breast for adequate soft-tissue coverage, a minimum pinch test of 2 cm is recommended. Soft-tissue thickness of less than 2 cm will increase the chance of rippling and wrinkling with a subglandular placement. If the pinch test is less than 2 cm, submuscular placement is recommended for greater soft-tissue coverage of the prosthesis.

Capsular contracture is rare with a saline implant. A double-bubble deformity occurs when the native glandular tissue lies at the lower pole of an implant, or when an implant falls below the inframammary fold. Infection and numbness are possible complications of implant surgery but are less common than wrinkling in a thin patient with subglandular implants.

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67. A 20-year-old man is brought to the emergency department four hours after he sustained a laceration of the left ear (shown) during an altercation. On physical examination, the pedicle is noted to be approximately 1.5 cm inferiorly and posteriorly. Which of the following is the most appropriate management?
- A) Amputation of the superior helix and placement in an abdominal subcutaneous pocket
 - B) Amputation of the superior helix and placement of the de-epithelialized remnant in a retroauricular pocket
 - C) Dermabrasion of the skin of the ear, repair of the laceration, and placement of the repaired flap under a retroauricular pocket
 - D) Primary closure with key sutures to match anatomic points
 - E) Removal of skin from the posterior surface, drilling of holes in the auricular cartilage, and inset of the superior helix in a postauricular bed

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The correct response is Option D.

The photograph of the ear shown previously depicts a near amputation of the helix. The pedicle is relatively small at 1.5 cm. The ear has an excellent blood supply and can survive with an even smaller pedicle. There is no evidence of ischemia. Anatomic primary closure is likely to be successful. A postoperative photograph is shown below.

For very narrow pedicles with evidence of ischemia, Elsayh technique can be used to enhance the blood supply and chance for survival. In this technique, the skin is removed from the ischemic surface and covered with a retroauricular skin flap.

The remaining options describe treatment of a complete amputation. Each option describes attempts to preserve the delicate and unique ear cartilage. An abdominal subcutaneous pocket can lead to scar tissue unsuitable for later use. Composite grafting of the retroauricular bed is best done by dermabrasion of the skin of the ear, repair of the laceration, and placement of the repaired flap under a retroauricular pocket. This utilizes the pocket principle described by Mladick.

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68. A 40-year-old woman comes to the office for consultation regarding breast reconstruction two years after undergoing modified radical mastectomy for breast cancer. Physical examination shows atrophy of the lower lateral pectoralis major muscle. Transection of which of the following nerves during mastectomy is the most likely cause of the atrophy?

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

The correct response is Option D.

The pectoralis major muscle is innervated by branches from the brachial plexus. The lateral cord gives off the lateral pectoral nerve, which crosses the axillary artery and vein and pierces the deep surface of the muscle. It supplies the medial and superior portions of the muscle. The medial cord gives off the medial pectoral nerve, which enters the deep surface of the pectoralis minor and then passes around the edge of the lateral pectoralis major muscle. At this point, this nerve is vulnerable to division during mastectomy. The medial and lateral pectoral nerves are named for the brachial plexus cord of their origin, not for the portion of the muscle that they supply.

The second intercostobrachial nerve supplies the skin of the axilla and inner arm. It is often transected or transiently injured during axillary dissection. The lateral intercostal nerves supply the breast, and the fourth intercostal nerve supplies nipple and areola sensation. The long thoracic nerve comes off the lateral and posterior cords and supplies the serratus anterior. Division of this nerve results in a winged scapula. The thoracodorsal nerve comes from the posterior cord and supplies the latissimus dorsi muscle.

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69. A 30-year-old woman comes to the office for consultation regarding a body lift two years after undergoing a gastric bypass procedure. On initial evaluation, the presence of which of the following medications would increase the patient's risk for an embolic event during surgery?

- A) Anticholesterol medications
- B) Antidepressants
- C) Diuretics
- D) Oral contraceptives
- E) Thyroid replacement

The correct response is Option D.

Patients undergoing bariatric procedures have many of the known risk factors for embolic events, such as long procedure duration, immobilization, and obesity. The risk of deep venous thrombosis, even with prophylaxis, has been reported to be as great as 9%. Oral contraceptives and estrogen replacement therapy are known to increase the rate of embolic problems, and patients should be counseled to stop these medications, if possible, before the procedure. Current recommendations for prophylaxis include proper positioning during surgery, early ambulation, antiembolic stockings, and pneumatic compression stockings. Consideration may also be given to the use of low-molecular-weight or unfractionated heparin before and after surgery.

Antidepressants, anticholesterol medications, thyroid replacement, and diuretics have not been associated with increased risk for pulmonary embolism.

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70. A 28-year-old woman comes to the office because she has had persistent numbness and tingling of the lip since undergoing alloplastic chin augmentation 12 months ago. Physical examination shows an aesthetically pleasing result with a healed submental scar and normal skin. Which of the following is the most likely cause of the patient's symptoms?

- A) Bone erosion
- B) Herpes labialis prodrome
- C) Infection of the prostheses
- D) Injury to a mental nerve
- E) Injury to the orbicularis oris muscle

The correct response is Option D.

Injury to the mental nerve during surgery would cause numbness and tingling of the lip (Bartling, et al. 1999). Usually this is temporary if good technique has been followed, but persistent numbness may indicate permanent nerve injury.

Viral prodrome states, as with herpes simplex labialis, often cause tingling, but sensibility is not usually affected. Infection of the prostheses would also likely cause swelling, tenderness, and erythema. Muscle injury can cause displacement but not numbness. Not enough time has passed for significant bone erosion to occur.

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71. A 24-year-old man comes to the office because he has had difficulty breathing through the nose, particularly on forced inspiration, for the past six months. He underwent cosmetic rhinoplasty one year ago. He does not have seasonal allergies or sinus problems. Physical examination shows a small dorsal hump; the nose is otherwise aesthetically pleasing and well proportioned. Intranasal speculum examination shows the septum minimally deviated anteriorly to the left. Cottle maneuver is positive on the right. Which of the following is the most appropriate management?
- A) Placement of alar graft
 - B) Placement of radix graft
 - C) Placement of spreader graft
 - D) Reduction of the component dorsal hump
 - E) Resection of the submucous septum

The correct response is Option C.

The patient described requires placement of a spreader graft to stent the right internal nasal valve. The Cottle maneuver confirms the presence of internal nasal valve pathology. With the patient breathing quietly through the nose, the cheek is retracted laterally to open the internal nasal valve. If this improves the patient's breathing, the Cottle maneuver is said to be positive and suggests collapse of the internal nasal valve on that side.

Alar grafting is not appropriate because it is indicated for overresection of the lower lateral cartilages and inspiratory collapse.

Radix grafting could be used as a means of camouflaging the dorsal hump. However, there is no functional indication for radix grafting in the patient described.

Reduction of the component dorsal hump is a stepwise technique that emphasizes the integrity of the upper lateral cartilages, preserves internal nasal valve function, and therefore minimizes the need for spreader grafts in primary rhinoplasty patients. The patient described already has internal nasal valve collapse on the right side, either as a complication of the rhinoplasty or previously undiagnosed.

Resection of the submucous septum alone is not appropriate because the patient described has a minimally deviated septum anteriorly that is not contributing to the nasal airway obstruction.

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72. Accessory mammary structures are most frequently found at which of the following sites?

- A) Axilla
- B) Buttock
- C) Neck
- D) Thigh
- E) Vulva

The correct response is Option A.

Accessory mammary structures are found along the embryonic milk line, which forms on the ventrolateral body wall from the axilla to the groin. These structures include most supernumerary breasts, which are most often found in the axilla just above or below the normal breast or in the groin. True accessory mammary structures occur less frequently in the inner surface of the upper arm and/or the inner surface of the thigh or the vulva. Ectopic mammary structures are found outside of the embryonic milk line and represent either the ectopia or displacement of the milk line. Ectopic breast tissue has been reported in the midline of the face, ear, neck, back, buttock, and outer thigh.

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73. An 8-year-old boy is brought to the office for follow-up examination six months after he underwent bilateral setback otoplasty. Physical examination shows a sharply ridged antihelical fold of the left ear. Which of the following is the most likely cause of this deformity?

- A) Aggressive placement of mattress sutures
- B) Full-thickness penetration of the auricular cartilage
- C) Inadequate superficial scoring of the auricular cartilage
- D) Scoring of the anterior auricular cartilage more than the posterior auricular cartilage
- E) Scoring of the posterior auricular cartilage more than the anterior auricular cartilage

The correct response is Option B.

Scoring of the auricular cartilage, usually with a Stenstrom rasp, weakens the auricular cartilage and causes it to bend. The scoring may be performed from either an anterior or a posterior approach, depending on the preference of the surgeon. Inadequate superficial scoring usually results in inadequate correction of the deformity with persistent ear prominence. It is the full-thickness penetration of the newly formed cartilage that causes an undesirable and unnatural result—a sharply ridged antihelical fold.

The aggressive placement of Mustarde mattress sutures may result in suture abscesses or sinus formation but does not result in a sharply ridged antihelical fold.

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74. A 26-year-old woman comes to the office because she has pain and tenderness of the right breast three weeks after undergoing augmentation mammoplasty. The patient is satisfied with the appearance of the prostheses and does not want them permanently removed. Temperature is 39.0°C (102.2°F). She has chills and sweating. Physical examination shows induration of the right breast and drainage from the surgical incision. Gram stain of the drainage shows gram-negative rods. Which of the following is the most appropriate management?
- A) Immediate hospitalization for intravenous antibiotic therapy
 - B) Oral antibiotic therapy and follow-up evaluation in three days
 - C) Removal of the implant, irrigation of the pocket, capsule debridement, and immediate reinsertion of new implant
 - D) Removal of the implant, irrigation of the pocket, capsule debridement, and reinsertion of new implant in six months
 - E) Removal of the implant, irrigation of the pocket, and immediate reinsertion of new implant

The correct response is Option D.

The patient described has a severe infection with an elevated temperature, chills, diaphoresis, and signs of cellulitis. The Gram stain of the leaking fluid implicates involvement of the implant pocket. An infection of the implant pocket is difficult to control without removal of the implant. The most appropriate management is removal of the implant, irrigation of the pocket, debridement of the capsule, and reinsertion of an implant several months later. This approach minimizes the costs and risks associated with prolonged salvage attempts.

Administration of antibiotics, either oral or intravenous, without drainage of the infected pocket is not likely to eradicate the infection. This treatment approach is indicated only for a superficial infection without involvement of the periprosthetic space.

In patients with mild infection, with or without implant exposure, implant salvage can be considered. In this case, removal of the implant, irrigation of the pocket, capsule debridement, and immediate reinsertion of new implants can be performed. However, it should be noted that this approach can increase costs and risks, such as capsular contracture. In any case of implant removal, debridement of as much of the capsule as possible is recommended.

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75. A 36-year-old woman is scheduled to undergo a circumferential body lift procedure for correction of skin laxity resulting from a 100-lb weight loss. After the preoperative consultation, a simultaneous procedure to correct the flat and unnatural appearance of the patient's buttocks is planned. Which of the following is the most appropriate method of buttock augmentation for this patient?

- A) Autologous gluteal flaps
- B) Autologous fat injections
- C) Silicone gel prostheses
- D) Solid silicone prostheses

The correct response is Option A.

Autologous gluteal flaps provide easily accessible donor tissue that can be used simultaneously in body lift procedures. The dermal fat flaps can be elevated safely to autoaugment the buttocks. This technique adds no more than 45 minutes to the procedure and does not add to the usual complications of body lift procedures in general.

Autologous fat transfer can be used to enhance buttock shape, but unfortunately the buttocks of many of these patients are deflated and do not have adequate donor sites for grafting. Free tissue transfers are not recommended for buttock augmentation. Silicone prostheses, both solid and gel types, are associated with less than optimal outcomes because of palpability and a greater risk of infection and dehiscence.

Augmentation with fat injections from liposuction is possible, but the results are less predictable than the use of vascularized tissue.

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76. A 35-year-old man comes to the office for consultation about a white spot on the tip of the nose. He first noticed it three months ago, and it has gradually become more prominent since then. He underwent rhinoplasty one year ago. Physical examination shows a 3-mm-diameter white area on the nasal tip between the medial crura. Gentle pressure on the surrounding skin makes the white area more prominent. Which of the following is the most likely diagnosis?
- A) Devascularization of the skin as a result of surgery
 - B) Displacement of the caudal septum
 - C) Fungal infection of the epidermis
 - D) Growth of a squamous cell carcinoma
 - E) Pressure on the skin of the nasal tip from a graft

The correct response is Option E.

Although all the responses are possible, pressure on the skin of the nasal tip from a graft is the most likely diagnosis, especially in thin-skinned patients, and the placement of implants in an exposed position invites late complications.

Growth of a squamous cell carcinoma is not appropriate because new lesions do not usually present as a white spot. Although devascularization might show some skin discoloration, it is unlikely to be localized to a small spot. Displacement of the caudal septum is not an appropriate response, because this usually causes problems with the columella, not the tip.

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77. A 72-year-old woman comes to the office for consultation because she has had inability to close the left eye, raise the ipsilateral eyebrow and lip, flare the nostril, or show the teeth since she experienced flu-like symptoms three months ago. She has had no previous surgeries and takes no medications. Physical examination shows ptosis of the left forehead, palsy of the ipsilateral mentalis and nasalis, and weakness of the zygomaticus major and depressor anguli oculi muscles. MRI shows intact facial (VII) and acoustic (VIII) nerve branches and no lesions. Which of the following interventions is most appropriate to achieve brow symmetry in this patient?
- A) Endoscopic brow lift procedure with no muscle transection
 - B) Injection of botulinum toxin (Botox) into the left frontalis muscle
 - C) Injection of Botox into the left orbicularis oculi muscle
 - D) Injection of Botox into the right frontalis muscle
 - E) Injection of Botox into the right orbicularis oculi muscle

The correct response is Option D.

The patient described has Bell palsy. Typical signs include ptosis of the brow and forehead, upper eyelid retraction, lower lid ectropion, decreased blink, and decreased ability to close the eye.

Injection of Botox is a temporary procedure that can be useful to achieve animated symmetry. The frontalis, zygomaticus, and depressor anguli oculi of the unaffected side are often targets for paralysis, so that the two sides can remain symmetric during animation. If the motor function returns, the affected side may require some mild Botox treatment; however, usually this is for blepharospasm.

An endoscopic forehead lift (Endobrow) or other static procedure may be useful once recovery seems unlikely and muscle denervation is probable (one to two years). A gold weight can help close the eye, a canthoplasty can tighten the tarsoorbicularis sling, and a brow lift can treat the ptosis. Studies have shown that in the older population, a skin resection procedure may be more effective than an Endobrow procedure.

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78. A 69-year-old woman comes to the office because she has had dryness, tearing, and irritation in both eyes for the past two years. Physical examination shows outward turning of the lower eyelid margin. Anterior eyelid distraction is 7 mm from the globe. Snap-back test is greater than one second. Muscle tone is normal bilaterally. Which of the following is the most likely cause of lower eyelid ectropion in this patient?
- A) Dehiscence of lower eyelid retractors
 - B) Horizontal laxity of the lower eyelid
 - C) Loss of lower eyelid tone secondary to paralysis of orbicularis oculi muscle
 - D) Neoplasia within the lower eyelid causing the eyelid to be pulled away from the globe
 - E) Vertical shortening of the anterior lamella of the eyelid

The correct response is Option B.

Causal factors leading to ectropion include horizontal laxity of the eyelid (involutional), vertical shortening of the anterior lamella of the eyelid (congenital or cicatricial), paralysis of the orbicularis oculi muscle (secondary to paralytic entropion) causing loss of eyelid muscular tone, and neoplasia within the lower eyelid pulling or forcing the eyelid away from the globe.

Physical examination findings of abnormal snap-back test and distraction test in the patient described suggest abnormal horizontal lid laxity.

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(Please note that this pictorial appears in color in the online examination)

79. A 5-year-old boy is brought to the emergency department after he sustained burns in a gasoline fire. Physical examination shows burns to 70% of the total body surface area, including the right ear (shown). Which of the following is the most appropriate initial management of the burns to this patient's ear?
- A) Application of mafenide acetate (Sulfamylon) cream and auto-amputation
 - B) Costochondral reconstruction with a temporoparietal flap
 - C) Debridement and coverage with a retroauricular pocket flap
 - D) Excision and full-thickness skin grafting
 - E) Excision and unmeshed split-thickness skin grafting

The correct response is Option A.

Ear burns are usually aggressively managed with mafenide acetate (Sulfamylon) cream, monitoring for chondritis, and allowing the severely burned region to auto-amputate. This is especially true for large total body surface area (TBSA) burns such as the one sustained by the patient described, where large areas of excision and grafting must be done to save the patient's life. This is largely a problem of ear deformity, not function, and therefore has a lower priority.

Mafenide acetate (Sulfamylon) cream is the best topical antibiotic agent suitable for the ear because it penetrates the eschar and cartilage. It is applied twice daily. Trauma to the ear by

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dressings, endotracheal tapes, or pillows should be avoided. The eschar should not be completely debrided, as it acts as a biological dressing that prevents desiccation.

The more aggressive managements of costochondral reconstruction or retroauricular flap reconstruction are not warranted in the acute phase and can limit future reconstructive options.

Excision and full-thickness skin grafting can be considered in the intermediate management but are generally contraindicated in such a large burn after the wounds become heavily colonized. Excision and split-thickness skin grafting can be considered as well.

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80. A 14-year-old girl is brought to the office for consultation regarding breast asymmetry. She is anxious and embarrassed about the appearance of her right breast. Physical examination shows hypoplasia of the right breast with superior nipple displacement, absence of the sternocostal head of the pectoralis muscle, and deficiency of subcutaneous fat and axillary hair. The left breast is B-cup size and appears normal. Which of the following is the most appropriate initial step for reconstruction of the right breast?
- A) Implantation of a saline breast prosthesis covered by a latissimus dorsi flap
 - B) Injection of autologous fat
 - C) Placement of an adjustable subcutaneous tissue expander
 - D) Placement of an adjustable tissue expander covered by a latissimus dorsi flap
 - E) Reconstruction with a TRAM flap

The correct response is Option C.

Abnormal breast development may affect the psychological progress of a teenaged girl. If the definitive reconstruction is performed too early, additional growth may result in asymmetry. If intense anxiety is encountered in a young female patient, early intervention can be considered. In the patient described, a subcutaneous tissue expander can be placed because the sternal portion of the pectoralis is missing. Subsequent expansion can be performed as the opposite breast develops. The soft-tissue envelope will expand to eventually allow placement of a permanent prosthesis under a latissimus dorsi muscle flap.

Placement of a saline breast prosthesis covered by a latissimus dorsi flap is not appropriate because additional development will likely require a larger prosthesis. Furthermore, as the patient grows, the latissimus with fat added or buried skin paddle may be required to further enhance areas of soft-tissue deficiency.

Injection of autologous fat is not currently accepted for breast augmentation.

Placement of a tissue expander covered by a latissimus dorsi flap is also not appropriate because expansion will attenuate the muscle.

Reconstruction with a TRAM flap is not appropriate because the patient will not have a definitive reconstruction with a matching breast. In addition, TRAM flaps are contraindicated prior to childbearing.

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81. A 55-year-old woman is scheduled to undergo concurrent suction lipectomy of the neck and lower abdomen and rhytidectomy. Weight is 110 lb (50 kg). Conscious sedation with a local anesthetic and tumescent solution is planned. The neck and face should be injected and this portion of the surgery performed prior to the injection and liposuction of the abdomen for which of the following reasons?
- A) The absorption rate of local anesthetic above the clavicles is two times faster than below the clavicles
 - B) The epinephrine must be injected immediately before suctioning or it will not be effective
 - C) The facial area requires more anesthesia so the sedation can be lightened during the abdominal portion of the case
 - D) The lower abdominal liposuction should be performed first to allow time for the epinephrine to work for the rhytidectomy
 - E) The peak absorption of tumescent solution from the abdomen is two hours, and surgery must be completed by this time

The correct response is Option A.

One of the key principles of this operation is safety in the amount of local anesthesia used and the timing of injection. The absorption of lidocaine from above the clavicles peaks at approximately five to six hours when injected into the neck via tumescent solution. The absorption of the tumescent peaks at approximately 12 hours for the trunk region (the thighs in the reference below). If the tumescent is given for the abdomen and several hours later for the face and neck, then the lidocaine absorption curves could be superimposed and reach a toxic level. An immediate bolus of all the local anesthetics may not be preferred for a similar reason, as the absorption curve might peak. The epinephrine will be needed in the local anesthetic to delay rapid absorption via vasoconstriction and should not be eliminated if larger doses of local anesthesia are needed, although the epinephrine and local dose can be diluted to give a similar vasoconstrictive effect. Local anesthetics are additive in their risk and have a certain degree of cross-reactivity in their doses. Mixing a less-than-toxic dose of bupivacaine plus a less-than-toxic dose of lidocaine can add to a toxic effect. If large procedures are to be considered under local anesthesia and toxic doses limits are being approached, the surgeon should consider separating operative dates or another choice of anesthesia.

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82. A 46-year-old woman comes to the office for consultation about periorbital rejuvenation. Examination of the lower eyelids shows a nasojugal groove, excess skin, descent of the lid-cheek junction, and a negative vector relationship. Measurement of eye prominence is 20 mm using the Hertel ophthalmometer. Which of the following is the most appropriate procedure to rejuvenate the periorbital area?

- A) Laser resurfacing
- B) Mid-face lift with pinch blepharoplasty and lateral canthopexy
- C) Placement of an infraorbital rim implant
- D) Skin-muscle blepharoplasty
- E) Transconjunctival blepharoplasty with fat redraping

The correct response is Option B.

Patients who have excess skin and a negative vector relationship of the globe to the orbital rim are at risk for lower eyelid malposition when undergoing procedures to rejuvenate the lower eyelid. The Hertel ophthalmometer can be used to measure eye prominence. Normal measurement is 15 to 17 mm; a measurement greater than 18 mm is indicative of a prominent globe.

In the patient described, the pinch blepharoplasty will remove excess skin. The mid face lift will correct the descended lid-cheek junction and provide support in conjunction with the lateral canthopexy of the lower eyelid.

Laser resurfacing will tighten the lower eyelid skin but will have an associated risk for eyelid malposition. It will not correct the descended lid-cheek junction or the nasojugal groove. Placement of an infraorbital rim implant will correct the negative vector relationship but alone will not address the mid face descent or laxity of lower eyelid skin. Skin-muscle blepharoplasty will manage the excess skin, but there is an increased risk of lower eyelid malposition. However, it will not correct the descent of the lid-cheek junction. Transconjunctival blepharoplasty with fat redraping will correct the nasojugal groove but will not address the excess lower eyelid skin.

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83. A 30-year-old woman comes to the office for consultation regarding aesthetic improvement of the nasal tip. Examination shows a narrow angulation of the lateral genu (dome) and a 90-degree angle of divergence of the middle crura with an intercrural distance of 8 mm. Which of the following is the most appropriate description of this variation?

- A) Boxy tip
- B) Lateral crus malposition
- C) Narrow lobule
- D) Nostril-lobular disproportion
- E) Supratip deformity

The correct response is Option A.

The boxy tip has been described as a square perimeter of the nasal base that is caused by the position of the lower lateral cartilage. The angle of divergence of the middle crura (and their length) determines the intercrural distance. A wide angle of divergence results in the lateral positioning of the domes appearing like the corners of a box. An angle of divergence of 90 degrees would give a long intercrural distance and a boxy tip. The optimal angle of divergence is approximately 30 to 60 degrees, depending on the literature.

Lateral crus malpositioning in a more cephalad direction can provide a flattened, broadened tip lacking in projection. This can lead to a boxy tip appearance without a long intercrural distance and obtuse angle of divergence. It is consistent with a type II boxy tip deformity, which is not described in this scenario. The scenario described more closely resembles a type I boxy tip deformity.

A narrow lobule would be seen with a more acute angle of divergence.

Nostril lobular disproportion relates to the medial and middle crura lengths and the relationship of the nostril length to the lobular length (ideal = 2:1).

A supratip deformity describes the fullness in the supratip area, often found after aggressive reduction rhinoplasty.

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84. A 25-year-old man comes to the office for consultation because he is dissatisfied with the appearance of his jawline. On physical examination, the bizygomatic distance is 15% wider than the bigonial width. Which of the following interventions is most appropriate for augmentation of the mandibular angle?

- A) Implantation of a porous polyethylene prosthesis
- B) Implantation of a silicone prosthesis
- C) Onlay bone grafting
- D) Onlay implantation of porous hydroxyapatite granules
- E) Sagittal ramus osteotomy with interpositional bone grafting

The correct response is Option A.

Augmentation of the posterior mandible can improve jawline definition and angularity as well as increase posterior facial width. Implantation of a porous polyethylene prosthesis currently offers the best option for augmentation of the posterior mandible. This easy-to-use prosthesis can be carved to the desired profile and secured by screw fixation to prevent displacement. The material becomes incorporated into the surrounding tissue, which makes it more tolerant to infection and erosion.

Implantation of a silicone prosthesis is not an appropriate intervention for the patient described because placement of larger prostheses can be difficult. Silicone prostheses have a smooth surface and do not develop bony ingrowth. They have also been associated with bone erosion and capsular contracture.

Onlay bone grafting of the region is not appropriate because this method has produced inconsistent results with resorption.

Onlay implantation of porous hydroxyapatite granules has been shown to provide good results. However, in the mandible, this method of augmentation has been associated with a higher level of complications than when used in other areas of the craniofacial skeleton such as the maxilla. These complications include infection, extrusion, and formation of seroma.

Interpositional bone grafting is not appropriate because it can be technically challenging to perform and can produce unpredictable results.

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85. Which of the following is the main disadvantage of reduction mammoplasty by liposuction alone?

- A) Dissemination of occult cancer
- B) Inability to breast-feed
- C) Inadequate correction of ptosis
- D) Increased hematoma formation
- E) Persistence of back pain

The correct response is Option C.

Liposuction alone is one of many techniques available to reduce the symptoms of macromastia. The primary advantage of this technique is the lack of scars. Several authors cite other advantages such as rapid return to work and exercise, decreased operative time, normal sensation, and full ability to breast-feed. Complications such as hematoma, seroma, and nipple necrosis are minimal compared to incisional techniques, and reductions of one to two cup sizes are reported. Symptoms of macromastia are relieved. Authors warn that this technique is not effective in young patients with dense breast tissue and little fatty tissue.

Disadvantages of this technique include difficulty assessing the amount of breast tissue removed because of the infiltration of tumescent solution, lack of pathologic examination, inadequate tissue removal in large reductions, and poor skin shrinkage. Short-term studies of postoperative mammograms show occasional benign calcifications, but longer-term studies are still needed. Dissemination of cancer is a theoretical risk but has not been reported. The incidence of occult cancer in reduction mammoplasty patients is less than 0.5%. Although nipples will rise somewhat with liposuction, the average elevation is 2 to 6 cm, and patients still have nipples which are at or below the inframammary fold (first- or second-degree ptosis).

The preferred candidate for liposuction-only reduction is described as a young patient with good skin elasticity, minimal to moderate hypertrophy, and no ptosis.

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86. A 45-year-old woman is undergoing abdominoplasty. She does not smoke cigarettes and currently takes estrogen replacement medication. Medical history includes a deep venous thrombosis with no pulmonary embolus 12 years ago. Which of the following is the most appropriate thromboembolism prophylaxis in this patient?

- A) Administration of aspirin
- B) Administration of enoxaparin and application of sequential compression devices
- C) Administration of warfarin pre- and postoperatively
- D) Application of elastic stockings and intravenous administration of heparin
- E) Early ambulation

The correct response is Option B.

Deep venous thrombosis (DVT) and pulmonary embolus (PE) can be deadly sequelae of hospitalization, immobilization, and general anesthesia. These risks can be minimized with proper prophylaxis at the time of surgery. This is especially important in plastic surgery: liposuction, abdominoplasty, belt lipectomy, and combined procedures all have a significant incidence of embolic risk.

Patients are generally divided into categories of risk. In 2002, the American Society of Plastic Surgery Task Force issued a practice guideline that divided patients into three levels of risk. Low-risk patients are under 40 years of age and are undergoing minor procedures. Moderate-risk patients are over 40 years of age and are under general anesthesia for more than 30 minutes. Medications such as estrogen cause moderate risk. High-risk patients have additional risk factors such as age over 60 years, long-duration operations, immobilization, malignancies, prior embolic disease, and hypercoagulable states.

Surgeons should have a high index of suspicion for DVT and PE. Patients with shortness of breath and tachypnea should be immediately evaluated for PE. Leg edema, calf tenderness, or palpable cords can be signs of DVT.

Evidence-based guidelines from the 2004 American College of Chest Physicians' Conference state that (1) aspirin alone should not be used as prophylaxis for any group; (2) for moderate-risk patients, unfractionated heparin or low-molecular-weight heparin is recommended; (3) for high-risk patients, prophylaxis with heparin three times per day or higher-dose low-molecular-weight heparin is recommended; (4) mechanical prevention should be used in patients who are at high risk for bleeding and as an adjunct to anticoagulation-based prophylaxis in other risk groups.

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Each local hospital may also have protocols for the prevention of thromboembolism, which can easily be formatted into the written operative orders.

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87. A 43-year-old woman is scheduled for reconstruction of the right breast with a latissimus dorsi flap. She is at greatest risk for which of the following complications?

- A) Chronic chest wall pain
- B) Dorsal wound dehiscence
- C) Partial flap necrosis
- D) Seroma
- E) Stiffness in the ipsilateral shoulder

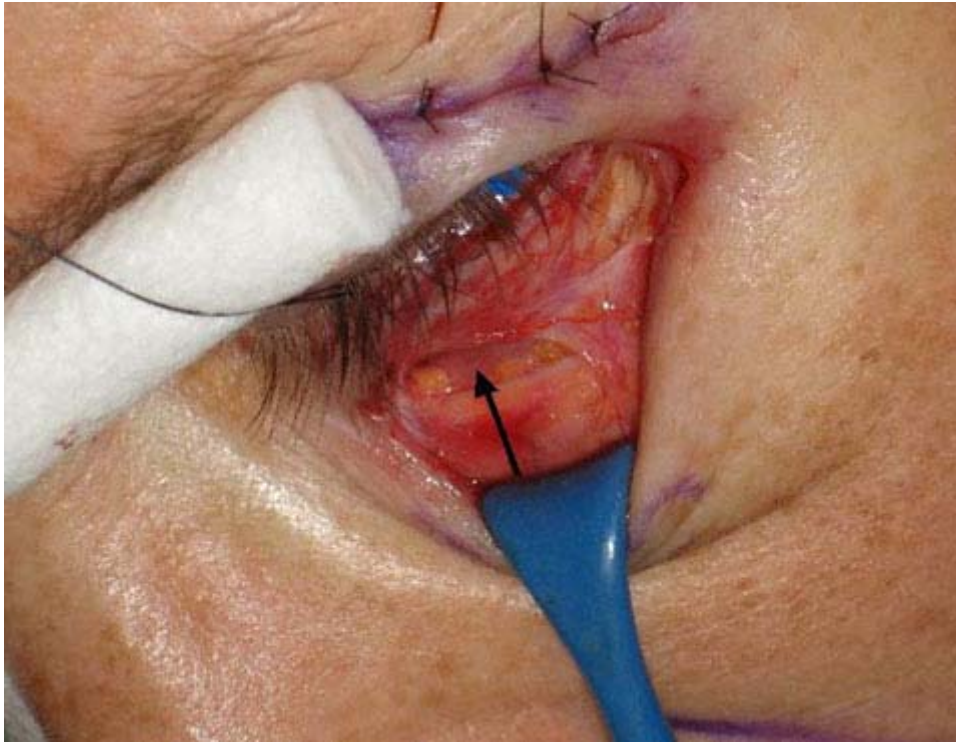
The correct response is Option D.

The most common complication in the scenario described is seroma formation, which is estimated to be as high as 35% to 60%. Other less common complications include chest wall pain (6%), dorsal wound dehiscence (4%), partial flap necrosis (1%–7%), and shoulder stiffness (1%).

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(Please note that this pictorial appears in color in the online examination)

88. A 46-year-old woman is undergoing blepharoplasty of the lower left eyelid. During removal of adipose tissue, the muscular structure indicated by the arrow in the photograph is inadvertently cauterized. To test the function of the structure, the patient should be asked to move her left eye in which of the following directions?

- A) Downward
- B) Downward and outward
- C) Inward
- D) Upward and inward
- E) Upward and outward

The correct response is Option D.

Injury to the inferior oblique muscle remains an infrequent but potentially debilitating complication of lower blepharoplasty. During transcutaneous blepharoplasty, the inferior oblique muscle is susceptible to injury because of its intimate association between the medial and central compartments. The inferior oblique muscle is reported to be the most frequently injured

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extraocular muscle following transcutaneous blepharoplasty. The possible etiologies of postoperative diplopia following lower lid blepharoplasty are manifold. Mechanisms of extraocular muscle injury may include intramuscular hemorrhage and edema, cicatricial changes within the muscle, and accidental incorporation of extraocular muscle in closure of orbital septum. Avoidance of these complications is best achieved through intimate understanding of eyelid anatomy from the transconjunctival perspective.

Clinical testing for each muscle is examined in its position of greatest efficiency. Thus the patient is asked to look in the direction noted below to test each muscle.

Upward and outward	Superior rectus
Downward and outward	Inferior rectus
Upward and inward	Inferior oblique
Downward and inward	Superior oblique
Inward	Medial rectus
Outward	Lateral rectus

Trauma to the inferior oblique muscle may result in an inability to elevate the eye in the adducted position.

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89. A 30-year-old man scheduled for placement of a chin prosthesis wants to minimize cutaneous scarring. Placement of an alloplastic chin prosthesis through an intraoral incision is planned. The surgeon should inform the patient that this approach is most likely to increase the risk of which of the following adverse outcomes?

- A) Capsular contracture
- B) Inferior malposition of the implant
- C) Lower lip dysfunction
- D) Mandibular resorption
- E) Mental nerve injury

The correct response is Option C.

The technique of intraoral placement of chin implants avoids a cutaneous scar but provides limited exposure to the menton without compromising the mentalis muscle. As a result, the intraoral approach is associated with lower lip dysfunction resulting from mentalis muscle division or detachment.

Inferior malposition of the implant is also a known complication of intraoral placement. Capsular contracture, mandibular resorption, and mental nerve injury occur similarly with either intraoral or transcutaneous placement.

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90. A 36-year-old woman comes to the office because she has persistent difficulty breathing through the nose two years after having rhinoplasty. Examination shows a deviated dorsum and an open roof deformity. Which of the following is the most appropriate method of reconstruction?

- A) Alar batten graft
- B) Columellar strut
- C) Dorsal onlay graft
- D) Lateral nasal wall graft
- E) Spreader grafts

The correct response is Option E.

Spreader grafts are usually paired and longitudinal, placed between the dorsal septum and the upper lateral cartilages in a submucoperichondrial pocket. Spreader grafts are used to restore or maintain the internal nasal valve, straighten a deviated dorsal septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity.

Alar batten grafts are nonanatomic grafts placed in a pocket extending from the piriform aperture to a paramedian position in the alar sidewall at the site of maximal, lateral, nasal wall collapse during inspiration.

The columellar strut helps maintain tip support and increase tip projection and also aids in shaping the columellar-lobular angle.

Dorsal sidewall onlay grafts are placed along the lateral side of the nose and are different shapes and sizes depending on the indications. They are used to combat localized lateral depressions or asymmetries of the body of the nose and especially to camouflage collapse of the upper lateral cartilages.

The lateral nasal wall graft is placed in an undermined pocket between the undersurface of the lateral crus and the vestibular skin; it is stabilized by suturing it to the crus. It is used to correct alar retraction, alar rim collapse, and concave, convex, or malpositioned lateral crura.

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91. A 22-year-old woman comes to the office for consultation regarding correction of breast asymmetry. She says the problem is with the left breast; she is happy with the size and shape of the right breast. Physical examination shows narrowing of the left breast at the base. At the mid portion, the inframammary fold of the left breast is higher than that of the right breast. The left areola is enlarged. The cup size of the left breast is B, and the cup size of the right breast is C. Which of the following is the most appropriate management?
- A) Augmentation mammoplasty of the left breast with radial scoring and areola reduction
 - B) Mastopexy of the left breast using a Wise-pattern technique with lowering of the inframammary fold
 - C) A pedicled TRAM flap to the left breast
 - D) Vertical reduction mammoplasty of the right breast

The correct response is Option A.

The patient described has a tubular breast deformity. The most appropriate management is augmentation mammoplasty of the left breast with radial scoring and areola reduction.

Contralateral reduction mammoplasty will not correct the shape of the affected breast. Reconstruction with a pedicled TRAM flap is quite aggressive for the patient described. A Wise-pattern mastopexy will not augment the volume and base of the affected breast.

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92. A 9-year-old boy is brought to the office for evaluation of failed replantation of the right ear after a dog bite injury 12 months ago. The patient had soft-tissue injury to the periauricular area with skin loss and infection six months ago. Physical examination today shows extensive periauricular scarring. Which of the following is the most appropriate next step in management?
- A) Coverage of carved autologous rib cartilage framework with a temporoparietal fascial flap
 - B) Creation of a subcutaneous pocket for eventual coverage of carved autologous rib cartilage framework
 - C) Creation of a subcutaneous pocket for eventual coverage of silicone framework
 - D) Placement of a tissue expander for eventual coverage of alloplastic (MedPor) framework
 - E) Referral to a prosthetic specialist

The correct response is Option A.

Temporoparietal fascial flap coverage is the best choice in the scenario described, when used with a carved autologous framework.

Use of a silicone framework is discouraged because exposure results in infection and loss of the foreign body.

Creation of a subcutaneous pocket for autologous rib framework can be difficult when there is scarring and contraction of the periauricular area. Exposure of the framework would be catastrophic.

Although criticized for lack of pliability because of the resultant capsule, in select situations, tissue expansion offers good results. In the scenario described, however, it would be complicated because of the extensive scarring.

Prosthetic ear replacement is rarely indicated in pediatric cases where there is loss of an ear or in congenital cases of microtia. A child is rarely compliant, and the prosthetic is easily displaced during a child's activities.

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93. An 82-year-old woman comes to the office because she has had excessive tearing and irritation of both eyes for the past three months. Physical examination shows severe lower eyelid laxity, scleral show, downward drift of the lateral canthus, and a shortened intercanthal distance bilaterally. Entropion is suspected. Which of the following is most likely to confirm the suspected diagnosis?

- A) Animation test of the orbicularis oculi muscle
- B) Hertel exophthalmometry
- C) Jones dye test
- D) Lower eyelid snap-back test
- E) Schirmer test

The correct response is Option A.

Involitional entropion can be confused with involitional ectropion in the static state because of the associated lower eyelid laxity in both instances. The two conditions are completely distinguishable on animation of the orbicularis oculi muscle. Inversion of the lower eyelid occurs on attempted eyelid closure in cases of involitional entropion. Causal factors include orbicularis dysfunction with the preseptal portion overriding the pretarsal portion, upper eyelid “closure kick,” disinsertion of lower eyelid retractors, loss of horizontal and vertical eyelid support, and loss of orbital fat volume.

Hertel exophthalmometry is an objective measure of globe position in relation to the orbit; although enophthalmos can be associated with entropion, the test cannot distinguish it from ectropion. Jones dye test is used to assess the lacrimal drainage system. Lower eyelid snap-back test indicates laxity in both entropion and ectropion. The Schirmer test is an objective measure of lacrimal secretory capacity only.

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94. A 35-year-old woman comes to the office for consultation regarding correction of the bulbous appearance of the tip of the nose. She says she would like the nasal tip to be more defined. On physical examination, the lateral crus of the lower lateral cartilage points toward the medial canthus. A cephalic trim of the lower lateral cartilages is planned. Which of the following interventions is most likely to maintain external nasal valve competence?
- A) Addition of an alar rim graft
 - B) Low to low lateral osteotomies of the nasal bones
 - C) Transection of the medial crura and cephalic repositioning of lateral crura
 - D) Use of spreader grafts
 - E) Use of transdomal sutures

The correct response is Option A.

When the lateral crus is malpositioned and a cephalic trim is planned, external valve incompetence can result. Adding support to the alar rim improves external valve competence. Transdomal suturing is used to treat wide domal arches. This often mandates the use of alar rim grafts to support the external nasal valve from the concavity that can occur with the sutures. Adding additional support in the form of batten grafts (below the lower lateral cartilage or onlay/overlay grafts on the lower lateral cartilage) provides increased support to the external nasal valve and supports the tip or derotates the tip as desired.

Spreader grafts open the internal nasal valve, while transdomal suturing and middle crural transection can result in a pinched tip, alar notching, and decreased tip support and often do not add support to the external nasal valve. Low to low lateral osteotomies may not support external valve competence with the removal of the Webster triangle and subsequent lateral base narrowing.

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95. A 35-year-old woman, gravida 4, para 4, has undergone uncomplicated augmentation mammoplasty with silicone gel–filled prostheses. According to prosthesis manufacturers and the United States Food and Drug Administration, which of the following is the recommended schedule of MRI screening to detect prosthesis rupture?
- A) One year after surgery, then every two years
 - B) Two years after surgery, then every two years
 - C) Two years after surgery, then every three years
 - D) Three years after surgery, then every two years
 - E) Three years after surgery, then every three years

The correct response is Option D.

Silicone gel–filled prosthesis ruptures are most often silent. MRI screening is currently the best method to diagnose silent rupture. Often neither the physician nor the patient will know if the prosthesis has a tear or a hole in the shell, which is why the United States Food and Drug Administration recommends MRIs at three years postoperatively and then every two years thereafter to screen for rupture.

Symptoms of silent rupture include hard knots or lumps surrounding the prosthesis or in the armpit; a change or loss of size or change in shape of the breast or prosthesis; and pain, tingling, swelling, numbness, burning, or hardening of the breast.

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96. A 54-year-old woman who recently had a 40-lb weight loss is scheduled to undergo a medial thigh lift procedure. Which of the following closure techniques for this procedure is most effective in decreasing the risk of lymphedema of the legs and knees?

- A) Anchoring the inferior skin flap to the superficial layer of the superficial fascia of the perineum
- B) Closing the flap to the recipient areas using the Scarpa fascia
- C) Superficial dissection over the femoral triangle
- D) Suturing the superficial fascial system of the flap to the Colles fascia
- E) Undermining the inferior skin flap deep to the adductor muscle fascia

The correct response is Option C.

The superficial fascia of the medial thigh consists of two layers: superficial and deep. The superficial layer is thick, loose, areolar in texture, and contains in its meshes much adipose tissue, the amount of which varies in different patients. The deep layer (Colles fascia) is thin, aponeurotic in structure, and of considerable strength.

In an attempt to limit untoward results, the medial thigh lift was modified to allow anchoring of the inferior skin flap to the tough and inelastic deep layer of the superficial fascia of the perineum. Using the Colles fascia as the central anchor for the medial thigh lift has produced more consistent and long-lasting results, decreasing the risk of problems commonly associated with the classic skin-suspension medial thigh lift—widened scars and labial distortion. In the groin, the depth of the incision is to the fascia lata in the region between the ischial tuberosity and the symphysis pubis. Lymphedema of the knee and leg can result if lymphatic vessels are damaged in the course of a medial thigh lift. The depth of the incision should remain superficial through the fat over the femoral triangle in order to leave lymphatics intact.

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97. A 25-year-old man is brought to the emergency department three hours after he sustained a total transection of the right ear in a motor vehicle collision. Replantation is planned. Which of the following locations on the amputated ear is most likely to contain a vessel suitable for anastomosis?

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

The correct response is Option C.

The principal blood supply of the external ear is the posterior auricular artery, which is a branch of the external carotid artery. It has numerous branches on the posterior or cranial surface of the ear, and multiple branches perforate the triangular fossa, concha, and lobule to supply the anterior surface of the ear. The superficial temporal artery gives off smaller branches to the superior portion of the ear and the lobule. These anastomose with the posterior auricular system. All of the arteries of the ear are extremely small, and microvascular repair is technically challenging. Often, a vein cannot be identified and many replantations are performed without venous drainage. Leeches and hyperbaric oxygen therapy are often employed. The posterior auricular artery is usually the largest vessel and is the point at which dissection generally begins on the posterior surface of the ear. The use of this vessel also allows the future use of a temporoparietal fascia flap reconstruction if needed.

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98. A 35-year-old woman comes to the office because she is unhappy with the appearance of her right breast. She underwent implantation of a silicone prosthesis in the right breast 15 years ago to correct asymmetry. She has required three revision surgeries for severe capsular contracture. She wants to have the implant removed, but she also wants to retain symmetry of the breasts. Examination shows grade 3 capsular contracture in the right breast. Which of the following is the most appropriate management of the right breast after removal of the implant?
- A) Excision of the capsule alone
 - B) Excision of the capsule and injection of aspirated fat
 - C) Excision of the capsule and insertion of a saline implant
 - D) Excision of the capsule and reconstruction with an autologous flap

The correct response is Option D.

The patient described requires implant removal and capsulectomy to remove the firm scar tissue surrounding the implant. Reconstruction with an autologous flap is the most appropriate management to maintain volume and avoid capsular contracture.

Implant removal, with or without capsulectomy, may treat the capsular contracture but will not leave her “full-breasted” as she desires. Even the use of textured or saline implants may cause capsular contracture.

Injection of lipoaspirates is unpredictable and may cause calcifications and fat necrosis.

Reconstruction with latissimus dorsi, TRAM, and DIEP flaps have all been described as methods of autologous breast augmentation and are good options to avoid implant problems.

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99. A 48-year-old woman comes to the office because she has had persistent epiphora since she sustained a naso-orbital-ethmoid fracture one year ago. Jones I fluorescein dye test is performed. If the results of this test are normal, in which of the following locations is the dye most likely to be found?

- A) Inferior meatus
- B) Lower canaliculus
- C) Middle meatus
- D) Nasolacrimal duct
- E) Upper canaliculus

The correct response is Option A.

Epiphora is the accumulation of tears that are not evacuated by the lacrimal drainage system. The tears will often overflow onto the cheek. Injuries to the lacrimal drainage system have been reported to occur in 5% to 21% of patients sustaining naso-orbito-ethmoid trauma. Jones I and Jones II dye testing can be used to diagnose the level of obstruction.

In a Jones I dye test, fluorescein dye is instilled into the conjunctival sac. A cotton-tipped applicator is placed under the inferior turbinate, the site of the inferior meatus. In a positive test, dye flows through the lacrimal system and exits at the inferior meatus. Dye is recovered on the applicator. In a negative test, no dye is recovered. This indicates an obstruction in the lacrimal drainage system.

The Jones II dye test is performed to localize the level of obstruction within the drainage system. This test is performed immediately after the Jones I test. An irrigation cannula is inserted into the punctum. Saline is irrigated through the cannula. If dye-stained fluid is obtained in the nose, the test is positive, and a partial obstruction of the lacrimal drainage system is diagnosed. If no dye is obtained in the nose, the test is negative. If dye exits the other canaliculus, the obstruction is in the lower portion of the system. If no dye returns through the other canaliculus, but dye refluxes through the same canaliculus, then the obstruction is in the upper part of the system.

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100. A 45-year-old woman comes to the office for consultation regarding reconstruction three years after undergoing resection of a left acoustic neuroma (vestibular schwannoma) that resulted in permanent paralysis of the left side of the face. Which of the following best describes the advantage of using microneurovascular muscle transfer over using a temporalis muscle sling to reconstruct this defect?

- A) Cheek augmentation
- B) Decreased operative time
- C) Earlier symmetry at rest
- D) Improved facial rejuvenation
- E) Increased ability for spontaneous expression

The correct response is Option E.

Free-muscle transplantation is the treatment of choice for long-standing facial paralysis. It enables the reconstructive surgeon to restore facial movement and some emotional animation. Permanent facial paralysis is one of the most important functional and aesthetic handicaps among the sequelae observed in plastic and maxillofacial surgery. The affected patient is deprived of one of the essential means of mental and affective expressions: the mimic.

In 1934, Gillies had the idea of lengthening the middle third of the temporalis muscle, flipped over the zygomatic arch, by using a strip of the fascia lata. The major disadvantage of Gillies' (temporalis transfer) technique, in addition to the intermediate graft, was to place the muscle under the skin, creating the zygomatic bulge and a cheek augmentation. Temporalis muscle transfer requires the patient to activate the trigeminal nerve for motor function, but this function is generally static rather than dynamic.

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Section 3: Craniomaxillofacial

101. An otherwise healthy 20-year-old woman comes to the office because she has had a painless lump on the left floor of the mouth for the past three weeks. The lump has increased in size during the past week. Physical examination shows a fluctuant, 2-cm blue mass that is not tender to palpation. Which of the following is the most likely diagnosis?
- A) Lingual thyroid
 - B) Ranula
 - C) Thyroglossal duct cyst
 - D) Torus
 - E) Vascular anomaly

The correct response is Option B.

A ranula is a mucocele or mucous extravasation phenomenon in the floor of the mouth, arising from the ducts of the sublingual or submandibular glands, often as a sequela of obstruction of the sublingual gland. It usually presents as a unilateral swelling of the floor of the mouth that is fluctuant and tinted blue or glossy white. Treatment includes marsupialization or surgical excision including the sublingual gland. The ranula may herniate through the muscles of the floor of the mouth and present as a “plunging ranula” or cervical mass.

A lingual thyroid is an uncommon condition in which the embryonic thyroid gland does not descend into the neck and presents as a firm, nontender mass at the tongue base.

A thyroglossal duct cyst represents residual epithelium-lined tracts that trace the path of descent of the thyroid and can be found anywhere in the paramedial region of the neck but are usually in the midline.

A torus is an exostosis and is a slow-growing, hard mass arising from the palate or mandible. The enlargement consists of bone covered by mucosa. Excision is indicated for tori that become symptomatic or bothersome.

Vascular anomalies are present at birth and grow with the patient. It would be unusual for a vascular anomaly to initially present in an adult.

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102. An 18-year-old woman is referred for evaluation of lower facial asymmetry. Examination shows the mandibular dental midline 6 mm to the left of the midsagittal plane, and the chin point and maxilla are coincident with the midsagittal plane. Which of the following procedures is most appropriate to correct the lower facial asymmetry?
- A) Le Fort I osteotomy with midline shift to the left and mandibular sagittal osteotomy with shift to the right
 - B) Mandibular sagittal osteotomy with midline shift to the left
 - C) Mandibular sagittal osteotomy with midline shift to the right
 - D) Mandibular sagittal osteotomy with midline shift to the left and sliding genioplasty to the right
 - E) Mandibular sagittal osteotomy with midline shift to the right and sliding genioplasty to the left

The correct response is Option E.

In assessing the orthognathic patient preoperatively, it is important to recognize all asymmetries and to be aware of potential asymmetries that may result from planned procedures. Combined osteotomies of the mandible and chin are indicated to bring the mandibular dental midline and the bony chin midline in line with the midsagittal plane in the patient described. To correct the jaw deformity, the mandibular dental midline would have to move to the right. The chin point would also move to the right and would therefore require an osteotomy and left shift.

Combining a Le Fort I and mandibular sagittal osteotomies would result in coincident dental midlines, but neither would be aligned with the midsagittal plane.

Correcting the dental midline alone with mandibular sagittal osteotomies would create a genial asymmetry that was not present preoperatively.

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103. The 4-month-old infant shown is examined one day after undergoing repair of a bilateral cleft lip and nose. On the basis of the photograph, this patient most likely has which of the following syndromes?

- A) Goldenhar
- B) Stickler
- C) Treacher Collins
- D) Van der Woude
- E) Velocardiofacial

The correct response is Option D.

The child shown in the photograph has a newly corrected bilateral cleft lip and nose. On the lower lip, there are prominent “lip pits,” which are accessory salivary glands. This is indicative of van der Woude syndrome, which is a syndrome of lower lip pit(s), with or without clefting, and with or without missing second premolars. This autosomal-dominant condition may also include hypodontia and clefting.

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Goldenhar syndrome is hemifacial microsomia with epibulbar dermoids and/or spinal and scapular anomalies.

Stickler syndrome is associated with Pierre Robin syndrome and includes flat facies, myopia, and spondyloepiphyseal dysplasia.

Treacher Collins syndrome is a syndrome of lateral facial clefting with mandibular anomalies, absent zygomas, microtia, lower eyelid colobomas, etc.

Velocardiofacial syndrome, also known as Shprintzen syndrome, is the 22q.11 deletion. This syndrome includes velopharyngeal insufficiency; congenital cardiac anomalies; facies with hypotonia, squared nasal root, narrow alar base, and floppy ears; and learning disabilities.

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104. A 24-year-old woman is brought to the emergency department after being involved in a motor vehicle collision. Physical examination shows multiple minor abrasions of the face. Clear rhinorrhea is noted. CT of the head shows a nondisplaced fracture of the posterior table of the frontal sinus. No other serious injuries are noted. The patient is admitted to the hospital, and antibiotic therapy is initiated. Which of the following is the most appropriate next step in management?
- A) Bed rest, head elevation, and observation
 - B) Cranialization of the frontal sinus
 - C) Craniotomy and repair of the dural tear
 - D) Lumbar puncture and drainage of spinal fluid
 - E) Obliteration of the frontal sinus

The correct response is Option A.

The patient described has a nondisplaced fracture of the posterior table of the frontal sinus with a cerebrospinal fluid (CSF) leak and should be treated with antibiotic coverage and maneuvers to facilitate spontaneous resolution of the leak. These include bed rest and head elevation greater than 30 degrees. If the CSF leak persists for more than four days, spinal drainage is recommended. Prolonged CSF leakage for longer than seven to 10 days requires craniotomy, repair of the dural laceration, and either obliteration of the sinus or cranialization.

In treating frontal sinus fractures, the involvement of the anterior sinus wall, posterior sinus wall, dural lining, and frontonasal duct are the major determinants of the type and extent of treatment.

Isolated anterior wall fractures without depression do not require surgical treatment. However, some authors recommend treatment with antibiotics for one week. In patients with isolated depressed anterior wall fractures, surgical correction to restore aesthetic contour is indicated. If there is frontonasal duct injury, the sinus mucosa is removed and the cavity is obliterated. During sinus obliteration, the mucosa usually is removed and the sinus is curettaged with a sharp periosteal elevator or a high-speed burr. The frontonasal duct can then be occluded with a pericranial flap or a bone graft and the sinus obliterated with autogenous fat, dermal fat, muscle, cartilage, bone, pericranial graft, Surgicel, bone wax, or other material.

Posterior table fractures without displacement, CSF leakage, or frontonasal duct involvement do not require surgical intervention but do require antibiotic treatment.

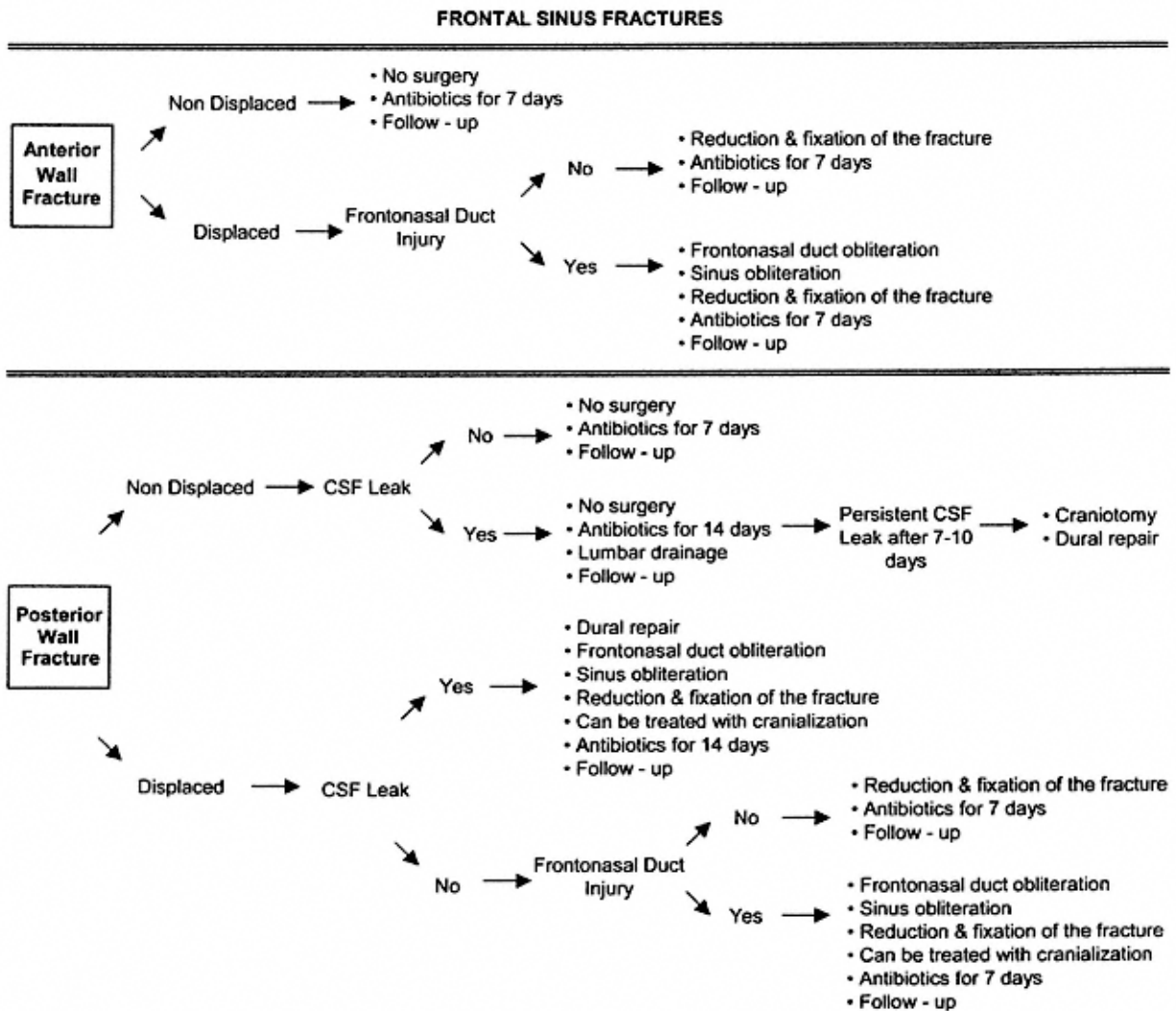
Posterior table fractures without displacement, but with CSF leakage, are initially treated conservatively as described above. Should the leakage persist for longer than 10 days despite measures to resolve spontaneously, a craniotomy with dural repair is required. This procedure is

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usually done in conjunction with neurosurgical colleagues. Displaced posterior wall fractures require exploration with repair of any dural tears and either sinus obliteration or cranialization. Cranialization involves removal of the entire posterior table, plugging of the frontonasal duct, repair of any dural lacerations, and separation of the intracranial cavity from the aerodigestive tract. The frontal lobe is then expected to fall into and fill the previous sinus cavity.

Although the specifics of treatment of frontal sinus fractures remain controversial, the illustration below shows a simple algorithm for treating these fractures.

Long-term follow-up with annual CT is required for all frontal sinus fractures.



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105. A 47-year-old man comes to the office for consultation about reconstruction following excision of a squamous cell carcinoma from the right mandibular angle and the body and floor of the mouth. The surgery entailed resection of the right hemimandible and dissection of the right neck. Which of the following is the most appropriate method of reconstruction?

- A) Osteocutaneous fibula flap
- B) Osteocutaneous radial forearm flap
- C) Osteocutaneous scapular flap
- D) Rectus flap with reconstruction plate

The correct response is Option A.

The patient described is set to undergo a right mandibular resection and right neck dissection. The simplest method of reconstruction is a right (ipsilateral to the recipient vessels) osteocutaneous fibula flap. This flap results in optimal placement of the pedicle vessels for microvascular anastomosis.

Unless osseous flaps are unavailable, a rectus flap with reconstruction plate should be avoided because of the high incidence of plate exposure after external beam radiation therapy.

A radial forearm flap would not provide adequate bone length for reconstruction of the defect described. Similarly, an osteocutaneous scapular flap lacks adequate bone stock for repair of such an extensive defect.

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106. Which of the following reference points are used in cephalometric analysis of the mandible?

- A) Glabella and subnasale
- B) Nasion and pogonion
- C) Orbitale and porion
- D) Orbitale and sella
- E) Sella and A point

The correct response is Option B.

“Nasion and pogonion” is the only option that has at least one point of reference on the mandible. A line drawn between the nasion and pogonion may be referred to as the facial axis plane, and it may be related to any of several other intersecting lines, such as the Frankfort horizontal (orbitale to porion) line, to evaluate the mandible. The sella, A point, and palatal plane are used to evaluate the position of the maxilla.

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107. At which of the following intraosseous locations is the inferior alveolar nerve farthest from the buccal cortex?

- A) Angle
- B) First molar
- C) Ramus
- D) Second premolar
- E) Third molar

The correct response is Option B.

The inferior alveolar nerve (IAN) is closest to the lingual cortex at the level of the first and second molars. The anatomy of the IAN is relevant in orthognathic and trauma surgery. The incidence of nerve transection during sagittal split osteotomy is 3.5% and usually occurs at the level of the third molar. Osteotomy design and chisel placement are based on knowledge of the anatomy of the IAN. The IAN enters the mandible on the medial side of the ramus approximately 10 mm below the sigmoid notch. It then courses through the canal that is closest to the buccal cortical plate in the region of the ramus and angle and down to the third molar; the average distance is 1.8 ± 1 mm. The nerve then swerves away at a position of 4.1 ± 1 mm from the buccal cortex as it passes the region of the first and second molars. As it traverses the mandibular body, it is lowest and closest to the inferior cortex (7.5 ± 1.5 mm) near its exit site at the level of the first molar and second premolar.

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108. A 12-year-old boy is brought to the emergency department because of double vision six hours after sustaining a blow to the eye with an elbow while jumping on a trampoline. He has had pain since the incident but has not had loss of consciousness. He had one episode of nausea and vomiting before arrival. Pulse rate is 45 bpm, respirations are 18/min, and blood pressure is 110/80 mmHg. Examination shows photophobia, periorbital ecchymosis, and restriction of extraocular motion. CT of the head shows a fracture of the orbital floor. Which of the following is the most appropriate time for surgical repair of the fracture?
- A) Emergently
 - B) 1 to 3 Days
 - C) 4 to 7 Days
 - D) 8 to 14 Days

The correct response is Option A.

Observation alone is not indicated for entrapment with nausea, vomiting, and oculocardiac reflex. Recent publications in the ophthalmologic literature emphasize the importance of urgent surgical intervention to prevent ocular muscle damage, improve postoperative function, and decrease the need for additional surgery.

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109. A young child with a birthmark develops severe thrombocytopenia and a coagulopathy. This syndromic presentation is associated with which of the following?

- A) Angiosarcoma
- B) Fast-flow vascular malformation
- C) Hemangioma
- D) Kaposiform hemangioendothelioma

The correct response is Option D.

Kasabach-Merritt syndrome accompanies kaposiform hemangioendothelioma.

Hemangiomas typically appear shortly after birth and then rapidly enlarge. This is followed by a longer period of slow involution. Vascular malformations, by contrast, are present at birth and then grow with the child. There is no involution. Arteriovenous malformations are subclassified as fast flow in nature, such as arteriovenous fistulae, or as slow-flow malformations, which are primarily venous in nature. Venous anomalies that are extremely large may cause a low-grade bleeding disorder, but this is a localized process and not defined as Kasabach-Merritt syndrome.

Angiosarcomas are uncommon malignant neoplasms characterized by rapidly proliferating, extensively infiltrating anaplastic cells derived from blood vessels and lining irregular, blood-filled spaces. Angiosarcomas are aggressive and tend to recur locally, spread widely, and have a high rate of lymph node and systemic metastases. The rate of tumor-related death is high.

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110. A 3-month-old female infant is being evaluated because of the abnormality shown in the photograph. The most likely cause of the abnormality is failure of which of the following prominences to merge?

- A) Mandibular with mandibular
- B) Maxillary with lateral nasal
- C) Maxillary with mandibular
- D) Maxillary with medial nasal
- E) Median nasal with median nasal

The correct response is Option E.

Incomplete merging of the median nasal prominences in the midline results in a median cleft (Tessier No. 0) as in the patient described. Failure of fusion of the maxillary prominence with the median nasal prominence results in a classic unilateral or bilateral cleft lip. Failure of the maxillary prominence to merge with the lateral nasal prominence will result in an oblique cleft (Tessier No. 3, 4, 5, or 6). Macrostomia (Tessier No. 7) results from failure of the maxillary and mandibular prominences to fuse. A mandibular cleft (Tessier No. 30) is a result of failure of the fusion of the mandibular prominences.

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111. Which of the following facial abnormalities is most characteristic of a patient with Treacher Collins syndrome?

- A) Oblique mandibular plane angle
- B) Orbital hypertelorism
- C) Negative overjet
- D) Positive overbite
- E) Vertical maxillary deficiency

The correct response is Option A.

Patients with Treacher Collins syndrome are classically characterized by malar hypoplasia secondary to a combination of Tessier Nos. 6, 7, and 8 clefts bilaterally. These patients also typically have a coloboma of the lower eyelid. They have an oblique mandibular plane angle with an anterior open bite. They have neither orbital hypertelorism nor vertical maxillary deficiency.

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112. A 17-year-old girl with Marfan syndrome comes to the office for an orthognathic evaluation. Intraoral examination shows a bilateral posterior lingual crossbite. Which of the following is the most appropriate management?

- A) Le Fort I osteotomy with palatal expansion
- B) Le Fort I osteotomy with palatal narrowing
- C) Mandibular osteotomy with narrowing
- D) Mandibular osteotomy with widening

The correct response is Option A.

Patients with Marfan syndrome typically have a high-arched and narrow palate resulting in a transversely constricted maxilla. Le Fort I osteotomy with palatal expansion is an appropriate surgical option for correcting the skeletal facial disharmony in the patient described.

Palatal narrowing would further worsen the skeletal problem.

Mandibular osteotomies are rarely performed to correct malocclusions based in the maxilla. However, if performed, they would generally be applied to narrow the mandible anteriorly.

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113. A 26-year-old woman comes to the office because she has had difficulty opening her mouth fully for the past three months. She says she has had “popping and clicking” in the temporomandibular joints (TMJs) with pain of varying severity for more than five years. Which of the following is the most likely cause of the internal derangement of the TMJs?

- A) Anterior dislocation with perforation
- B) Anterior dislocation with reduction
- C) Anterior dislocation without perforation
- D) Anterior dislocation without reduction

The correct response is Option D.

The patient has an anterior dislocation without reduction. “Popping and clicking” in the TMJs are due to an anterior relationship of the articular disc to the mandibular condyle. A reducible disc is associated with essentially normal range of motion as translation is allowed to occur. A nonreducible disc maintains an anterior position and does not allow translation to occur fully. Thus, hypomobility of the mandible results.

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114. A 6-year-old boy is evaluated because of severe pain on opening his mouth. One week ago, he hit his chin in a fall. Physical examination shows chin deviation to the right and premature contact of the molar region on the right. Facial radiographs are ordered. The most likely cause of these findings is fracture of which of the following segments of the mandible?

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

The correct response is Option C.

Mandibular condyle fractures are the most common facial fractures seen in children. In a recent review of more than 1250 pediatric maxillofacial fractures, condylar injuries constituted 34.9% of all mandible fractures; however, the angle (17.7%), body (14.9%), ramus (8%), and symphysis (9%) are also important sites of potential mandible fracture.

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115. In the developing embryo, the stapes is formed from tissues of which of the following visceral arches?

- A) First
- B) Second
- C) Third
- D) Fourth
- E) Fifth

The correct response is Option B.

The first visceral arch ultimately forms the malleus, incus and the structures of the mandible. The second arch forms the stapes, the styloid and the facial musculature. The third arch forms the stylopharyngeus. The fourth, fifth and sixth arches contribute to the pharyngeal and laryngeal muscles as well as the thyroid cartilage.

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116. A 31-year-old woman comes to the office with her husband for consultation about the risk that their child will have a cleft lip deformity. Neither of them have a cleft lip deformity, but they have a 2-year-old child with an isolated unilateral cleft lip deformity. Which of the following percentages best represents the risk that this couple will have another child with a cleft lip deformity?

- A) 2%
- B) 4%
- C) 9%
- D) 15%
- E) 22%

The correct response is Option B.

The genetics of the cleft lip (CL) deformity, with or without a cleft palate (CL/P) or an isolated cleft palate deformity (CP), are complicated and do not follow a typical mendelian inheritance pattern. The cause is thought to be multifactorial, involving both genetic and environmental factors. Most researchers agree that there is a genetic component to the development of the CL/P or CP deformities. This is supported by studies in cleft monozygotic twins, in whom the concordance rate is 30% to 60% compared with 1% to 4.7% in dizygotic twins. Families with a member with a CL/P or CP deformity have a higher risk than the general population of having another child with a similar deformity. The increased risk is outlined in the table below.

Family Members	CL and CL/P	CP
One child with a deformity	4%	2%
One parent with a deformity	4%	6%
One parent and one child with deformities	17%	15%
Two children with deformities	9%	

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117. A 16-year-old girl who has had repair of bilateral cleft lip, nose, and palate, and a pharyngeal flap has the occlusion shown in the photograph and radiograph. She has 12 mm of negative overjet. Cephalometric evaluation shows no mandibular abnormalities. Which of the following is the most appropriate procedure for aesthetic correction of the malocclusion?

- A) Le Fort I maxillary advancement
- B) Le Fort I maxillary distraction osteogenesis
- C) Mandibular setback with advancement genioplasty
- D) Segmental maxillary advancement
- E) Two-jaw maxillary advancement and mandibular setback

The correct response is Option B.

For children with orofacial clefting and severe Class III malocclusion, maxillary advancement is the procedure of choice. When there is a large maxillary move to be performed (greater than 6 to 8 mm), and there has been prior surgery resulting in scarring in the region (cleft lip, cleft palate, alveolar bone graft, pharyngeal flap), large movements of the maxilla are challenging and result in significant relapse. In addition, when there is normal shape and position of the mandible, surgery on the mandible is not indicated. Historically, because of the difficulty in performing the large required movements of the maxilla, the “difference” of movement would be shared

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between the maxilla and mandible. For a 12-mm movement, 6 mm of anterior movement of the maxilla would be performed, and the mandible would be set back 6 mm. Today, with the option of mid-face distraction, the appropriate aesthetic large movements of the maxilla can be performed to spare unnecessary surgery on the mandible.

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118. A 42-year-old man is brought to the emergency department 30 minutes after sustaining trauma to the face in a motor vehicle collision. Physical examination shows periorbital ecchymoses on the right, malar flattening, and enophthalmos. Neurologic examination shows numbness on the upper right lip. Radiographs show a displaced zygomaticomaxillary complex fracture. Anatomic reduction of each of the following is required in this patient EXCEPT

- A) greater wing of the sphenoid
- B) inferior orbital rim
- C) nasomaxillary buttress
- D) zygomaticofrontal suture
- E) zygomaticomaxillary buttress

The correct response is Option C.

Approximately 15% to 22% of patients with orbital fractures develop enophthalmos because of increased bony intraorbital volume. This is most frequently associated with a zygomaticomaxillary complex fracture that has not been reduced adequately. It is critical that an anatomic reduction be obtained to prevent the development of this difficult late complication. It is also critical that appropriate anatomic reduction of the greater wing of the sphenoid and lateral wall of the orbit is obtained after reduction of a fracture of the zygomaticomaxillary complex. Correct reduction of the inferior orbital rim, zygomaticofrontal suture, and zygomaticomaxillary buttress is also important but does not ensure the reduction of the lateral wall. The surgeon must therefore verify that the complete reduction of all structures has been performed. Reduction of the nasomaxillary buttress is not typically involved in this type of fracture pattern.

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119. A 74-year-old man comes to the office because he has had a painful sore in his mouth for the past three months. Physical examination shows a 3-cm ulcerative lesion of the base of the tongue on the left and a 4-cm node in Zone II of the left side of the neck. Biopsy of specimens from the lesion shows squamous cell carcinoma. No distant metastases are noted. Which of the following is the most accurate TNM staging of this tumor?

- A) T1 N2a M0
- B) T1 N3 M0
- C) T2 N1 M0
- D) T2 N2a M0
- E) T3 N2a M0

The correct response is Option D.

Tumors of the oral cavity and oropharynx are staged according to the TNM (tumor, node, metastasis) system. The mobile tongue (anterior to the circumvallate papillae) is part of the oral cavity, whereas the base of the tongue is part of the oropharynx. A tumor with dimensions greater than 2 cm but less than 4 cm is stage T2. A single, 4-cm, mobile node is stage N2a.

Oral cavity and oropharynx:

- | | |
|-----|--|
| T1 | Tumor <2 cm |
| T2 | Tumor >2 but <4 cm |
| T3 | Tumor >4 cm |
| T4 | Tumor invades adjacent structures, such as cortical bone, tongue, skin, or soft tissue of the neck |
| | |
| N1 | One ipsilateral node: <3 cm |
| N2a | One ipsilateral node: >3 but <6 cm |
| N2b | Multiple ipsilateral nodes: <6 cm |
| N2c | Bilateral contralateral nodes: <6 cm |
| N3 | Any nodes >6 cm |
| M0 | No distant metastases |
| M1 | Presence of distant metastases |

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120. A 45-year-old man has persistent maxillary sinusitis subsequent to open reduction and internal fixation of pan-facial fractures and a failed course of antibiotics. Surgical enlargement of the ostium of the sinus is planned as a drainage procedure via an endoscopic approach. Direction of the endoscope into which of the following areas within the nasal cavity is most appropriate?

- A) Inferior concha
- B) Inferior meatus
- C) Middle meatus
- D) Superior concha
- E) Superior meatus

The correct response is Option C.

The natural ostium of the maxillary sinus is located in the middle meatus, corresponding with the posterior portion of the ethmoidal infundibulum. Relative to the sinus, the ostium is located high and toward the back of the medial wall of the sinus, which is suboptimal for drainage by gravity. However, studies show directional movement of the mucosal cilia inside the sinus toward the ostium. Maxillary antrostomy involves enlarging the natural ostium and resecting the uncinate process of the ethmoid with the assistance of endoscopes. The frontal sinus also drains into the middle meatus. The inferior meatus receives the draining orifice of the nasolacrimal duct at the junction of the anterior and middle thirds of the meatus. The superior meatus contains openings to the posterior ethmoidal cells and the sphenoidal sinus. The sphenopalatine foramen is also located in the superior meatus and connects the nasal cavity with the pterygopalatine fossa. The inferior concha and the superior concha do not contain ostia. They are curved bony structures that roof their respective meatus.

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121. Dermoid cysts of the nasal dorsum, anterior encephaloceles, and nasal gliomas are all thought to result from failed closure of which of the following structures?

- A) Anterior fontanelle
- B) Dorsum sellae
- C) Fonticulus frontalis
- D) Foramen rotundum
- E) Metopic suture

The correct response is Option C.

Failed closure of the fonticulus frontalis, an embryonic fontanelle between the inferior frontal bone and nasal bone, may result in three main types of midline anterior anomalies: nasal dermal sinus, anterior cephalocele, and nasal glioma. Although closure may be affected by various factors such as gender and race, the anterior fontanelle closes by 24 months in 96% of children. Forming the posterior boundary of the sella turcica, the dorsum sellae is formed by a square plate of bone ending with two tubercles, the posterior clinoid processes. The foramen rotundum, located in the anteromedial sphenoid bone, allows exit of the maxillary nerve (V2) and is never expected to seal. Premature closure of the metopic, or vertical forehead, suture may result in metopic craniosynostosis and trigonocephaly.

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122. An 18-year-old man is undergoing presurgical orthodontic therapy for a dentofacial skeletal deformity. A current photograph is shown. Orthognathic surgery is planned. Repositioning of the maxilla during this procedure may result in each of the following changes EXCEPT

- A) cephalic rotation of the nasal tip
- B) decreased width of the nasal alar base
- C) flattening of the upper lip
- D) obstruction of the nasal airway
- E) reduced exposure of the vermilion

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The correct response is Option B.

The patient shown has vertical maxillary excess as well as mandibular retrognathia. Le Fort I osteotomy with vertical impaction of the maxilla is necessary. Superior repositioning of the maxilla may result in several undesirable changes in nasolabial aesthetics, including increased width of the nasal alar base. Decrease in the width of the nasal alar base will not result from this procedure. Other possible nasal changes include cephalic rotation and increased projection of the nasal tip, reduction in the nasolabial angle, as well as flattening and shortening of the upper lip with resultant loss of visible vermilion.

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123. Which of the following fractures of the facial bones is most common during childhood?

- A) Frontal sinus
- B) Le Fort
- C) Nasal
- D) Orbital

The correct response is Option C.

Of the options listed, nasal fractures are the most common. However, in most pediatric series they fall second to mandibular fractures. In children, mandibular fractures have been reported at 32% to 65%, nasal fractures at 12% to 45%, Le Fort fractures 2% to 8%, and orbital fractures 14% to 16%. Frontal sinus fractures are rare, except in late teenage years when pneumatization of the sinus is approaching its completion.

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124. A 12-year-old girl is brought to the emergency department after she sustained injuries in a motor vehicle collision. Physical examination shows extensive lacerations of the right medial orbit and forehead (shown) with complete transection of the medial canthal tendon (MCT). For effective reattachment of the MCT with transnasal wiring, which of the following is the most appropriate direction of resuspension of the tendon in relation to the anterior lacrimal crest?

- A) Anterior and inferior
- B) Anterior and superior
- C) Directly horizontal
- D) Posterior and inferior
- E) Posterior and superior

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The correct response is Option E.

The medial canthal tendon (MCT) consists of three limbs: 1) a prominent anterior limb that inserts medially on the anterior lacrimal crest, 2) a thinner posterior limb that attaches to the posterior lacrimal crest, and 3) a vertical limb of fascia that inserts on the medial orbital rim inferior to the nasal frontal suture. The resultant vectors of these attachments suggest that resuspension of the entire complex of the MCT following disruption should be posterior and superior to the anterior lacrimal crest.

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125. A 6-year-old boy with hemifacial microsomia undergoes mandibular distraction. Which of the following is the correct sequence of phases in distraction osteogenesis of the mandible?

- A) Activation, consolidation, latency
- B) Activation, latency, consolidation
- C) Consolidation, latency, activation
- D) Latency, activation, consolidation
- E) Latency, consolidation, activation

The correct response is Option D.

The correct sequence of phases in distraction osteogenesis of the mandible is latency, activation, and consolidation. Latency is the period immediately following the corticotomy and application of the distraction device. It ranges from one to seven days, during which no movement of the bony segments occurs. After the latency phase is the activation phase, during which the distraction device is turned to lengthen the gap between the bones by 1 mm/d. This is typically done with one 0.5-mm turn twice daily. After the device has been activated to achieve the desired lengthening, the consolidation phase begins. During this time, the device is left in place but not activated. The consolidation phase is generally twice the number of days necessary for the activation phase.

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126. Which of the following regions of the adult mandible has the highest incidence of fracture?

- A) Angle
- B) Body
- C) Coronoid
- D) Ramus
- E) Symphysis

The correct response is Option A.

The angle of the mandible has the highest incidence of fracture—up to 30%. Incidence of fracture is 15% to 20% for the body and parasymphysis. The presence of an isolated symphyseal or parasymphyseal fracture should alert the surgeon to the possibility of a second fracture near the angle.

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127. A 50-year-old woman comes to the office because she has a two-week history of left-sided facial weakness. She also has had painless swelling of the left cheek for six months. On examination, a left parotid mass is palpated. Fine-needle aspiration biopsy of the specimen shows few malignant epithelial cells. Which of the following is the most likely diagnosis?

- A) Adenocarcinoma
- B) Adenoid cystic carcinoma
- C) Carcinoma expleomorphic adenoma
- D) Mucoepidermoid carcinoma
- E) Squamous cell carcinoma

The correct response is Option D.

The parotid gland is the most common site for salivary gland tumors. Approximately 70% of salivary gland tumors occur in the parotid gland; approximately 75% of all parotid tumors are benign, and the remainder are malignant. The most common benign tumor of the parotid is a pleomorphic adenoma. The most common malignant neoplasm of the parotid gland for both adults and children is mucoepidermoid carcinoma (29.3% to 43.5% of all malignant salivary gland tumors). The histology of mucoepidermoid carcinoma may include both epithelial cells and mucinous cells, but, with higher histologic grades, the presence of mucinous cells is scant or absent.

The incidence of other salivary gland malignancies, such as adenocarcinoma (14%), adenoid cystic carcinoma (20%), carcinoma expleomorphic adenoma (5%), and squamous cell carcinoma (8%), is less overwhelming and therefore statistically less likely.

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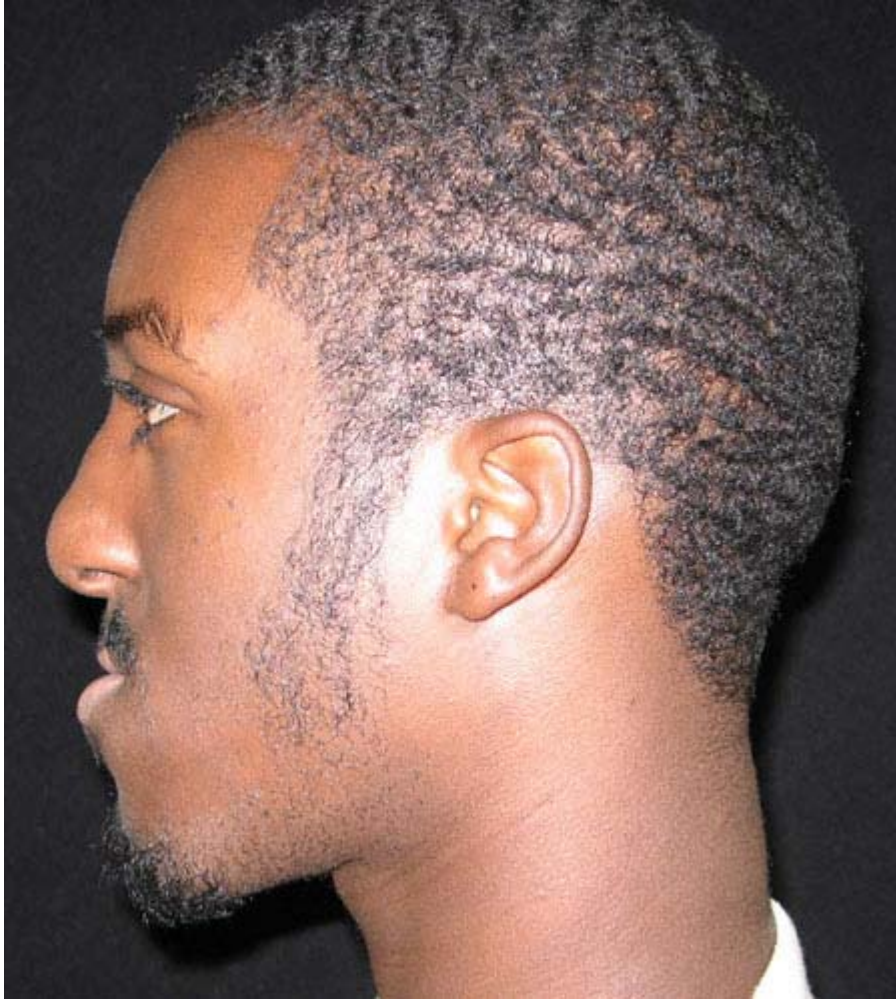
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128. A 25-year-old man who underwent repair of unilateral cleft lip and palate comes to the office for consultation regarding a dentofacial deformity. On cephalometric analysis, the SNA angle is 70 degrees (N 81.2 degrees), the SNB angle is 80 degrees (N 77.3 degrees), and 18-mm negative overjet is noted. Which of the following is the most appropriate management for correction of this deformity?

- A) Le Fort I advancement and jumping genioplasty
- B) Le Fort I advancement and sagittal split osteotomy advancement
- C) Le Fort I advancement and sagittal split osteotomy setback
- D) Le Fort II advancement
- E) Le Fort III advancement and mandibular setback

The correct response is Option C.

The patient shown below has maxillary retrusion and mandibular prognathism, which is most appropriately treated with a maxillary (Le Fort I) advancement and a sagittal split osteotomy (mandibular setback). The Angle class III malocclusion is demonstrated in photograph, and cephalometric analysis shows overprojection of the mandible and underprojection of the maxilla. Le Fort I advancement also could be attempted but would be difficult for such a discrepancy in occlusion; bimaxillary prognathism would result.



(Please note that this pictorial appears in color in the online examination)

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129. Interorbital distance is most accurately determined by measuring the distance between which of the following structures?

- A) Anterior lacrimal crests
- B) Inferior orbital fissures on a plain anteroposterior cephalogram
- C) Lateral aspects of the medial canthi on standard anteroposterior photograph
- D) Pupils on a standard anteroposterior photograph
- E) Supraorbitale (SOr) — the most anterior point of the intersection of the orbital roof and its lateral contour

The correct response is Option A.

By convention, the interorbital distance is determined as the shortest distance between the medial walls of the orbit. This usually falls at the dacryon, which refers to the craniometric point at the junction of the anterior border of the lacrimal bone with the frontal bone. The normal distance is approximately 25 mm in women and 28 mm in men.

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130. A 1-year-old girl is referred to the office by her pediatrician for evaluation of a fused metopic suture noted incidentally on CT two weeks ago when the patient was examined after a fall. On physical examination, no abnormalities of eye position or forehead shape are noted. A metopic suture is palpable. Which of the following is the most appropriate initial management?

- A) Bicanthal advancement
- B) Endoscopic release of the suture
- C) Helmet band therapy
- D) Strip craniectomy
- E) Observation

The correct response is Option E.

Cranial vault sutures close in early adulthood, except for the metopic suture, which begins to close in early childhood. Metopic ridging alone, without hypotelorism, without forehead triangulation, and with normal development, is not an indication for surgery.

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131. According to Tessier's classification, a cleft involving both the nasal ala and medial canthus is classified as which of the following types?

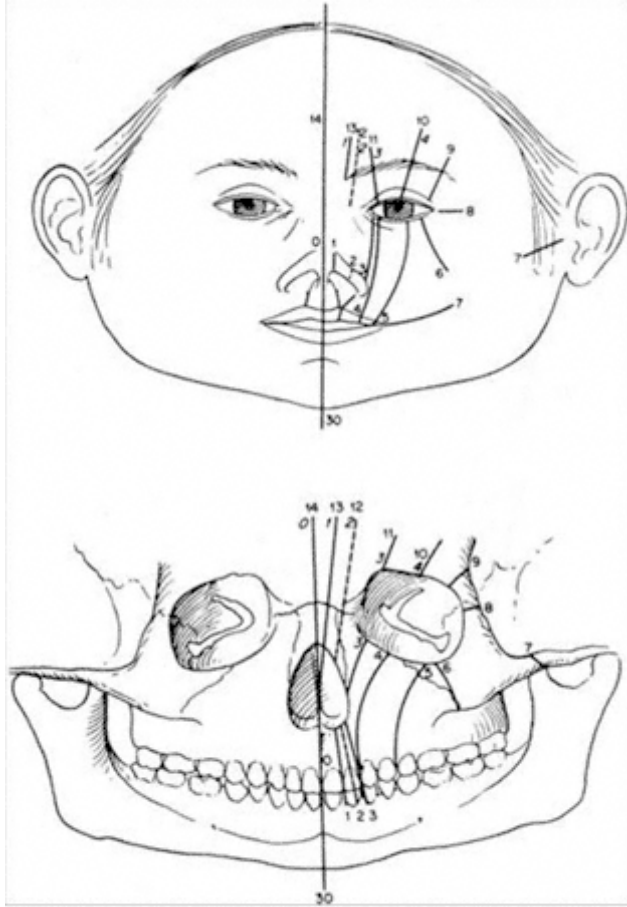
- A) No. 1
- B) No. 2
- C) No. 3
- D) No. 4
- E) No. 5

The correct response is Option C.

The Tessier No. 3 facial cleft goes through the lateral aspect of the nasal ala and into the region of the medial canthus. Typically, the nasolacrimal system is disrupted. This cleft is sometimes referred to as an oronasal-ocular cleft.

The No. 1 cleft begins in the cupid's bow and extends through the dome of the nasal ala. The No. 2 cleft lies lateral to the No. 1 cleft in the middle third of the alar dome; it does not involve the medial aspect of the eye. The No. 4 cleft does not involve the nose; instead, it often originates lateral to the cupid's bow and extends cephalically to the lower eyelid. The No. 5 cleft is relatively rare. It typically originates just medial to the lateral commissure and extends cephalically to the lateral aspect of the lower eyelid.

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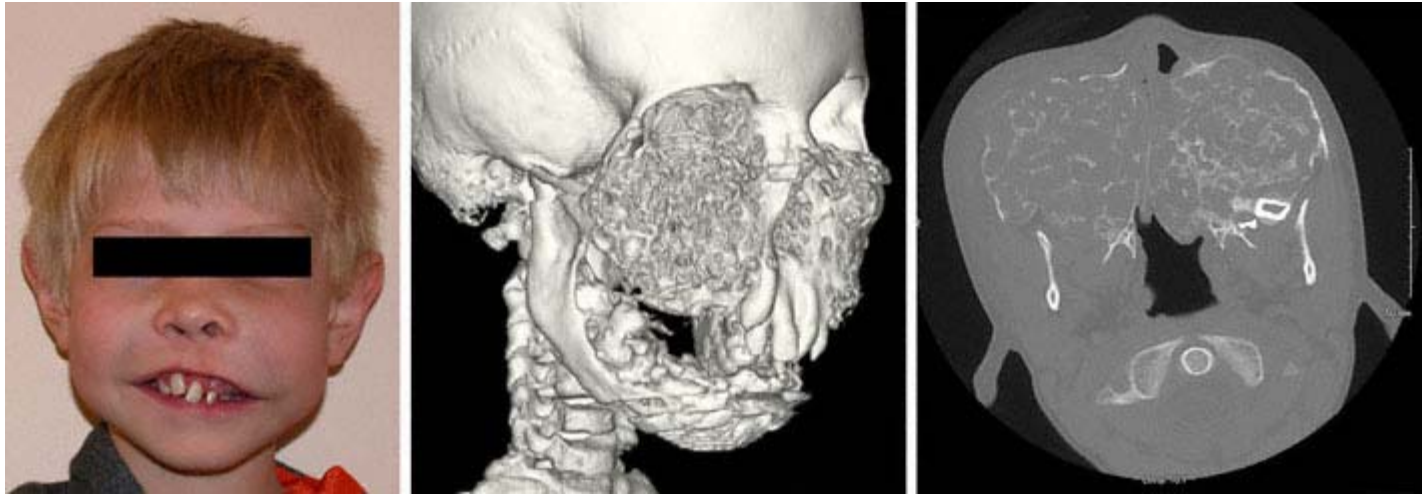


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Tessier P, Anatomical classification of facial, cranio-facial and
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132. A 10-year-old boy is brought to the office because he has had progressive enlargement of the face during the past two years. He now has difficulty chewing. A photograph, three-dimensional CT, and standard CT of the face are shown. Which of the following is the most likely diagnosis?

- A) Cherubism
- B) Monostotic fibrous dysplasia
- C) Osteomyelitis
- D) Romberg disease
- E) Treacher Collins syndrome

The correct response is Option A.

The patient described has cherubism. The disease is named for the cherub-like appearance of the cheeks and face. The fibro-osseous process involves the mandible and maxilla. Typically, it involves progressive infiltration and destruction of the craniofacial skeleton. It is benign and hereditary (autosomal dominant). Examination of biopsy specimens shows giant cell lesions.

Monostotic fibrous dysplasia is ruled out with the CT showing multiple foci of growth.

Romberg disease (progressive hemifacial atrophy) commences in adolescence or later and progresses with the classic coup de sabre deformity and affects both soft tissues and bone. Treacher Collins syndrome is a congenital abnormality of the embryonic derivatives of the first and second branchial arches and has a classic facial dysmorphic appearance.

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133. A 70-year-old woman is brought to the emergency department after a fall. Examination shows periorbital ecchymosis, epistaxis, and a bluish bulge of the septal mucosa. No other serious injuries are noted. CT shows fracture of the nasal septum. Which of the following is the most appropriate next step in management?
- A) Administration of intranasal oxymetazoline (Afrin)
 - B) Drainage of hematomas and resection of septal cartilage
 - C) Evacuation of hematomas through a direct incision
 - D) Nasal packing only
 - E) Needle aspiration of hematomas

The correct response is Option C.

Hematomas can develop between the septal mucoperichondrium and the cartilage in fractures and dislocations of the septum. Untreated septal hematomas may lead to septal perforation or fibrosis with eventual septal distortion, abscess, or complete septal necrosis with development of a saddle nose deformity. Prompt diagnosis and treatment of septal hematomas are essential to prevent such sequelae. Septal hematomas should be treated promptly with an L-shaped incision over the hematoma with thorough evacuation using suction and irrigation. This can be followed by loose repair of the incision to allow drainage and quilting sutures to prevent reaccumulation. It should be followed by internal nasal packing, systemic antibiotic coverage, and close follow-up to ensure absence of reaccumulation. Generally, although septal hematomas tend to be bilateral, they should not be incised on both sides because through-and-through septal perforation may occur. If the entire hematoma cannot be evacuated with a unilateral approach, the incisions on each side should be made at different levels.

Observation and administration of intranasal oxymetazoline (Afrin) spray are not appropriate treatment options because a persistent hematoma can result in significant morbidity. Resection of septal cartilage at the time of drainage should be avoided because septal perforation may occur. Needle aspiration can be used for small hematomas. However, it is not the treatment of choice and may require multiple attempts and extremely close follow-up to ensure resolution. Resection of septal cartilage at the time of drainage should be avoided because septal perforation may occur.

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134. A 1-month-old boy with Pierre Robin sequence is brought to the office for consultation regarding micrognathia. Physical examination shows posterior placement of the base of the tongue caused by displacement of the mandible. Attachment of which of the following muscles is the most likely cause of this finding?

- A) Anterior digastric
- B) Posterior digastric
- C) Genioglossus
- D) Geniohyoid
- E) Mylohyoid

The correct response is Option C.

Osteotomy of the mandible and application of distraction devices serves to move the distal segment of bone anteriorly. The base of the tongue reliably follows the chin point because of the attachment of the genioglossus muscle.

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135. The 6-month-old infant shown has dysmorphology consistent with which of the following diagnoses?

- A) Craniosynostosis
- B) Deformational plagiocephaly
- C) Hemifacial microsomia
- D) Orbital hypertelorism
- E) Romberg disease

The correct response is Option A.

This 6-month-old infant presents with the classic dysmorphology of left unilateral coronal (frontoparietal) craniosynostosis. This condition presents with an obvious ridging of the left coronal suture and retrusion of the ipsilateral forehead and superior orbital rim. There is a

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C-shaped deformity of the face, convex ipsilateral. The nasal root is deviated to the ipsilateral affected suture, and the ipsilateral eye is drawn superolaterally with the palpebral fissure open wider. The ipsilateral ear is also displaced inferiorly.

Hemifacial microsomia (craniofacial microsomia) presents with unilateral asymmetric facial features and may include a smaller or absent orbit, zygoma, and mandible. There is often an upward cant to the occlusion and ipsilateral oral commissure secondary to the mandibular microsomia. The ipsilateral ear is often malformed, and the deformity may range from minor anomalies to complete microtia with atresia. Hemifacial microsomia may present with bilaterality.

Romberg disease is an acquired craniofacial anomaly that most often presents either in infancy or early adolescence. Romberg disease is believed by some to be a variant of linear scleroderma. This presents often with discoloration of the scalp and forehead that progresses with a linear subcutaneous atrophy. The linear deformity has been referred to as the coup de sabre. The soft-tissue atrophy progresses and may begin to affect the underlying skeleton as well. The process progresses from two to 10 years usually and “burns itself out.” Conventional treatment has been to clinically follow these patients until the progressive unilateral atrophy ceases and then reconstruct the resulting defect with standard craniofacial techniques.

Orbital hypertelorism (OHT) usually is a physical finding of a larger clinical presentation, such as midline craniofacial clefting, frontal encephaloceles, frontonasal dysplasia, etc. OHT is defined as greater-than-normal bony orbital separation and is measured by cephalometric analysis: from dacryon to dacryon. OHT is found by clinically measuring the medial intercanthal distance (MICD) and subtracting 4 to 6 mm. OHT has been subdivided into first degree = MICD 30 to 34 mm, second degree = MICD 34 to 40 mm, and third degree = MICD greater than 40 mm.

In deformational plagiocephaly, there is an ipsilateral narrowing of the palpebral fissure with a lower eyebrow, an inferiorly positioned ipsilateral ear, and a normal nasal root and anterior fontanelle. The cranial vault looks compressed from forehead to opposite occiput.

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136. Which of the following foramina of the middle cranial fossa hosts passage of the oculomotor (III), trochlear (IV), and abducens (VI) nerves?

- A) Optic canal
- B) Ovale
- C) Rotundum
- D) Spinosum
- E) Superior orbital fissure

The correct response is Option E.

The foramen that allows passage of the oculomotor (III), trochlear (IV), and abducens (VI) cranial nerves is the superior orbital fissure, which is located at the orbital apex. This foramen also transmits the lacrimal, frontal, and nasociliary nerves; the sympathetic branches; the superior and inferior ophthalmic veins; the orbital branch of the middle meningeal artery; and the recurrent branch of the lacrimal artery. Hemorrhage or traumatic edema inside this foramen causes a unique collection of symptoms due to compression and loss of function of the traveling nerves, termed *superior orbital fissure syndrome*. The apex of the orbit also contains two other foramina: the optic canal, which transmits the optic (II) nerve and the ophthalmic artery, and the inferior orbital fissure, which allows passage of the infraorbital and zygomatic nerves. The foramen rotundum communicates between the middle cranial fossa and the pterygopalatine fossa. The maxillary division of the trigeminal (V) nerve is the only structure that passes through this foramen. The foramen ovale links the middle cranial fossa to the infratemporal fossa and transmits the mandibular division of the trigeminal nerve, the lesser petrosal branch of the glossopharyngeal (IX) nerve, the accessory meningeal branch of the maxillary artery, and an emissary vein. The foramen spinosum, located adjacent to the foramen ovale, also sits between the middle cranial and the infratemporal fossae. The foramen spinosum contains the meningeal branch of the mandibular division of the trigeminal nerve and the middle meningeal artery and vein.

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137. A 24-year-old man comes to the office with his wife to request information about their risk for having a child with cleft lip and palate. The man underwent repair of an isolated cleft lip and palate in infancy. His mother also had an isolated cleft lip and palate and underwent removal of salivary gland pits from her lower lip. The patient's wife has no family history of cleft lip and palate. Which of the following percentages best represents the likelihood that this couple will have a child with a cleft deformity?
- A) 5
 - B) 10
 - C) 25
 - D) 50
 - E) 80

The correct response is Option D.

Families with van der Woude syndrome (cleft lip/palate and lip pits) are known to have an autosomal dominant clefting mutation. The patient described has a 50% chance of transmitting the cleft locus to a child. Similar mendelian genetic models would apply to other scenarios.

Although there are cases in which clefting is not transmitted in an autosomal dominant or recessive fashion, most cases of isolated cleft lip/palate follow a multifactorial model of genetic transmission.

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138. A 30-year-old woman sustains a nasoethmoid fracture in a motor vehicle collision. Radiographs of the fracture site show extensive fracture comminution that extends into the point of insertion of the medial canthal tendon. Transnasal medial canthopexies are to be performed for fracture fixation. The classification of this fracture is Markowitz and Manson type 3. Which of the following is the most appropriate management?
- A) External nasal splint fixation
 - B) Kirschner wire fixation
 - C) Rigid plate fixation
 - D) Transnasal wiring

The correct response is Option D.

The Markowitz and Manson system is used to classify nasoethmoid fractures according to the status of the bone fragment into which the medial canthal tendon inserts. In a type 1 fracture, there is a large central fragment. The fragment can be reduced and a plate can be applied to stabilize the nasoethmoid region. Type 2 fractures exhibit comminution of the central fragment, but the point of insertion of the medial canthal tendon remains intact. Patients with type 3 fractures have extensive comminution of the segment that extends into the point of tendon insertion. Because stabilization with a plate is not possible due to the lack of bone, transnasal canthopexy is typically required to stabilize the medial canthal tendon.

Nasoethmoid fractures can be classified further according to whether they are unilateral or bilateral and their extension into other areas of the facial skeleton (see the figures below).



Fig. 1. Complete type 1 injury. Bilateral single-segment injuries displaced at the articulation with the frontal bone.



Fig. 2. Type 2 injury. Bone fractures do not extend into the area of canthal insertion.

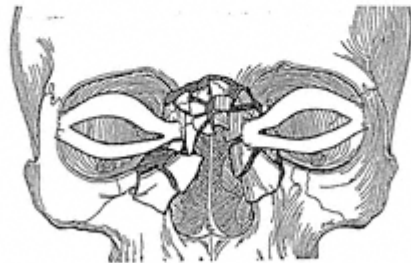


Fig. 3. Type 3 injury. Bone fractures extend into the bone providing canthal insertion. Management of the injury requires canthal detachment and reattachment in order to perform the reduction.

Figures adapted with permission from Markowitz BL, Manson PN, Sargent L, et al. Management of the medial canthal tendon in nasoethmoid orbital fractures: the importance of the central fragment in classification and treatment. *Plast Reconstr Surg*. 1991;87:843-853.

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139. Which of the following is involved in the initial cascade of bone healing?

- A) Monocyte
- B) Neutrophil
- C) Osteoblast
- D) Osteoclast
- E) Platelet

The correct response is Option E.

Within seconds of a fracture, a series of events that regenerate the continuity and function of a fractured (or cut) bone begins. The initial critical player is the platelet. Platelets are indispensable storehouses for growth factors. Following fracture or osteotomy, platelets initiate hemostasis of the clotting cascade. The hematoma condenses over the next three to five days, and the alpha granules of platelets release platelet-derived growth factor, fibroblast growth factor, and transforming growth factor- β . These growth factors are used in the next phases of bone healing.

Osteoclasts and osteoblasts are used during bone remodeling. Osteoclasts develop a “cutting core” that will resorb older bone. Osteoblasts release factors, such as alkaline phosphatase, leading to new bone deposition. Irregularities in osteoblast and osteoclast function can lead to diseases such as fibrous dysplasia.

Monocytes guide soft-tissue wound healing.

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140. A newborn girl is evaluated because she has facial anomalies. Examination shows bicoronal synostosis, mid-face hypoplasia, and complex syndactyly of the hands and feet. Genetic screening of the infant's blood is most likely to show anomalies in the receptor for which of the following growth factors?

- A) Epidermal growth factor (EGF)
- B) Fibroblast growth factor (FGF)
- C) Platelet-derived growth factor (PDGF)
- D) Transforming growth factor (TGF)- α
- E) TGF- β

The correct response is Option B.

Premature closure of the skull bones leading to facial distortion with a usually tall skull and fusion of the fingers and toes, known as syndactyly, are the major features of Apert syndrome (AS). Another name for this disorder is acrocephalosyndactyly. A French physician, Apert, first reported the syndrome that bears his name in 1906. He detailed the skull malformation, mid-face hypoplasia (underdevelopment), and hand abnormalities. Apert syndrome, which is an autosomal dominant disorder, is sporadic in most cases. Two unique mutations in the fibroblast growth factor (FGF) receptor 2 gene located on chromosome 10 were discovered in 1995. This gene directs the development of bone formation.

TGF- β is a multifunctional peptide that controls proliferation, differentiation, and other functions in many cell types. For example, TGF- β 3 has been associated with scarless wound healing in mice. TGF- α is upregulated in some human cancers. Produced in macrophages, brain cells, and keratinocytes, it induces epithelial development. It is closely related to EGF and can bind to the EGF receptor with similar effects. TGF- α stimulates neural cell proliferation in the adult injured brain. PDGF is active in wound healing.

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141. Which of the following muscles controls depression and protrusion of the mandible?

- A) Buccinator
- B) Digastric
- C) Lateral pterygoid
- D) Masseter
- E) Temporalis

The correct response is Option C.

The muscles of mastication are involved in the process of biting and chewing. These are all inserted upon the mandible and innervated by the mandibular division of the trigeminal (V) nerve. The lateral pterygoid muscle originates from the greater wing of the sphenoid, the inferotemporal crest, and the lateral pterygoid plate and inserts on the neck of the mandibular condyle and articular disc of the temporomandibular joint. Its action is to depress, protrude, and move the mandible from side to side. The masseter muscle originates from the zygomatic arch and inserts on the mandibular angle, ramus, and condyle. Its action is to close the jaw. The medial pterygoid muscle originates on the medial aspect of the lateral pterygoid plate of the sphenoid in the tuberosity of the maxilla. It inserts on the medial surface of the ramus of the mandible and acts to close the jaw. The temporalis muscle originates from the temporal fascia and entire temporal fossa. It inserts on the coronoid process and the anterior border of the ramus of the mandible and acts to close and retract the jaw. The buccinator muscle is innervated by the facial nerve (VII). Although this muscle aids in mastication by compressing the cheek, thus holding food under the teeth, it is not considered a muscle of mastication.

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142. A 20-year-old man comes to the office for consultation regarding malocclusion. On physical examination, the mandibular incisors are anterior to the maxillary incisors. The mesial buccal cusp of the maxillary first molar lies distal to the buccal groove of the mandibular first molar. These findings are characteristic of which of the following Angle classifications?

- A) Angle class I
- B) Angle class II, division I
- C) Angle class II, division II
- D) Angle class III

The correct response is Option D.

Angle class I, or normal occlusion, is characterized as having the mesial buccal cusp of the upper first molar occluding in the buccal groove of the mandibular first molar. In Angle class II, both divisions I and II, the mandibular dentition is distal to its class I position. Class II, division 1 is lingually inclined, and Class II, division 2 is labially inclined. In Angle class III malocclusion, the mandibular molar is anterior to its normal position with the maxillary molar.

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143. A 46-year-old man comes to the office because he has pain in the jaw and trismus after being involved in a motor vehicle collision two days ago. Radiographs show a mandibular fracture. In adults, the normal range of vertical mandibular opening is closest to which of the following?

- A) 11 to 20 mm
- B) 21 to 30 mm
- C) 31 to 40 mm
- D) 41 to 50 mm
- E) 51 to 60 mm

The correct response is Option D.

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

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

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144. Which of the following nerves supplies sensation to the superior anterior aspect of the helix of the ear?

- A) Arnold
- B) Auriculotemporal
- C) Great auricular
- D) Greater occipital
- E) Lesser occipital

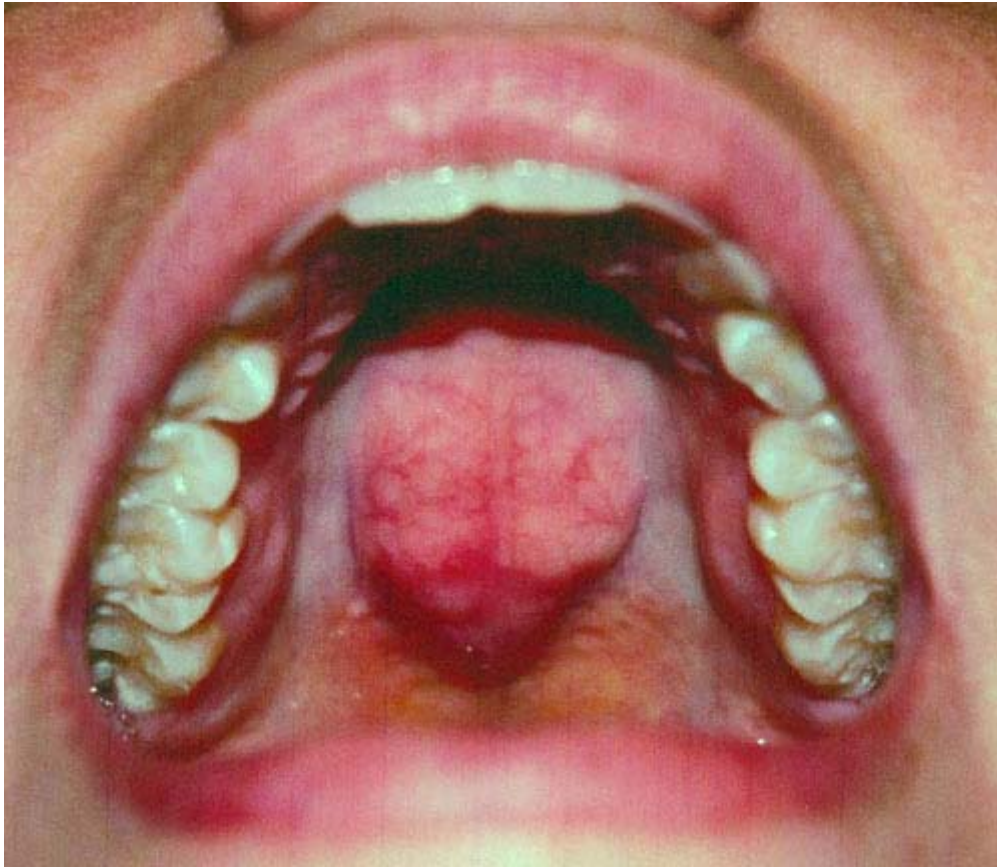
The correct response is Option B.

Sensation to the external ear is provided by the great auricular nerve, auricular branch of cranial (X) nerve (Arnold nerve), the auriculotemporal nerve, a branch of the mandibular branch of cranial (V) nerve (trigeminal nerve), and the lesser occipital nerve. Sensation to the superior anterior aspect of the helix is provided by the auriculotemporal nerve. The Arnold nerve provides sensation to the ear canal, whereas the posterior aspect of the external ear is provided by the lesser occipital nerve and most of the inferior two thirds of the external ear is provided by the great auricular nerve. The greater occipital nerve provides sensation to the skin and the posterior aspect of the scalp.

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(Please note that this pictorial appears in color in the online examination)

145. An otherwise healthy 15-year-old boy is brought to the office by his parents because he has had painless swelling of the hard palate for the past year. A photograph of his mouth is shown. Physical examination shows a lesion that is solid, firm, fixed, noncompressible, nontender, and covered with healthy palatal mucosa. Which of the following is the most likely diagnosis?
- A) Craniofacial fibrous dysplasia
 - B) Maxillary torus
 - C) Skull base glioma
 - D) Squamous cell carcinoma
 - E) Submucous cleft palate

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The correct response is Option B.

In an otherwise healthy young patient with a solid asymptomatic lesion consistent with bone on the hard palate, the most likely diagnosis is a maxillary torus or torus palatinus.

Maxillary and mandibular tori are benign osteoblastic tumors and tend to be well encapsulated, circumspect, submucosal, and expand gradually without invading adjacent structures. Torus palatinus occurs on the midline of the hard palate and requires treatment only if it becomes symptomatic or interferes with function.

Fibrous dysplasia is a benign tumor of bony origin that may present as a component of McCune-Albright syndrome (polyostotic fibrous dysplasia) or as a localized condition of the craniofacial skeleton, usually the upper facial skeleton. An isolated palatal occurrence of fibrous dysplasia would be highly unlikely.

Gliomas are believed to be encephaloceles that have lost their intracranial connections. External gliomas usually appear at or just lateral to the nasal root as reddish, firm, noncompressible, lobular lesions with cutaneous telangiectasia. They do not transilluminate or pulsate. Skull base gliomas are usually intranasal, and while potentially being associated with bony defects, would not present in this fashion.

Although squamous cell carcinoma frequently presents as an intraoral mass, it is not the most likely diagnosis in a healthy, young patient with a hard bony lesion of the palate.

Submucous cleft palates present with bifid uvulas, a bony notch or defect at the edge of the hard palate, and a zona pellucida, or thin, bluish, strip of mucosa in the midline of the soft palate secondary to diastasis of the levator muscle.

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146. A 5-year-old girl is brought to the office because she has had a three-month history of progressive asymmetry around the right orbit. She had a “black eye” following a blow to the right eye six months ago. The bruise resolved in seven days without treatment. Physical examination shows 5 mm of vertical orbital dystopia with pulsatile exophthalmos. Which of the following is the most likely diagnosis?

- A) Growing skull fracture
- B) Nonhealed zygoma fracture
- C) Orbital tumor
- D) Periorbital cellulitis
- E) Retrobulbar hematoma

The correct response is Option A.

A growing skull fracture results from a skull or orbital fracture that is associated with a partial dural disruption. The growing and pulsatile brain herniates through the dural disruption, creating a leptomeningeal cyst. The fracture does not heal; it separates or “grows.” Growing skull fractures commonly occur in the skull base/orbital roof and result in vertical orbital dystopia and vertical descent of the globe with subsequent remodeling of the zygoma. Reconstruction includes reduction and correction of the leptomeningeal cyst, dural reconstruction, and correction of the bony defects with autogenous bone grafts.

A nonhealed zygoma fracture also could present in the same manner as in the scenario described but would not worsen slowly and would likely be noted immediately after trauma. Pulsatile exophthalmos is not usually found with a zygoma fracture.

An orbital tumor could present in the manner described but, given the history, is less likely.

Periorbital cellulitis does not present in the manner described. It is associated with a relatively rapid erythema, fever, and other clinical signs of infection.

A retrobulbar hematoma, although it may potentially result in globe displacement, is an acute process that would not likely develop six months after the injury.

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147. A 37-year-old man is brought to the emergency department one hour after he sustained injuries to the face in a motor vehicle collision. Physical examination shows lacerations around the bridge of the nose and mobility of the bony pyramid. Radiographs show a fracture of the nasal bones. Absence of sensation of the nasal septum and lateral nasal wall is noted. This patient has most likely sustained injuries to which of the following nerves?

- A) Anterior ethmoidal
- B) Frontal
- C) Infraorbital
- D) Infratrochlear
- E) Lacrimal

The correct response is Option A.

The ophthalmic branch or first division of the trigeminal nerve enters the orbit via the superior orbital fissure. The three sensory branches include the lacrimal, frontal, and nasociliary nerves. The nasociliary nerve courses above the optic nerve and below the superior rectus muscle. Its first branch is the posterior ethmoidal nerve, which provides sensation to the posterior ethmoid sinuses. The terminal branches of the nasociliary nerve are the anterior ethmoidal nerve and the infratrochlear nerve. The former exits via a foramen of the same name, and ultimately reaches the roof of the nose, providing sensation to the septum and lateral wall. Its terminal branch, the dorsal nasal nerve, supplies innervation to the tip.

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148. A 17-year-old boy is referred for consultation about correction of a bilateral crossbite deformity. The patient has an otherwise normal facial profile. A lateral cephalogram taken with the mouth in repose indicates 2 mm of maxillary incisor show. Which of the following best describes this finding?

- A) Horizontal maxillary deficiency
- B) Horizontal maxillary excess
- C) Normal incisor display
- D) Vertical maxillary deficiency
- E) Vertical maxillary excess

The correct response is Option C.

Incisor display of 1 to 4 mm is considered normal.

Horizontal maxillary discrepancies generally are noted in conjunction with posterior crossbites. The horizontal maxillary deficiency is the most common transverse maxillary discrepancy. Horizontal maxillary excess is unusual and would be cause for evaluating the mandible for transverse deficiency.

Lack of incisor display in repose generally indicates vertical maxillary deficiency. Incisor display of greater than 4 mm, especially in male patients, is considered to be associated with vertical maxillary excess. Up to 5 mm of incisal show is considered aesthetically acceptable in female patients. When smiling, the entire clinical crown is normally displayed from the gingival enamel junction to the incisal edge. More or less display with smiling may also be associated with vertical maxillary excess or deficiency.

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149. A 24-year-old man is brought to the emergency department one hour after he sustained injuries to the face and head in a motor vehicle collision. Physical examination shows a 5 × 1.5-cm laceration of the forehead, ecchymosis over the glabellar region, and watery nasal discharge. CT of the head shows a fracture of the frontal sinus. Which of the following findings on analysis of the nasal discharge confirms cerebrospinal rhinorrhea?

- A) Alpha fetoprotein
- B) Beta-2 transferrin
- C) Glucose
- D) Halo sign
- E) Potassium

The correct response is Option B.

The most common clinical finding in a frontal sinus fracture is a laceration of the forehead. Any hematoma or ecchymosis in the glabellar region may indicate serious injury. Part of the evaluation for a frontal sinus fracture includes examining the nose for cerebrospinal fluid (CSF) leak. There are multiple modalities to evaluate for the presence of CSF leak, including the halo sign, which demonstrates a halo effect on filter paper from the draining spinal fluid, evaluation of the fluid for glucose, total protein, or electrolytes. Although all of these are possible, they lack in sensitivity and specificity. The best method of evaluating for CSF rhinorrhea is beta-2 transferrin. Beta-2 transferrin is a protein produced by neuroaminidase activity in the brain, which is uniquely found in the CSF and perilymph of the central nervous system. Beta-2 transferrin is absent in other body secretions. Therefore, its detection is invaluable in diagnosing a CSF leak. Rhinorrhea containing beta-2 transferrin does not, however, demonstrate the location of the CSF leak. This is confirmed either operatively or radiologically using high-resolution CT and magnetic resonance cisternography. Alpha fetoprotein is used as a serum marker in hepatocellular carcinoma and nonseminomatous germ cell tumors but is not used to identify CSF leaks.

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150. A 60-year-old man comes to the office for consultation regarding a 1.5-cm squamous cell carcinoma of the lower lip and commissure without regional or distant disease. The patient chooses to undergo radiation therapy using 5000 cGy fractionated over six weeks. Which of the following best represents the effectiveness of this treatment in achieving a disease-free state?
- A) 35%
 - B) 50%
 - C) 65%
 - D) 80%
 - E) 95%

The correct response is Option E.

Treatment of cancer of the lip up to 2 cm with radiation therapy is very effective, reaching cure rates of 90% to 95%. These rates are similar to cure rates with surgical excision. With increased tumor burden, the success of radiotherapy lessens to 75% to 80% for T2 lesions and to 40% for T3 and T4 lesions with involvement of the regional lymph nodes. Radiation therapy should be discussed as an alternative treatment in patients with superficial lip cancer that spreads over more than one third of the lip, cancer that involves the commissure, or recurrent cancers, and in patients who are unable or unwilling to undergo surgery.

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Section 4: Hand

151. A 35-year-old man comes to the office for evaluation of purulent drainage from the surgical wound one year after open reduction and internal fixation of tibia and fibula fractures sustained in a motorcycle collision. Radiographs show osteomyelitis and nonunion of tibia and fibula fractures. He is taken to the operating room for debridement of scarred and fibrotic soft tissue, removal of hardware, and application of external fixation. A cutaneous scapula free flap is used to close an 8-cm defect. Intravenous antibiotics are initiated and continued for six weeks. Three months later, the purulent drainage recurs. Which of the following is the most likely cause of treatment failure?
- A) Flap closure was under tension
 - B) Inadequate antibiotic therapy
 - C) Inadequate bone debridement
 - D) Use of a cutaneous scapula free flap rather than a muscle free flap
 - E) Use of a one-stage rather than a two-stage procedure

The correct response is Option C.

Lower extremity osteomyelitis following trauma is a challenging problem with high complication rates. The key to success is adequate debridement of both bone and soft tissue followed by coverage with vascularized tissue. The patient described had debridement of soft tissue but not bone. The bone is a persistent source of infection and the scarred fibrotic soft tissue is poorly vascularized, thus crippling the immune response. Without adequate bone debridement, early recurrence is likely. Muscle flaps fill the resultant defect, enhance blood flow, and improve immunologic defense against microorganisms.

The scapula flap can easily provide skin paddles of 10×15 cm; therefore, closure under tension would not be a problem.

A bone biopsy is helpful in identifying the bacteria and choosing the best antibiotic, but it does not substitute for bone debridement.

Though muscle flaps are generally more effective in the treatment of osteomyelitis than cutaneous flaps, many authors have demonstrated that well-vascularized skin flaps can be successful.

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Many authors have demonstrated success with one-stage reconstructions for traumatic osteomyelitis. Again, success is dependent upon performing adequate bone and soft-tissue debridement followed by a well-vascularized flap.

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152. A 45-year-old woman who is employed as a physician is brought to the emergency department three hours after sustaining a ring avulsion injury to the ring finger of the nondominant left hand. Examination of the amputated part shows avulsion of digital vessels at the level of the proximal phalanx and avulsion of bone at the level of the distal interphalangeal joint. Which of the following is the most appropriate initial step in management?

- A) Amputation at the level of the metacarpophalangeal joint
- B) Amputation at the level of the proximal interphalangeal joint
- C) Coverage with a radial forearm flap
- D) Ray amputation
- E) Replantation

Please note: Question 152 has been deleted from the examination.

The correct response is Option E.

Ring avulsion injuries are severe and involve components of amputation and avulsion. Before the common use of microsurgery, these injuries were treated with amputation. Because of the severity of these injuries, debate continues as to whether they are best treated by amputation or attempted replantation. The consensus is that attempted replantation should be performed. A higher success rate is achieved when more than one vein is reconstructed and, if possible, two arteries are reconstructed. Overall, a successful replantation rate of 80% has been associated with ring avulsion injuries. Patients with a normal proximal interphalangeal (PIP) joint and intact flexor superficialis tendon are good candidates for replantation.

Replantation of the digit is more likely to maintain the grip strength of the hand than the other reconstructive options listed. Coverage with a radial forearm flap would not allow normal sensation of the hand and is a much less desirable reconstruction method. Although thin, this flap is significantly bulkier than a normal digit. Amputation at the PIP joint in this digit would not have viable coverage. Amputation at the metacarpophalangeal level and ray amputation are appropriate choices if replantation fails. Studies have shown that both procedures result in a decreased grip force compared to a successful replantation.

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153. A 54-year-old man comes to the office because he has a two-year history of difficulty straightening the small finger of the dominant right hand. He reports that the finger “catches” when he puts on gloves or reaches into his pockets. He has no history of serious illness. Physical examination shows firm cords extending along the palmar surface of the small finger axis and the ulnar border of the proximal phalanx. Flexion contracture of the metacarpophalangeal (MCP) joint is 30 degrees, and flexion contracture of the proximal interphalangeal (PIP) joint is 65 degrees. Palmar/digital fasciectomy with complete correction of the PIP joint contracture is planned. Which of the following best describes the long-term outcome of both joints?

	MCP	PIP
A)	Good	Good
B)	Good	Poor
C)	Poor	Good
D)	Poor	Poor

The correct response is Option B.

Treatment of the PIP joint flexion contracture in Dupuytren disease can be difficult and often unsatisfying because early (within one to three years) partial recurrence is common. Adding to this frustration is the failure of recurrent PIP joint disease to respond to therapy and splinting as effectively as MCP joint recurrences.

Primary treatment of PIP joint Dupuytren contractures often results in incomplete correction; this also stands in contrast to the complete correction typically obtained at the MCP joint.

Recurrent PIP joint disease may require more aggressive management, including more extensive joint release (accessory collateral ligaments, palmar plate/check rein ligaments, flexor sheath) and possible dermatofasciectomy with full-thickness skin graft reconstruction. Outcomes from reoperation are guarded, and arthrodesis of the PIP joint as a salvage procedure may be warranted.

Routine release of the volar/palmar plate has not been shown to improve outcomes for primary correction of PIP joint contractures in Dupuytren disease.

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154. A 25-year-old woman comes to the office because she has had a raised raw lesion on the dominant right forearm for the past three years since undergoing a cardiac transplantation. The area has slowly increased in size during the past year. She says she has taken oral and topical antibacterial and antifungal agents irregularly for the past year. She currently takes prednisone. Physical examination shows a 3-cm-diameter mass with a raw surface on the dorsal aspect of the right mid forearm. Which of the following is the most appropriate next step in management?
- A) Acticoat dressing
 - B) Biopsy for culture and pathology
 - C) Contrast and noncontrast MRI
 - D) Excision of the lesion followed by skin grafting
 - E) Reduction in immunosuppression

The correct response is Option B.

Solid organ transplantation continues to be a successful treatment of organ failure (heart, lung, liver, kidney, and bowel). Solid organ transplant patients are referred for management of various hand and upper extremity problems. Organ transplant recipients are predisposed to diabetes mellitus, obesity, gout, osteoporosis, and atherosclerosis. Transplant combination therapy increases the risk of diabetes mellitus. Risk of gout is also increased. Prolonged corticosteroid use increases the risk for fracture, tendon and ligament rupture, and avascular necrosis. Transplant patients develop acute or chronic ischemia of their upper extremities because of the progression of atherosclerosis. Malignant skin tumors, malignant solid tumors, and lymphoproliferative disorders develop with greater frequency in immunosuppressed patients. Cyclosporine immunosuppression appears to drive the time course of tumor development earlier. Moreover, fungal and bacterial infections such as mucormycosis are more common in immunosuppressed patients. In the scenario described, the most useful intervention is to perform a biopsy of a mass specimen for infection (bacterial, fungal, and atypical pathogen) and histopathology. With this information, the treatment can be cause-specific.

Acticoat is a layered silver ion dressing. When activated with water, Acticoat provides a rapid and sustained release of silver ions within the dressing and to the wound bed for three or seven days. Acticoat is bactericidal against antibiotic multiresistant clinical isolates, specifically against methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococcus. Imaging with contrast and noncontrast MRI may demonstrate involved tissue type and volume but does not direct treatment as to cause. Wide excision and skin graft coverage may be required, but the cause must be established prior to treatment. Reduction in immunosuppression may lessen the volume of the mass but risk transplant rejection.

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155. A 25-year-old man who is blind is brought to the emergency department two hours after sustaining a crush injury to the index finger of the dominant right hand at the flexion crease of the metacarpophalangeal joint. Physical examination shows full flexion and extension of the index finger. Sensation to pinprick is absent in the fingertip. Radiographs show no abnormalities. During surgical exploration, disruptions to the radial and ulnar digital nerves are noted. After debridement of the traumatized nerve ends, a 10-mm gap is noted in each digital nerve. Which of the following is the most appropriate management of each digital nerve?
- A) Bone shortening with primary repair
 - B) Flexion of the index finger with primary repair
 - C) Mobilization of nerve ends with primary repair
 - D) Polyglycolic acid conduit between nerve ends
 - E) Radial sensory nerve graft between nerve ends

The correct response is Option D.

In the first prospective, randomized multicenter evaluation of a bioabsorbable conduit for nerve repair, Weber et al. reported superior sensory recovery when polyglycolic acid conduits were used to repair nerve gaps greater than 8 mm compared to nerve graft repairs.

Although bone shortening has been described as a means of relieving tension on primary nerve repairs, this is clearly not the best choice when less morbid options for nerve reconstruction exist for the patient described. Another conduit available for small nerve gaps is vein, although that offers little mechanical resistance to kinking and collapse in larger defects.

Mobilization of the nerve with primary repair would likely place the nerve repair under some tension, which inhibits nerve regeneration. Management of short gaps by flexing joints to facilitate a tension-free repair can be problematic when the digit is mobilized because of scar formation.

Nerve grafts are an improvement over extensive nerve mobilization and limb positioning but are not without sequelae. Nerve graft harvest produces scarring, formation of neuroma, and loss of donor site function, in addition to increasing operating room and anesthesia time. The sural and posterior interosseous nerves are commonly used as grafts. Because of loss of sensitivity and potential for symptomatic neuromas, the radial sensory nerve is not commonly used as a graft.

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156. An 84-year-old man comes to the office because he has had pain and purulent drainage from the left groin incision site since undergoing a left common iliac artery to common femoral bypass procedure performed for critical stenosis of the iliac artery three weeks ago. Temperature is 38.8°C (101.8°F), blood pressure is 140/90 mmHg, and pulse rate is 100/min. Physical examination shows an exposed vein graft at the groin incision site. A magnetic resonance angiogram shows a patent bypass graft; the superficial femoral artery is patent, but a profundus branch is occluded. Following debridement, wound coverage with which of the following flaps is the most appropriate next step?

- A) Anterior lateral thigh
- B) Gracilis muscle
- C) Rectus femoris muscle
- D) Sartorius muscle
- E) Vastus lateralis muscle

The correct response is Option D.

The sartorius muscle would provide the most reliable option for wound coverage for the patient discussed. The sartorius muscle flap originates from the anterior iliac spine and inserts into the medial tibia. Eight to eleven perforators off the superficial femoral artery segmentally supply the sartorius, a type V muscle flap. The proximal pedicle is located approximately 6 cm from the anterior superior iliac spine. The sartorius muscle is adjacent to the femoral vessels.

The anterior lateral thigh, rectus femoris, and vastus lateralis muscles all are supplied by branches of the lateral femoral circumflex vessel. The gracilis muscle is supplied by the medial femoral circumflex artery. Both medial and lateral circumflex arterial branches originate from the proximal portion of the profunda femoris artery. Occlusion of the profunda would make the use of these flaps risky and may result in flap loss.

The rectus femoris muscle is a type I muscle flap with a single dominant blood supply from the lateral femoral circumflex artery.

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157. A 14-year-old boy is brought to the office because he is unable to extend the proximal interphalangeal (PIP) joint of the long finger of the dominant right hand beyond 60 degrees of flexion. Six months ago, he sustained partial-thickness burns to the palmar surface of the long finger. The remaining fingers were spared. He has been performing active and passive range of motion exercises under the guidance of a therapist. Examination shows a thick scar extending the full width of the palmar skin and from the mid proximal phalanx to the distal interphalangeal flexion crease. With full passive flexion of the metacarpophalangeal (MCP) joint, the PIP joint can be extended nearly completely. Which of the following is the most appropriate management?
- A) Continued hand therapy and observation
 - B) Daytime dynamic extension splinting and nighttime static extension splinting
 - C) Injection of a corticosteroid into the scar and continued hand therapy
 - D) Release of the contracture and full-thickness skin grafting
 - E) Z-plasty lengthening of the scar and continuous static extension splinting

The correct response is Option D.

Despite optimal management of hand burns with splinting and occupational therapy, scar contractures may still occur. As in other contractures of the fingers, management depends on the elements responsible for the loss of motion. In the patient described, the severe PIP joint contracture shows adequate correction with MCP joint flexion, implying a primary derangement of the skin. Involvement of deeper structures (volar plate, collateral ligaments) would not correct with altered position of the MCP joint.

As a primary intervention, the optimal treatment of the patient described is division of the contracted cord and interpositional, full-thickness skin grafting.

For initial treatment and early, immature contracture management, therapy and dynamic splinting are critical interventions. In an established, mature burn scar, attempts at stretching the scar (continued hand therapy or dynamic extension splinting) will be unlikely to correct the defect.

Injection of a corticosteroid may be beneficial for keloids or hypertrophic scars; however, it would not correct the burn scar contracture in the patient described.

Correction of PIP joint contractures with more extensive dissection (joint release) requirements may devitalize tissues essential for skin graft take. In the scenario described and in the setting of secondary corrective surgery, local flaps such as the cross-finger flap may prove more useful.

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Local tissue rearrangement (Z-plasty) is effective in narrow scars but will be difficult and likely ineffective in broad scars.

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(Please note that this pictorial appears in color in the online examination)

158. A 47-year-old woman is brought to the emergency department 30 minutes after sustaining an amputation injury to the dominant right hand. The amputated part was wrapped in a wet towel immediately after the injury and has been kept on ice since that time. Physical examination shows a guillotine-type amputation of the hand at the distal aspect of the palm with minimal injury proximal and distal to the amputation. A photograph is shown. Which of the following structures is expected to have the poorest recovery following successful replantation?

- A) Extensor digitorum communis
- B) First dorsal interosseous
- C) Flexor digitorum profundus
- D) Flexor digitorum superficialis
- E) Flexor pollicis brevis

The correct response is Option B.

The first dorsal interosseous is in the zone of injury. When amputations occur through the distal aspect of the palm, the intrinsic muscles are usually injured and intrinsic function is poor despite successful replantation. Finger abduction and adduction, metacarpophalangeal joint flexion, and proximal and distal interphalangeal joint extension and key pinch are limited as a result.

Debridement of injured muscle is recommended to prevent contracture and intrinsic tightness. In this setting, movement is generated by extrinsic muscle groups without the fine-tuning of motion usually provided by the intrinsic muscles.

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With sharp lacerations at the level of the distal palm, the flexor digitorum profundus and superficialis and extensor digitorum communis tendons typically function well with good repair technique, appropriate rehabilitation, and occasional secondary surgery. The flexor pollicis brevis is proximal to the zone of injury.

The mechanism of injury is an important determinant in the outcome of the repair. Sharp injuries have the most discrete area of damage and therefore tend to have greater recovery of function. Blunt and avulsion-type mechanisms, which have greater zones of injury, require more extensive reconstruction and are associated with less complete restoration of function, including motion and sensibility. In addition to functional considerations, replantation of the amputated hand serves the patient by restoring the appearance of the hand.

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159. A 35-year-old man is brought to the emergency department four hours after sustaining an injury to the dominant right hand when he fell while skiing. He reports pain in the thumb. Examination shows swelling and no palpable mass on the ulnar aspect of the metacarpophalangeal (MCP) joint of the thumb. Application of radial stress to the joint shows 5 degrees of laxity; stress on the opposite thumb shows no laxity. Plain-film radiographs show no abnormalities. Which of the following is the most appropriate management?
- A) Arthroscopic reduction
 - B) Immobilization of the thumb in a spica cast
 - C) Movement and increased range of motion of the thumb as tolerated
 - D) Open suture repair of the ulnar collateral ligament
 - E) Percutaneous pin fixation of the joint

The correct response is Option B.

The patient described has sustained an injury to the ulnar collateral ligament (UCL) of the MCP joint of his thumb. To select the appropriate therapy, the extent of the injury must be determined (ie, partial versus complete disruption of the UCL). In the patient described, 5 degrees of thumb MCP joint laxity compared to the opposite side indicates that he has sustained a partial tear of his UCL. It is generally accepted that incomplete tears may be treated successfully with immobilization; complete tears require operative treatment. A thumb spica cast provides adequate immobilization to allow healing of a partial tear of this patient's UCL; percutaneous pin placement to immobilize the MCP joint would be excessive. A percutaneous approach to MCP immobilization is occasionally used in conjunction with operative treatment of a complete disruption of the UCL.

A thumb MCP joint with greater than 30 degrees of laxity, or greater than a 15-degree differential in laxity compared to the contralateral side, demonstrates clinical evidence of a complete disruption of the UCL. With a complete tear of the UCL, a Stener lesion may result whereby the adductor aponeurosis interposes itself between the ends of the completely disrupted UCL, thus preventing ligamentous healing despite prolonged immobilization. Both open suture repair of the UCL and arthroscopic reduction without suture repair of the UCL have been described as operative treatment modalities for Stener lesions.

Excessive flexion and premature range of motion have been shown to increase the strain on the healing ligament; thus the patient's thumb should be immobilized. However, the splint could be fashioned to leave the interphalangeal (IP) joint free and allow active range of motion in the IP joint to prevent adherence of the extensor tendon to the injured MCP joint capsule.

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160. A 34-year-old man who works as a fisherman comes to the office because he has had several nontender nodules on the right hand and forearm and swelling of the right hand for the past four weeks. Medical history includes a 0.3-cm laceration to the palm of the right hand sustained six weeks ago. Treatment at that time consisted of bacitracin/polymyxin B ointment. Examination of the right hand shows synovitis of the flexor tendons of the long and ring fingers. Surgical exploration of the flexor sheaths shows exuberant granulation material. In addition to surgical drainage, administration of which of the following is the most appropriate treatment?
- A) Acyclovir
 - B) Betamethasone
 - C) Cephalexin
 - D) Interferon alfa-2a
 - E) Rifampin

The correct response is Option E.

Mycobacterium marinum is an uncommon cause of granulomatous disease and infective flexor tenosynovitis. Of the nontuberculous mycobacteria, *M. marinum* is the most common pathogen. *M. marinum* resides in warm water environments; patients report a history of a laceration or mild trauma and dealing with fish or shellfish or cleaning their home aquarium. Infection with *M. marinum* should be considered in patients with chronic, persistent ulceration of the hand or synovitis and a history of occupational or recreational activities with regular exposure to seawater or fresh water. Presentation of this infection often is delayed because of its indolent nature. Lesions are often present two to four weeks after inoculation. Typical operative findings include exuberant granulating synovium. Antimicrobial treatment includes antitubercular drugs, but the organism also responds to trimethoprim-sulfamethoxazole, doxycycline, and clarithromycin. These drugs generally have fewer side effects than the traditional antituberculosis medications.

Acyclovir is used for viral infections and would not have a role in the scenario described. Use of betamethasone or other corticosteroids can worsen symptoms and infection in mycobacteria infections. Cephalexin (Keflex) is one of the most commonly used oral medications for soft-tissue and hand infections but is not appropriate in the scenario described. Interferon alfa-2a is an immune modulator and has no place in this picture of atypical clinical purulent tenosynovitis.

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161. A 55-year-old man who is a woodworker is brought to the emergency department 45 minutes after completely severing the thumb of the nondominant left hand just distal to the interphalangeal joint while using a table saw. The amputated digit was wrapped in a moist gauze towel immediately after the injury. The patient smokes one pack of cigarettes daily. Physical examination shows a clean cut through the thumb with minimal tissue loss. Which of the following is the most appropriate management?
- A) Great toe transfer
 - B) Moberg advancement flap
 - C) Replantation of the thumb
 - D) Revision amputation
 - E) Split-thickness skin graft

The correct response is Option C.

An amputated thumb is an indication for replantation in the hands of an experienced microsurgeon with the appropriate team regardless of the level of injury to the thumb. In the scenario described, the thumb is well preserved and the cut is clean with no avulsion injury. Attempts should be made to preserve the length and function of the thumb with replantation.

Immediate pollicization of the great toe is not indicated in the scenario described, where the distal amputated thumb is well preserved and available for replantation. If the amputated part had been mangled, lost, or inappropriately preserved, thumb reconstruction with great toe transfer could be offered as a reconstructive option.

The importance of the thumb in hand function precludes any further amputation of the thumb. Although the thumb wound would likely close by secondary intention if there is no exposed bone, it is best to preserve as much length as possible, making replantation the operation of choice for the thumb.

If the part is not replantable, the volar advancement flap, or Moberg flap, is indicated for preservation of length and soft-tissue coverage of exposed bone. A split-thickness skin graft could potentially also be used for coverage but would require shortening of the exposed bone and would not provide the sensibility that is helpful in the use of the thumb. Reconstruction of the thumb does not offer restoration of length and is not appropriate in this clinical situation.

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162. A male newborn has the isolated congenital deformities of the left hand shown in the photographs. Which of the following procedures is most likely to provide optimal function of the hand?

- A) Amputation of the long, ring, and small fingers
- B) Full-thickness matrix grafting
- C) Phalangeal lengthening of the small and ring fingers
- D) Radial metacarpal lengthening of the index and long fingers
- E) Toe-to-hand transplantation

The correct response is Option C.

The patient described has an isolated congenital anomaly of the left hand known as shortened fingers or brachydactyly. The most functional improvement is to lengthen the small and ring fingers to facilitate power grip and opposition. One method is nonvascularized toe phalanx grafting; another is distraction lengthening. This procedure should be performed when the patient is between 8 and 12 months of age.

Amputation would not add to the patient's function. Full-thickness matrix grafting is for reconstruction of the nail matrix complex. Lengthening the second and third metacarpals would not address the functional deficit. The patient's thumb appears to be quite functional, so toe-to-hand transplantation is not appropriate.

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163. A 27-year-old man with a cocaine addiction is brought to the emergency department one hour after sustaining amputation of the thumb of the nondominant left hand at the distal third of the proximal phalanx while using a circular saw. The amputated part was wrapped in a towel and placed on ice. Replantation is performed with an anastomosis of the ulnar digital artery to the radial artery at the anatomic snuffbox with a vein graft. Two weeks after the procedure, there is partial survival of the replanted thumb with exposure of the flexor pollicis longus. Use of which of the following flaps is most appropriate for reconstruction?
- A) First dorsal metacarpal artery
 - B) Moberg
 - C) Reverse posterior interosseous artery
 - D) Reverse radial artery
 - E) Thenar

The correct response is Option A.

A durable, sensate, well-vascularized reconstruction is required. The most appropriate flap for reconstruction of the defect in the scenario described is the first dorsal metacarpal artery. When paired with the first dorsal metacarpal nerve, this flap provides sensate coverage of large defects to the distal volar aspect of the thumb. Photographs are shown below.

The Moberg flap is a sensate advancement flap used to reconstruct volar thumb tip defects of up to 1 cm. This defect is too large. Use of this flap would endanger the blood flow for the replanted thumb, and it would have a high likelihood of partial flap loss.

The reverse posterior interosseous artery flap is a pedicled fasciocutaneous flap often used to reconstruct the dorsum of the hand or the first web space. A proximal extension would be required for the flap to reach the distal volar aspect of the thumb. Tip necrosis is a known complication of this nonsensate flap.

The reverse radial artery flap is often a fine choice for thumb reconstruction. In the scenario described, however, ligating the radial artery proximal to the harvested flap may compromise the vascular supply to the replanted thumb. The replanted thumb has already displayed signs of potential vascular compromise caused by the loss of the thumb tip after replantation.

The thenar flap is a random flap used to cover volar tip defects of the long and ring fingers. The defect in the patient described could not be covered with a thenar flap.

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164. A 42-year-old woman comes to the office for evaluation of a severely painful mass on the upper right arm and numbness in the right forearm six months after undergoing decompression neuroplasty with submuscular transposition. This procedure was performed for progressively worsening compression of the dominant ulnar nerve at the elbow. She developed severe complex regional pain syndrome two weeks after the procedure. Physical examination shows a 0.5-cm mass proximal and central to the medial epicondyle that is adherent to the skin and extremely sensitive. Examination shows decreased sensation to light touch over the ulnar volar forearm. Following excision of the neuroma, which of the following is the most appropriate next step in management?

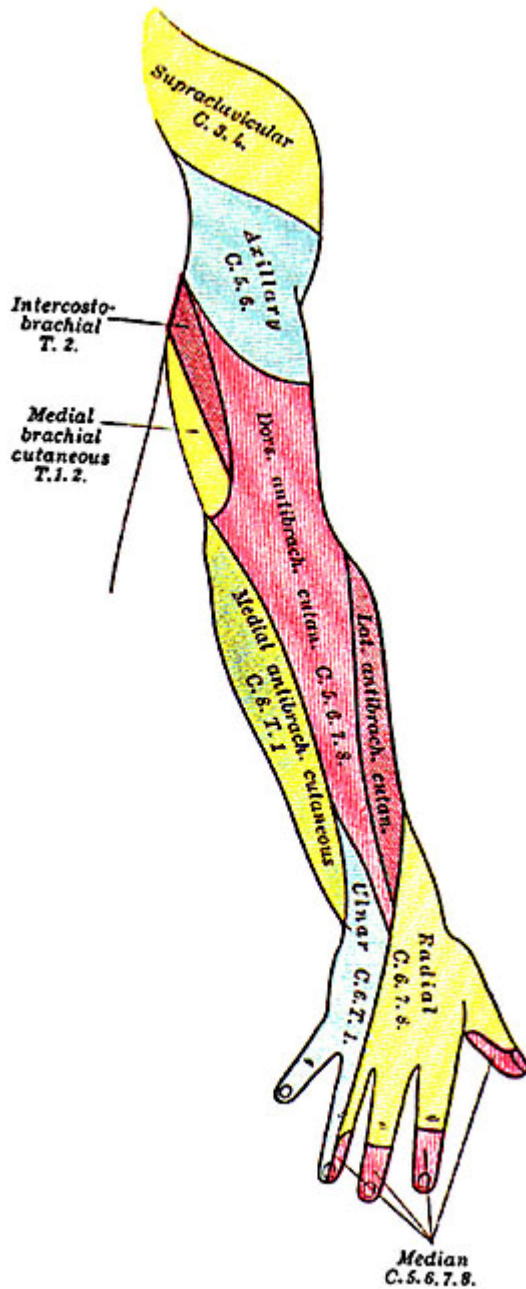
- A) Medial epicondylectomy
- B) Nerve stump implantation
- C) Stress occupational therapy program
- D) Topical lidocaine patch
- E) Ulnar nerve vein wrap

The correct response is Option B.

The ulnar nerve neuroplasty is complicated by complex regional pain syndrome (CRPS) with an associated nerve injury. The medial antebrachial cutaneous nerve (MABC) of the forearm originates from the medial cord of the brachial plexus (shown in the diagram below). The MABC derives from the C8 and T1 roots. In the mid arm, the MABC and the basilic vein pierce the deep fascia and provide sensation to the overlying ulnar volar forearm skin. The MABC can be injured during ulnar nerve at the elbow neuroplasty. If CRPS develops from an identifiable nerve injury, resolution is best achieved by identifying and correcting the nerve injury. In the scenario described, excision and tensionless implantation into adjacent muscle or bone is the most appropriate option.

Medial epicondylectomy would not address the primary MABC neuroma, nor would wrapping the ulnar nerve with a vein graft. A stress occupational therapy program can be useful in CRPS without an identifiable nerve injury. With the injury described, however, the pain more likely would worsen. Topical transdermal anesthetic patches can alleviate but not resolve the nerve pain.

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165. A 5-year-old boy is brought to the burn clinic seven days after sustaining burns to the palm when he touched a hot charcoal grill. Physical examination shows third-degree burns involving 90% of the nondominant right palm. Tissues deep to the dermis are healthy. After debridement, which of the following is the most appropriate coverage of the defect?

- A) Full-thickness skin graft from the groin
- B) Glabrous dermal graft from the plantar foot
- C) Pedicled groin flap
- D) Reverse radial forearm flap
- E) Split-thickness skin graft from the thigh

The correct response is Option B.

“Replacing like with like” remains the mantra of plastic surgery, as the increasing use of glabrous skin for reconstruction of both palmar and plantar defects attests. Glabrous skin is designed to withstand greater pressure and shear force than other skin. In addition, glabrous skin used as a graft does not appear to suffer from the pigmentation changes that occur in other full-thickness grafts. The chief limitation of glabrous skin grafting is the limited supply of donor sites.

Full-thickness grafting from the groin would close the wound but would be subject to the limitations noted above.

Both the groin flap and the radial forearm flap could reconstruct this defect; however, both are more extensive procedures than necessary to cover the wound.

Split-thickness grafting of the palm, particularly in the setting of burn injury, has been shown to lead to earlier reoperation because of contracture.

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166. A 35-year-old woman comes to the office because she has had severe pain in the right index finger for the past six years. She has been evaluated by internal medicine, endocrine, and pain specialists who found no abnormalities. She is receiving psychiatric care. She takes hydrocodone bitartrate (5 mg)–acetaminophen (500 mg) but still has pain. She describes marked sensitivity to cold and severe paroxysmal pain on one spot on the nail of the index finger. Examination shows a 3-mm, bluish shadow. A photograph of the nail is shown. Which of the following is the most likely diagnosis?

- A) Giant cell tumor
- B) Glomus tumor
- C) Inclusion cyst
- D) Mucous cyst
- E) Neuroma

The correct response is Option B.

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By clinical evaluation, the most likely diagnosis is a glomus tumor. A glomus tumor is a caricature of a normal glomus body; it reflects hypertrophy (hamartoma) of the normal neuromyoarterial glomus body. A glomus body has an afferent arteriole, anastomotic canal, primary collecting vein, intraglomus reticulum, and capsular portion. The classic triad is hypersensitivity to cold, paroxysmal pain, and pinpoint localization. Love pin test duplicates the severe pain. Hildreth test alleviates the pain by temporarily placing a tourniquet at the base of the digit. Cold sensitivity is another diagnostic test. The mass may be visible under the matrix. Transillumination is helpful, and MRI can localize the mass. Appropriate treatment in the scenario described is excision, either transmatrix (see the intraoperative photograph below) or lateral.

The triad of pinpoint localization, cold sensitivity, and paroxysmal pain is unique for glomus tumors. A giant cell tumor of the tendon sheath or of the bone is not painful. An inclusion cyst usually results from trauma and enlarges with sebaceous material. A mucous cyst develops from arthritis as a ganglion cyst. A painful nerve scar or neuroma usually results from injury.



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167. A 30-year-old woman who is a professional athlete comes to the office one week after sustaining an injury to the thumb of the dominant right hand. Physical examination and radiographs confirm a displaced Bennett fracture. Closed reduction of the fracture followed by percutaneous pin fixation is planned. In addition to longitudinal traction on the thumb while exerting pressure over the dorsoradial aspect of the metacarpal base, which of the following is the most appropriate reduction maneuver?

- A) Palmar abduction and pronation of the thumb
- B) Palmar adduction and pronation of the thumb
- C) Palmar abduction and supination of the thumb
- D) Palmar adduction and supination of the thumb

The correct response is Option A.

The mechanism of injury in both Bennett and Rolando fractures is an axially directed force through the partially flexed metacarpal shaft. The Bennett fracture is a two-part fracture with a volar lip fragment of variable size and the remaining metacarpal base, which subluxates radially, proximally, and dorsally. The Rolando fracture involves a Y- or T-shaped split into the trapeziometacarpal joint. In a Bennett fracture, there is an avulsion of the main substance of the thumb metacarpal from the volar ulnar portion of the metacarpal base. The main portion of the thumb metacarpal is usually subluxated radially and dorsally by the combined pull of the thumb extensors, the abductor pollicis longus, and the adductor pollicis longus.

Pronation of the distal fragment is important for reduction of a Bennett fracture, as well as for apposition of the volar oblique ligament in trapezial fractures and trapeziometacarpal dislocations.

Closed reduction with percutaneous fixation should generally be attempted, with open reduction being reserved for cases in which residual joint incongruity persists following attempts at closed reduction.

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168. A 34-year-old man is brought to the emergency department one hour after sustaining a 7-cm laceration to the left wrist during a suicide attempt. The patient is unconscious but breathing. Physical examination shows a clean, linear radial laceration. Pulsatile arterial bleeding from the wound is noted. A tourniquet is applied to the upper left arm and inflated to 250 mmHg of pressure. Three hours later, the tourniquet is released, and the patient is brought to the operating room. The artery is ligated, and the tendons are repaired. Surgical exploration shows no nerve laceration. The next day, the patient has no sensation or motor function in the left hand. After three days, normal function returns. Which of the following Sunderland grades is the most appropriate classification for this injury?
- A) I
 - B) II
 - C) III
 - D) IV
 - E) V

The correct response is Option A.

Nerve injuries can be classified with a system that was first described by Seddon and modified by Sunderland. The table below summarizes these nerve injury classifications. The nerve injury described is classified as Sunderland grade I. Rapid nerve recovery is likely. The patient described had the tourniquet in place for longer than the generally accepted recommended period. Studies have shown that tourniquets should be released after two hours of use. Because of the prolonged use in the scenario described, the patient has sustained neurapraxia. When a tourniquet is used, the nerves and muscles are susceptible to injury. The nerves are particularly sensitive to pressure injury. Two-hour use is a guideline; if additional time is needed, it is generally thought that five minutes of reperfusion is necessary for every 30 minutes of tourniquet time.

A Sunderland grade I injury corresponds with neurapraxia. Complete recovery is expected. A grade II injury corresponds with axonotmesis and slow but complete recovery. Sunderland III, IV, and V injuries do not recover spontaneously. Axonotmesis and neurotmesis occur with Wallerian degeneration; therefore, significant regeneration often takes place only after surgery.

Sunderland	Seddon	Expected recovery	Rate of recovery
I	Neurapraxia	Complete	Rapid
II	Axonotmesis	Complete	Slow
III		Variable	Slow
IV		None	No recovery
V	Neurotmesis	None	No recovery

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169. A 53-year-old woman comes to the office because she has a one-year history of burning pain that extends from the left shoulder to the fingers of the nondominant left hand since falling in a parking lot. She is unable to use the left arm because of the pain. She keeps the left elbow flexed, the wrist in palmar flexion, and the fingers extended. She also has had intermittent redness over the skin of the affected hand. At the time of injury, she sustained severe bruising. Two stellate ganglion blocks have not relieved the pain. Physical examination shows a 3-cm-diameter area of warm, red, indurated skin on the dorsum of the left hand. There is no other swelling or temperature difference over the arm compared with the right arm. Passive range of motion is normal. Which of the following is the most appropriate next step?
- A) Application of a short arm cast
 - B) Cold challenge test
 - C) Physical therapy
 - D) Stellate ganglion block
 - E) Three-phase bone scan

Please note: Question 169 has been deleted from the examination.

The correct response is Option A.

Factitious illnesses go undiagnosed and misdiagnosed for long periods and therefore are often improperly treated. These patients are often given the diagnosis of reflex sympathetic dystrophy (RSD), which has been more recently referred to as complex regional pain syndrome. Reflex sympathetic dystrophy can be an elusive diagnosis. However, there are diagnostic criteria that give credibility to the diagnosis, including the following: diffuse extremity pain, pain relief from stellate ganglion block, sensory changes including allodynia and hyperesthesia, stiffness, trophic changes, vasomotor changes, temperature differences, and diffuse swelling.

Factitious disorder is highly likely in the patient described, who presents with a dysfunctional posture and pain but few of the other changes that would be expected from long-standing RSD. The patient has had no improvement with stellate ganglion block, which is highly suggestive of a nonsympathetic pain complex.

The localized erythema and swelling on the dorsum of the hand are indicative not of diffuse RSD, but of factitious or self-induced injury for secondary gain. Secretan syndrome refers to self-induced fibrosis of the dorsum of the hand from repetitive striking of the dorsum of the hand. Treatment of this condition is short-term casting to protect the hand from the patient's self-abuse. Improvement with casting will further substantiate its factitious etiology.

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During consultation with the patient described, further information must be obtained as to potential secondary gain (ie, a pending lawsuit against the owner of the parking lot where she fell or malingering to avoid work). Insurance investigators often conduct video surveillance of these patients to reveal the true use of their extremity. Psychiatric evaluation is needed in many of these cases.

Cold challenge test and three-phase bone scan are both not appropriate because they are diagnostic tools for the diagnosis of RSD and are not needed with the patient's presentation. Three-phase bone scans at best have a sensitivity of only 50%. In one study, 20 of 61 patients with no symptoms of RSD had a bone scan positive for RSD. After six months, three-phase bone scans correlate poorly with RSD. The cold challenge test measures the response of the hand to exposure to cold and then rewarming. This test is better as a monitoring test for RSD than a diagnostic test.

Physical therapy treats the real problem and is not the most appropriate step, although the majority of these patients undergo physical therapy for extended periods.

Stellate ganglion block is not appropriate because the patient described does not have RSD and has already had two previous unsuccessful blocks, which further rules out RSD.

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170. A 45-year-old man comes to the office because he has a one-year history of a dark streak on the nail of the thumb of the nondominant left hand. Biopsy of the specimen of involved nail bed tissue shows 1-mm-thick malignant melanoma. Which of the following is the most appropriate surgical intervention?

- A) Mohs micrographic surgery
- B) Wide soft-tissue excision
- C) Amputation at the interphalangeal joint
- D) Amputation at the mid metacarpal joint
- E) Ray amputation

The correct response is Option C.

The nail bed is unique because it is directly adherent to the underlying distal phalanx periosteum. Early studies recommended metacarpal or metacarpal ray amputations for invasive melanoma; however, recent studies have shown the efficacy of more conservative amputations without altering survival rate or local recurrence rate. Treatment goals are eradication of the tumor and preservation of function. Therefore, amputation at the level just proximal to the disease is recommended.

Pigmented lesions in the nail bed pose a significant diagnostic responsibility. Although they are almost always pigmented, their presentation could be confused with benign melanonychia striata, fungal infections, junctional nevi, warts, foreign bodies, subungual hematomas, pyogenic granuloma, and paronychia. Melanoma presenting in an advanced stage has a high mortality rate. Confirmation with biopsy is essential. Treatment recommendations for melanoma in situ are wide soft-tissue excision with nail bed ablation and full-thickness skin grafting. Mohs micrographic surgery is not appropriate because it is a technique to remove a tumor with minimal margins and is primarily a soft-tissue excision.

Wide soft-tissue excision does not take into account the unique anatomy of the nail bed and adherence to the underlying distal phalanx. Amputation at the mid metacarpal joint and ray amputation are not appropriate because they are unnecessarily radical.

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171. A 53-year-old man comes to the emergency department because he has pain and swelling of the right forearm. The patient's behavior is erratic and his speech is slurred, making it difficult for the nurse to determine the duration of his symptoms. He staggers when attempting to walk into the examining room, and a strong odor of alcohol is noted on his breath. Vital signs are within normal limits. Physical examination of the arm shows no erythema, and the skin is intact. Radiographs show no fractures. Which of the following additional findings in this patient is an indication for forearm fasciotomy?
- A) Accentuation of pain with passive muscle stretching
 - B) Decreased grip strength compared with the opposite hand
 - C) Decreased sensation of the fingers compared with the opposite hand
 - D) Intracompartment pressures of 25 mmHg
 - E) Tender and firm muscle compartments

The correct response is Option A.

Compartment syndrome occurs when the tissue pressure within a limited space results in decreased tissue blood flow, oxygenation, and function. It is primarily a clinical diagnosis based on muscle and nerve ischemia. The hallmark of muscle ischemia is pain, which is persistent, progressive, and unrelieved by immobilization. Accentuation of pain with passive muscle stretching is the most reliable clinical test for making the diagnosis of compartment syndrome. Diminished sensibility is the second most important finding, indicating ischemia of the nerve as it passes through the affected compartment. Weakness is the third most important finding, especially when progressive. Palpation of the forearm compartments for tenderness and tautness associated with the above signs should confirm the diagnosis.

Commonly held pressure thresholds for fasciotomies are as follows: (1) in normotensive patients with positive clinical findings and intracompartment pressures greater than 30 mmHg for an unknown time or a duration believed to be less than eight hours, (2) in uncooperative or unconscious patients with compartment pressures greater than 30 mmHg for less than eight to 10 hours, and (3) in hypotensive patients when compartment pressures are 20 mmHg below diastolic blood pressure for less than eight to 10 hours. If it is believed that a patient has compartment syndrome based on clinical evaluation, regardless of the compartment pressures, a fasciotomy should be performed.

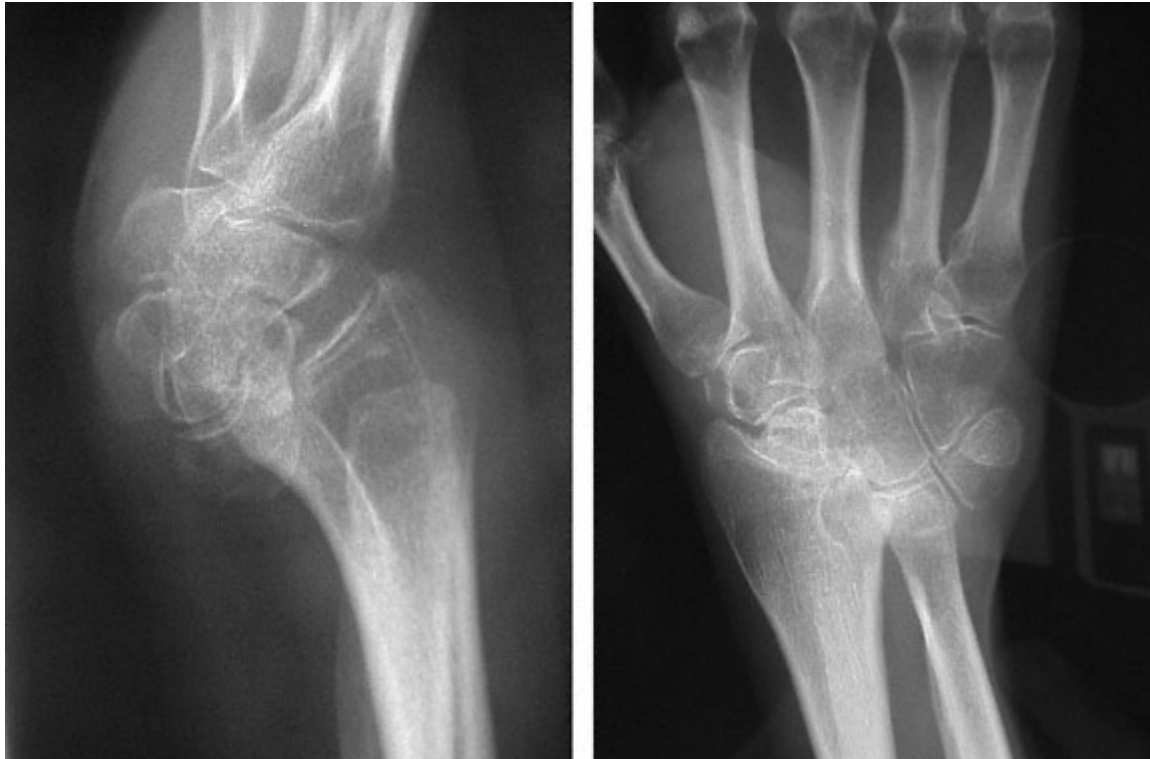
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172. A 76-year-old woman comes to the office because she has had progressive loss of extension of the nondominant long, ring, and small fingers during the past two years. She has had intermittent pain and swelling of the dorsal aspect of the wrist. Examination shows full, painless range of motion of the wrist. Radiographs are shown. Which of the following is the most appropriate management?

- A) Direct repair
- B) Graft repair
- C) Injection of a corticosteroid
- D) Placement of the arm in a short cast
- E) Tendon transfer

The correct response is Option E.

In the scenario described, the extensors to the small, ring, and long fingers have ruptured from an attritional inflammatory process, most likely rheumatoid arthritis (see the photograph below). Vaughn-Jackson reported this phenomenon of spontaneous extensor rupture in two cases in 1948. The rupture can result from inflammatory weakening of the tendons directly or secondary to attrition from underlying bony irregularity. The ruptures are typically painless and

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spontaneous. Operative findings will direct repair or reconstruction. Proximate tendon ends can be repaired; separated tendon ends with noncontracted muscle can be grafted. Tendon transfers should be used in instances where contracted muscles do not relengthen on stretching. In the scenario described, with the extensor indicis proprius and extensor digitorum communis (EDC) of the index finger intact, the EDC of the long, ring, and small fingers can be transferred to the EDC of the index finger.

Injection of a corticosteroid can alleviate inflammation but will not correct ruptured extensors. Likewise, casting will not correct the ruptured extensors.



(Please note that this pictorial appears in color in the online examination)

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173. A 21-year-old man is brought to the emergency department four hours after sustaining a high-velocity gunshot wound to the lower extremity while hunting. Physical examination shows perforation of the soft tissues and fracture of the proximal tibia. The projectile is assumed to be a 7.62-mm fully jacketed bullet. It appears to have passed through the leg. No gross contamination of the wound is noted. Radiographs show no evidence of bullet remains. Debridement of the wound in the operating room is planned within six hours of the original injury. Which of the following is the most appropriate prophylactic antibiotic therapy for this patient?
- A) A cephalosporin and an aminoglycoside for 24 hours
 - B) A cephalosporin and an aminoglycoside for 72 hours
 - C) First-generation cephalosporin for 24 hours
 - D) First-generation cephalosporin for 72 hours
 - E) No prophylactic antibiotic therapy is necessary

Please note: Question 173 has been deleted from the examination.

The correct response is Option B.

High-velocity gunshot wounds result from rifles with muzzle velocities greater than 2000 to 3000 ft/s. These weapons, typically hunting and military firearms, tend to cause more damage than low-velocity rifles.

High-velocity rounds cause tissue damage from the passage of missile through tissue as well as by a secondary shock wave and a cavitation effect. The cavitation effect can have a diameter up to 10 to 40 times the diameter of the bullet. Internal pressures in the cavitation chamber can reach 100 to 200 atmospheres, which can cause explosive destruction and suck debris into the wound through a vacuum effect.

Although low-velocity gunshot wounds may not require prophylactic antibiotics, the recommendation for high-velocity wounds is to administer cephalosporin and an aminoglycoside for 48 to 72 hours. Furthermore, penicillin should be administered if gross contamination is present, ie, risk for clostridial or similar infections. High-velocity weapon wounds usually should be treated operatively for debridement, whereas low-velocity wounds may be treated nonoperatively.

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174. A 45-year-old man comes to the office because he has a two-day history of progressive pain and swelling in the right forearm. He also has had a sore on the right thumb for seven days. Three weeks ago, he had an infection after a fishhook became imbedded in the thumb while he was fishing. At that time, he underwent surgical debridement of flexor tenosynovitis of the thumb followed by antibiotic therapy. Today, temperature is 37.2°C (99°F). Examination shows erythema and swelling of the thumb, hand, and right forearm to the elbow. A 2-cm papule is noted on the dorsum of the thumb. Which of the following is the most appropriate next step in management?
- A) Culture and pathology of the papule
 - B) Debridement of the papule
 - C) MRI of the upper extremity
 - D) Targeted mycobacteriophage therapy
 - E) Triple antituberculous therapy

The correct response is Option A.

Cultures at 25°C to 32°C (77°F to 89.6°F) may grow nonmotile acid-fast bacilli in seven to 21 days. If culture results are negative but the history and clinical findings are consistent with *Mycobacterium marinum* infection, then treatment should still be strongly considered. Additionally, performing a biopsy on the lesion may help identify the organisms.

Debridement of skin lesions often is unnecessary; however, if a deeper infection is diagnosed, debridement and drainage may be indicated. Mycobacteriophages are viruses that infect mycobacteria. They are currently commercially available but are still being refined as a tool to rapidly identify the specific species in mycobacterial infections. They are also being developed as a future modality for treatment of these infections.

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175. A 45-year-old woman comes to the office for consultation because she has a two-month history of stiffness of the wrists and fourth and fifth metacarpophalangeal joints bilaterally when she awakens in the morning. The stiffness lasts approximately two hours. Physical examination shows warm, edematous, and tender joints. Radiographs of both hands show narrowed joint spaces and bony erosions. Which of the following is the most appropriate next step to confirm the suspected diagnosis?
- A) Arthritis Impact Measurement Scale score
 - B) Examination of joint aspirate
 - C) Intra-articular injection of triamcinolone
 - D) Radiographs of the cervical spine
 - E) Serum rheumatoid factor assay

The correct response is Option E.

The most appropriate next step in establishing the diagnosis in the scenario described is obtaining a complete blood count, rheumatoid factor (RF), and erythrocyte sedimentation rate. Rheumatoid arthritis (RA) has a prevalence of approximately 1% in the United States. Female-to-male ratio is approximately 3:1, and the age of onset is usually between 25 and 50 years. The diagnosis is typically made when four of seven qualifying criteria established by the American Rheumatism Association are met:

- Morning stiffness lasting longer than one hour before improvement
- Arthritis involving three or more joints
- Arthritis of the hand, particularly involvement of the proximal interphalangeal, metacarpophalangeal, or wrist joints
- Bilateral involvement of joint areas
- Positive serum RF
- Rheumatoid nodules
- Radiographic evidence of RA

A rheumatologist should be consulted soon after the diagnosis is made. The diagnosis must be established before documentation of the baseline disease or initiation of a rheumatoid work-up or any therapy. A complete blood count indicates the presence of anemia in approximately 80% of patients with RA. Erythrocyte sedimentation rate is elevated in approximately 90% of patients with RA. A serum RF result is positive in approximately 70% of patients with RA.

The Arthritis Impact Measurement Scale aids in documenting baseline disease activity and damage but is not used for establishing the diagnosis.

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Joint fluid analysis of the inflamed joint usually shows a leukocyte count of 2000 to 5000/mm³ without crystals or bacteria. Gout is diagnosed by evidence of urate crystals in the synovial fluid and usually has a monoarthritic presentation. More than 75% of acute gout attacks affect the lower extremity. The clinical presentation of the patient described is most likely RA, and joint fluid analysis is not part of the initial steps in establishing the diagnosis.

Injection of triamcinolone is often used to treat flexor tenovaginitis (trigger finger) or aid in the diagnosis of carpal tunnel syndrome. Clinicians will sometimes inject triamcinolone into osteoarthritic joints for temporary pain relief. Many patients with RA are on a medical regimen including an oral corticosteroid. Injection of triamcinolone is not performed to aid in the diagnosis of RA.

Rheumatoid arthritis can affect the cervical spine with inflammation and destruction of cartilage, bone, and ligaments, most commonly in the upper cervical spine. Laxity and destruction of ligaments can lead to significant instability with frank subluxation and cord damage. Once the diagnosis of RA is established, severity of the disease can be evaluated, which is especially important if a surgical procedure is planned. Cervical spine evaluation is not part of the initial steps in establishing the diagnosis.

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(Please note that this pictorial appears in color in the online examination)

176. A 57-year-old woman who has rheumatoid arthritis comes to the office for consultation because she has had increased pain and swelling of the dominant right hand for the past six months. The pain interferes with activities of daily living, and she is unhappy about the appearance of the hand. A photograph of the hand is shown. Current medications include naproxen, infliximab, and methotrexate. Physical examination shows metacarpophalangeal (MCP) synovitis. The ulnar drift can be corrected passively. Radiographs show marked narrowing of MCP joint spaces. In addition to extensor tendon rebalancing, intrinsic release, and synovectomy, which of the following is the most appropriate management?

- A) A1 pulley release
- B) Extensor digitorum communis tendon transfer
- C) Intra-articular injection of triamcinolone
- D) Silicone MCP joint arthroplasty
- E) Wrist arthrodesis

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The correct response is Option D.

In addition to extensor tendon rebalancing, intrinsic release, and synovectomy, the most appropriate management is silicone MCP joint arthroplasty. Alleviation of joint pain, improvement of function and appearance, and retardation or correction of deformity are the surgical indications for rheumatoid arthritis (RA). Surgery will neither restore normal function nor improve grip strength or dexterity. The patient described has persistent pain caused by articular destruction of her MCP joint. The photograph shows MCP synovitis, extensor digitorum communis ulnar sublimation, and MCP ulnar drift. Tendon rebalancing will improve finger alignment and extensor lag. Intrinsic release will help balance the forces causing ulnar drift. Synovectomy will retard tendon rupture and misalignment. Silicone MCP joint arthroplasty will alleviate the painful bone-on-bone contact. Pyrocarbon MCP joint arthroplasty can be considered in young or high-demand RA patients who have less than 60 degrees of extension lag, less than 45 degrees of ulnar deviation, and no severe dislocation or shortening.

A1 pulley release is contraindicated in RA patients because the pulleys help maintain alignment of the digits; tenosynovectomy is preferred.

Extensor tendon transfers are indicated after extensor tendon ruptures caused by inflammation. They are not indicated for the correction of ulnar drift.

Oral corticosteroids are often included in the medical regimen of an RA patient. Injections of corticosteroids may be used to temporarily alleviate the inflammation associated with osteoarthritis, but they will not correct articular destruction.

Joint fusion (arthrodesis) is indicated in RA patients for stabilization of joints that must sustain high load forces or in patients with arthritis mutilans. Thumb MCP joint arthroplasty is not recommended; fusion is the treatment of choice. Partial or complete wrist and distal interphalangeal joint fusions are often indicated with malalignment. However, MCP joint fusion would cause unnecessary and severe functional limitations in the low-demand patient described.

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177. A 17-year-old girl comes to the office because she has persistent wrist drop and weakness of digit extension three weeks after she fractured the intraarticular distal portion of the radius while snowboarding. Open reduction and internal fixation was performed under general anesthesia. A wide-cuff, pneumatic tourniquet was placed over cast padding; inflation pressure was 100 mmHg over the patient's systolic blood pressure. Reduction was difficult, and tourniquet time was 180 minutes. Use of which of the following interventions is most likely to have decreased the risk of this complication?
- A) Elastic stocking rather than cast padding beneath the tourniquet
 - B) Esmarch bandage as the tourniquet
 - C) Narrow width tourniquet cuff
 - D) Standard inflation pressure of 250 mmHg
 - E) Tourniquet deflation/reperfusion period

The correct response is Option E.

The intervention most likely to decrease the incidence of nerve palsy in the patient described is providing a period of tourniquet deflation ("breather period") during which tissue acidosis may reequilibrate.

Despite advances in equipment and technique, complications from tourniquet use in upper extremity surgery still occur. The most common problems involve either neurologic or skin complications. Experimental studies suggest that most neurologic sequelae appear to be related to prolonged ischemia, high local tourniquet pressure, or some combination of the two.

Both elastic stockings and cast padding have been shown to decrease skin complications from tourniquet use; neither has been shown to have any effect on neurologic complications.

Esmarch bandages, although effective as tourniquets, provide unpredictable levels of pressure on the arm and have consequently been replaced by automated cuffs and pumps.

Wide tourniquets, with ratios of cuff width to arm circumference greater than 0.5:1, have been shown to achieve hemostasis at lower pressures than narrow cuffs.

Although many surgeons reflexively set upper extremity tourniquets at 250 mmHg, the optimal inflation pressure to minimize risk and maximize hemostasis appears to vary widely depending on body habitus, type of anesthesia, and comorbidities such as hypertension.

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178. A 20-year-old man comes to the emergency department after falling on the thumb of the dominant right hand during basketball practice. The thumb remained in a “bent back position” despite the coach’s attempt to straighten it. Radiographs of the hand are shown. Which of the following is the most appropriate treatment?

- A) Closed reduction
- B) Dynamic traction splinting
- C) Open reduction
- D) Percutaneous pin fixation in flexion
- E) Serial splinting

The correct response is Option A.

The radiographs show a dorsal dislocation of the thumb. Most metacarpophalangeal (MCP) dislocations of the thumb are dorsal and are reducible. The standard technique is gentle hyperextension of the MCP joint with direct pressure on the dorsal base of the proximal phalanx. The mechanism of the dislocation is a disruption of the volar plate, dorsal capsule, and portions

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of the collateral ligaments. Reduction becomes more difficult when the volar plate becomes interposed between the metacarpal head and the proximal phalanx. Hyperextension helps extricate the volar plate and allow reduction. Reduction can also be inhibited when the flexor pollicis longus (FPL) and the thenar musculature ensnare the metacarpal head like a noose. A median nerve block added to a radial nerve block allows the thenar musculature to relax and loosen its noose. Further wrist flexion can loosen the FPL. The volar plate usually ruptures from the metacarpal side. Observation of the location of the sesamoid bones, which are imbedded in the volar plate, will give evidence of the location of the disruption. The scenario described demonstrates volar plate disruption from the metacarpal side.

Dynamic traction splinting is treatment for a pylon fracture or a comminuted articular fracture. This technique uses distraction to allow alignment of the fracture fragments and adds range of motion to reduce stiffness.

Open reduction is appropriate if closed reduction is unsuccessful using adequate anesthesia and appropriate reduction maneuvers. Open reduction can be performed through a volar, dorsal, or lateral approach. Proponents of the dorsal approach avoid endangering the volar digital nerves, which are pushed very close to the skin by the metacarpal head. In contrast, the volar approach allows repair of the volar plate if needed.

Percutaneous pin fixation in flexion does not provide for reduction of the soft-tissue components of the dislocation (eg, volar plate). Furthermore, there is no need for pins with closed reduction.

Serial splinting is not appropriate because of the possibility that longitudinal traction may convert a simple dislocation into a complex one.

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179. A 32-year-old man who works as a carpenter comes to the office for follow-up examination seven days after sustaining a 2-cm laceration to the dorsum of the left thumb proximal to the interphalangeal joint while using a knife. In the emergency department, the laceration was sutured, and the thumb was immobilized with a splint. On physical examination, the wound is clean. No infection is noted. Weak extension of the interphalangeal joint is noted. The patient cannot extend the thumb off the tabletop. Laceration of which of the following tendons is most likely?

- A) Abductor pollicis longus
- B) Extensor carpi radialis brevis
- C) Extensor carpi radialis longus
- D) Extensor pollicis brevis
- E) Extensor pollicis longus

The correct response is Option E.

The patient described has an injury to the extensor pollicis longus (EPL) tendon, which can be difficult to diagnose in the emergency department. Often, a patient will have weak active extension at the interphalangeal joint. The thumb extensor mechanism receives fibers from the abductor pollicis brevis, adductor pollicis, the ulnar head of the flexor pollicis brevis, and the EPL. If the EPL is lacerated, there may be weak extension at the interphalangeal joint; however, the thumb cannot be actively lifted off a tabletop. The extensor pollicis brevis, abductor pollicis longus, extensor carpi radialis longus, and extensor carpi radialis brevis do not contribute to the extension of the thumb off a tabletop.

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180. A 45-year-old woman is brought to the emergency department immediately after sustaining a traumatic amputation injury to the thumb of the nondominant left hand. The digit was not recovered. Physical examination shows amputation at the proximal aspect of the proximal phalanx and a volar soft-tissue defect extending to the level of the metacarpophalangeal (MCP) joint. The flexor pollicis longus tendon and digital nerves are lacerated at the MP joint. Which of the following is the most appropriate method of reconstruction?
- A) Completion amputation and index finger pollicization
 - B) Transplantation of the contralateral great toe
 - C) Transplantation of the ipsilateral great toe
 - D) Widening of the first web space with a four-flap Z-plasty followed by coverage of the thumb with an innervated first dorsal metacarpal artery flap
 - E) Widening of the first web space with a four-flap Z-plasty followed by coverage of the thumb with a microvascular great toe pulp flap

The correct response is Option C.

Transplantation of the ipsilateral great toe to the thumb would provide the best function for the patient described. With the degree of shortening that occurs with the level of amputation described, lengthening of the thumb is an important component of reconstruction. This reconstruction can be accomplished with transplantation of the first or second toe, distraction lengthening of residual bone or osteoplastic reconstruction using a flap for soft-tissue coverage, and vascularized or nonvascularized bone autograft. The ipsilateral great toe provides the most complementary anatomy when transplanted to the thumb. Toe transplantation can be performed at the time of injury or in a delayed fashion.

Although pollicization of the index finger can be performed in adults, it is typically reserved for amputation from the level of the carpometacarpal joint to the middle of the metacarpal. The functional outcome and aesthetics are inferior to those of great toe transplantation to the residual portion of the thumb. Incomplete conversion of position sense following pollicization is more common in adults than in children.

For amputations through the middle to distal aspect of the proximal phalanx, widening of the first web space with Z-plasty and other local flaps or regional flaps, such as reverse radial forearm or posterior interosseous artery flaps, may provide sufficient length and motion for good function.

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181. A healthy 30-year-old woman is brought to the emergency department three hours after sustaining an amputation injury to the thumb and fingers of the dominant right hand when it was caught in an industrial roller. The amputated digits were placed in dry cloth, placed on ice, and transported with the patient. Physical examination shows amputation of the thumb through the interphalangeal and metacarpophalangeal joints. The amputations of the index, long, ring, and small fingers are through the proximal phalanges. Severe crush injuries are also noted in the thumb and index finger. Which of the following is the most appropriate management?
- A) Debridement of the stump and completion amputation of all digits
 - B) Part-by-part replantation of the long, ring, and small fingers followed by completion amputation of the thumb and index finger
 - C) Part-by-part replantation of the thumb and index finger followed by digit-by-digit replantation of the long, ring, and small fingers
 - D) Digit-by-digit replantation of the thumb and index finger followed by part-by-part replantation of the long, ring, and small fingers
 - E) Heterotopic replantation of the long finger to the thumb position, ring finger to the long finger position, and small finger to the ring finger position

The correct response is Option E.

Contraindications to replantation of hand and digits include the following:

1. Upper extremity time in the proximal to mid forearm with ischemia time greater than six hours
2. Concomitant life-threatening injuries
3. Multiple level injury
4. Severe crush or avulsion injury
5. Extreme contamination
6. Systemic illness or surgical history precluding replantation
7. Self-mutilation cases and psychotic patients

The patient described has a mutilating hand injury with severe, multiple-level, crush amputation to the thumb and index finger rendering them unsuitable for replantation. Heterotopic replantation or transpositional microsurgery is the replantation of a digit in a nonanatomic location when the native digit is unsuitable or unavailable for replantation. There is no definitive rule for heterotopic replantation in cases of mutilating hand injury. The restoration of prehensile function is the primary goal in reconstruction following mutilating hand injuries. The thumb

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accounts for 40% to 50% of hand function. Other goals include establishment of at least two digits for tripod pinch, functional web spaces, wrist stability, transverse and longitudinal arches of the hand, and aesthetically pleasing appearance. Amputated digits may be replanted at the thumb position to provide restoration of prehensile function. Although establishment of index and middle fingers may be more aesthetically appealing, the use of the long and ring finger and the intervening longer web space will aid in tripod pinch. Priorities in hand reconstruction with heterotopic replantation following mutilating hand injury should be individually tailored to the clinical situation.

Digits may be replanted “digit by digit” or “part by part.” “Digit by digit” refers to complete replantation of one digit at a time. A “digit-by-digit” repair is suitable in cases where the amputated digits have differing warm ischemia times and the digit in the best condition is replanted first in a salvage effort. “Part by part” refers to grouping the repair of a similar part for all amputated digits. Although the exact order of replantation is controversial, it typically starts with skeletal fixation before soft-tissue repair. The order is typically flexor tendons, extensor tendons, arteries, and veins. Arteries are typically repaired first, because venous efflux allows identification of veins for anastomosis. Some authors advocate venous repair first in guillotine amputations to reduce venous stasis and operative time from blood in the operating field. A “part-by-part” approach is generally used when the amputated digits all have the same degree of ischemia.

Closure of the amputated stumps would not make use of the other digits for replantation.

Although restoration of pinch is important, replantation of the severely crushed thumb and index fingers in any order would be inappropriate and would not likely survive.

Replantation of the long, ring, and small fingers alone would leave the patient without a working thumb and pinch grip.

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182. A 6-year-old boy is brought to the office because of enlargement of the index and long fingers that has been progressing since infancy. A photograph of the fingers is shown. He has not had pain. Two-point discrimination is 6 to 8 mm in the affected digits. Which of the following is the most appropriate treatment?
- A) Administration of thyroid supplements
 - B) Radiation therapy to the fingers
 - C) Ray amputation of the index finger
 - D) Surgical debulking and epiphysiodesis
 - E) Systemic administration of oral corticosteroids

The correct response is Option D.

The photograph shows a case of macrodactyly of both the index and long fingers. This deformity is caused by the development of a lipomatous hamartoma usually within the digital nerves with resulting overgrowth of the hand and fingers within the distribution of the tumor. If the affected fingers are sensate, then debulking procedures, in addition to epiphysiodesis (premature closure of the growth plates), at the distal interphalangeal, proximal interphalangeal, and metacarpophalangeal joints may slow progression of the disease process. Epiphysiodesis should be performed when the fingers are at the adult length.

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Radiation and thyroid supplementation are not known to affect the growth of such tumors and carry significant side effects. The affected digits are often insensate and stiff with cold intolerance. When indicated by painful, functionally massive overgrowth, amputation is an option, although generally not initially. Systemic administration of corticosteroids is the treatment for some forms of congenital hemangiomas.

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183. A 7-year-old boy is brought to the clinic three weeks after he underwent closed reduction and percutaneous pin fixation of a supracondylar fracture of the left humerus. A cast was applied at the time of surgery. The patient was lost to follow-up until presentation at the clinic. The parents say his pain has been poorly controlled with acetaminophen and codeine and that he has not been moving his fingers or wrist. There is no history of fever since surgery. Physical examination shows ecchymosis and edema of the left forearm and hand. Severe pain is exacerbated with passive movement of the fingers and wrist; there is no detectable active flexion of the fingers or wrist. Abduction, adduction, and extension of the fingers and wrist are weak. Strong ulnar and radial pulses are palpated at the wrist, and the fingers are warm with good color. Capillary refill time is less than two seconds. Sensation to light touch is present but diminished in the ulnar and median nerve distributions. Which of the following is the most appropriate next step in management of this patient's condition?
- A) Continued cast immobilization
 - B) Electromyography and nerve conduction studies
 - C) Immediate fasciotomies and debridement
 - D) Intravenous antibiotic therapy
 - E) Occupational therapy

The correct response is Option E.

The scenario described is a case of a delayed presentation of compartment syndrome. This presentation could result from a prolonged delay to reduction of a fracture that causes compression of the brachial artery, bleeding into fascial compartments, or a cast that is too tight. Delays in recognition of compartment syndrome result in muscle necrosis and the development of Volkmann contracture. The extent of the injury is determined by the mechanism of injury and the involvement of certain muscle compartments. Milder injuries affect the deep flexor compartments. More severe injuries affect the superficial flexor and extensor compartments and hand-intrinsic muscles.

In the absence of deep space infection or distal ischemia, acute management involves the maintenance of supple joints with physical therapy and dynamic splinting.

Reconstruction is performed once the tissues have stabilized. At the time of reconstruction, debridement of fibrotic tissue and neurolysis of the median and ulnar nerves are performed. Restoration of motion is accomplished through muscle slide, tendon transfers, and functional free muscle flaps. Four weeks after the injury, muscle necrosis has occurred and the contracture established. Fasciotomies and debridement in this period will make wound care more complex

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and increase the risk of infection. Some surgeons recommend this intervention for treatment in the late acute phase (2–10 days).

Intravenous antibiotics would not be indicated in the absence of infection.

Electromyography and nerve conduction studies are not appropriate because, although nerve injury can occur as a consequence of treatment of trauma or fracture, isolated nerve injury is not consistent with the clinical scenario described.

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184. A 37-year-old woman undergoing flexor tendon repair receives an axillary block. A tourniquet is used. Twenty minutes into the procedure, the patient says she has discomfort. Intolerance of the tourniquet is most likely caused by incomplete block of which of the following nerves?

- A) Axillary
- B) Median
- C) Musculocutaneous
- D) Radial
- E) Ulnar

The correct response is Option C.

The musculocutaneous nerve powers elbow flexion and forearm supination. Below the elbow, as the lateral antebrachial cutaneous nerve, it provides sensory function. An incompletely blocked musculocutaneous nerve is most likely to contribute to tourniquet intolerance. The axillary block is administered at the level of the terminal nerves of the brachial plexus. Both the musculocutaneous and axillary nerves leave the axillary sheath proximal to the level of injection. Because of this, they may be inadequately blocked with this anesthetic technique. Because the sensory distribution of the axillary nerve is above the level of the tourniquet application, it is less likely to contribute to tourniquet intolerance than an incompletely blocked musculocutaneous nerve. Multiple injection techniques, paresthesia elicitation, nerve stimulation, and ultrasound guidance increase the probability of a successful block. Administration of additional local anesthetic within the sheath, within the coracobrachialis muscle, or at the elbow can be used to block the musculocutaneous nerve if necessary. The interocostobrachial nerve conveys sensation from the medial aspect of the arm and must also be blocked for tourniquet tolerance.

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185. A 7-year-old boy who has cerebral palsy is brought to the office because he has a thumb-in-palm deformity of the left hand. Physical examination shows contractures of the first web space and spasticity of the adductor pollicis brevis, flexor pollicis brevis, first dorsal interosseous, and flexor pollicis longus muscles. Hyperextension of the metacarpophalangeal joint of the thumb and weakness of the abductor pollicis longus, extensor pollicis longus, and extensor pollicis brevis muscles is also noted. A photograph of the hand is shown. Which of the following is the most appropriate management?

- A) Capsulotomy of the metacarpophalangeal joint
- B) Injection of botulinum toxin into the abductor pollicis brevis muscle
- C) Release of the adductor pollicis muscle
- D) Shortening of the tendon of the first dorsal interosseous muscle
- E) Transfer of the extensor pollicis longus tendon to the ulnar aspect of the thumb

The correct response is Option C.

Of the management options listed, only release of the adductor pollicis muscle addresses a cause of the thumb-in-palm deformity associated with cerebral palsy. This deformity results from an

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imbalance caused by variable degrees of spasticity of adductors and flexors, contracture of the first web space, weakness of extensors and abductors, and laxity of the metacarpophalangeal (MCP) joint (see photographs below).

Spasticity of the flexor pollicis brevis, adductor pollicis brevis (APB), and first dorsal interosseous muscles causes flexion and adduction deformities and can be treated with release or repositioning of the muscles. The flexor pollicis longus tendon can be lengthened or used for an abductorplasty when spastic. Contracture of the skin and fascia of the first web space also resists abduction. This can be addressed at the time of muscle release through the use of local flaps and Z-plasty techniques.

Weakness of the extensor pollicis longus (EPL), extensor pollicis brevis (EPB), and abductor pollicis longus (APL) muscles prevents active extension and abduction. These deficits can be addressed with tendon transfers and tendon rerouting. The EPL can be rerouted or divided and redirected radially to provide thumb abduction. A number of muscles, including the palmaris longus, brachioradialis, flexor carpi radialis and ulnaris, extensor carpi radialis brevis and longus, and flexor digitorum superficialis, have been used as donors for tendon transfers to the APB and EPL to improve abduction and extension of the thumb. The APL and EPB tendons can be imbricated if lax.

Laxity of the MCP joint contributes to hyperextension and instability. Arthrodesis or capsulodesis can be performed to improve joint stability. Depending upon the functional status of the thumb, arthrodesis of the interphalangeal or carpometacarpal joints may be performed as alternatives to MCP arthrodesis.



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186. An otherwise healthy 30-year-old woman comes to the office for consultation regarding severe pain in both thumbs that has been worsening during the past three years. Physical examination shows severe transverse curvature of the nails of both thumbs starting from the proximal nail bed and increasing distally. The patient has no history of serious infection. Which of the following is the most appropriate management?
- A) Coverage with cross-finger flap from the dorsum of the index finger
 - B) Digital and wrist sympathectomy
 - C) Elevation of the nail plate and dermal grafting under the matrix
 - D) Removal of the nail plate and ablation of the matrix
 - E) Serial compression splinting

The correct response is Option C.

Pincer-nail syndrome has been described as constriction in the distal portion of the shape of the nails such that there is an excessive transverse curvature of the nail plate that increases from the proximal to distal, resulting in constant severe pain. The etiology of the deformity has since been attributed to many factors including psoriasis, ill-fitting shoes, developmental anomalies, β -blocking agents such as practolol, allergic reaction, underlying epidermoid cyst, subungual exostosis, and osteoarthritis.

Several authors have used dermal and collagen matrix grafts for correction. This surgery corrects the deformity by grafting soft-tissue collagen under the nail matrix, reelevating the edges.

Coverage with a cross-finger flap is not thought to be necessary for the correction of this deformity but may be useful in other nail bed deformities such as hook-nail. Sympathectomy probably would not help as this is not an ischemic etiology. Various treatments for nail ablation either with chemical or electrocautery have been described. These treatments relieve the pain but result in permanent loss of nail aesthetics and function. Serial compression splinting is occasionally used for ingrown toenails but is not described for use in pincer deformity.

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187. A 10-year-old boy is brought to the office because he has pain in the right long finger two days after sliding into second base during a baseball game. Examination shows tenderness over the proximal phalanx of the finger. A radiograph of the hands is shown. The patient is at increased risk for which of the following?

- A) Chondrosarcomas
- B) Diffuse osteoarthritis
- C) Hypertrophy of the right upper extremity
- D) Lung metastases
- E) Subcutaneous venous malformations

The correct response is Option A.

The patient described has an increased risk for development of chondrosarcomas. The patient, whose multiple enchondromas were identified because of a pathologic fracture, has either Ollier disease or Maffucci syndrome. In Maffucci syndrome, patients also have subcutaneous venous malformations. The enchondromas in either Ollier disease or Maffucci syndrome have a 20% to

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30% chance of malignant degeneration. Biopsy of the tumor should be performed, and the patient should undergo tumor surveillance.

No evidence suggests that patients with multiple enchondroma have increased risk of diffuse osteoarthritis.

Patients with Klippel-Trenaunay syndrome or capillary-lymphatic-venous malformation (CLVM) are often diagnosed at birth with soft-tissue or skeletal hypertrophy. Although the patient described may be diagnosed with Maffucci syndrome if he has subcutaneous venous malformations, he would not be at an increased risk for development of a CLVM or a hypertrophied limb.

Lung metastases can be seen with giant cell tumors. Giant cell tumors of the bone commonly affect the articular ends of long bones, and patients typically complain of pain and swelling. Radiographic examination shows a well-circumscribed eccentric lucency with no periosteal reaction, no surrounding sclerosis, no involvement in the adjacent joint, and no cell tumors of the bone.

The presence of subcutaneous venous malformations with multiple enchondromas indicates Maffucci syndrome. Having multiple enchondromas does not increase the risk for development of venous malformations.

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188. A 42-year-old man comes to the office because he has a three-month history of significantly decreased grip strength of the dominant left hand since undergoing fusion of the proximal interphalangeal (PIP) joint of the long finger for traumatic arthritis of the joint. Fusion was performed with the PIP joint held in approximately 30 degrees of flexion. Radiographs show a well-healed fusion site. Physical examination shows a 25% decrease in grip strength of the left hand compared with the nondominant uninjured hand. Full active range of motion of the distal interphalangeal and metacarpophalangeal joints of the injured finger is noted. Which of the following is the most likely cause of these findings?

- A) Disuse atrophy
- B) Extrinsic tightness
- C) Flexor tendon injury
- D) Intrinsic tightness
- E) Quadriga effect

The correct response is Option E.

A quadriga (from the Latin *quadria* [four] and *jungere* [to yoke]) is a four-horse chariot that was raced in the Olympics and other sacred games. The patient described is experiencing weakness caused by the quadriga effect imposed by the fusion of the PIP joint of the long finger.

PIP fusion is often well tolerated in the index finger because that finger's relatively independent profundus function does not impose a significant quadriga effect on the other fingers during power grasp. PIP fusion of the long finger, however, has been shown to decrease the excursion of all profundus tendons, reducing grip strength. PIP fusion restricts profundus excursion to a greater extent than distal interphalangeal (DIP) or metacarpophalangeal (MCP) joint fusion. A significant decrease in grip strength occurs when the PIP joints of the index and small fingers are fixed at less than 45 degrees and when the long and ring fingers are fused in a position of less than 60 degrees of flexion. Any time there is limitation of profundus excursion in the long through small fingers, some decrease in grip strength is expected. By fusing the PIP joint, excursion of the profundus tendon within the finger is effectively limited.

Disuse atrophy would be unlikely in the patient described, as atrophy of the muscle bellies would have to occur in the forearm, which is far away from the site of injury. Extrinsic tightness would be noted in cases where MCP flexion limits PIP flexion. Intrinsic tightness would be noted if the patient was found to have inability to flex the PIP joint with MCP extension. Flexor tendon injury is unlikely if DIP joint and MCP joint motion are normal.

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189. A 7-year-old boy is brought to the emergency department one hour after sustaining a fracture of the small finger of the nondominant left hand when he fell down a flight of stairs. A radiograph of the left hand is shown. Which of the following is the most likely diagnosis?

- A) Extra-articular fracture
- B) Fracture-dislocation
- C) Salter-Harris type I fracture
- D) Salter-Harris type II fracture
- E) Salter-Harris type III fracture

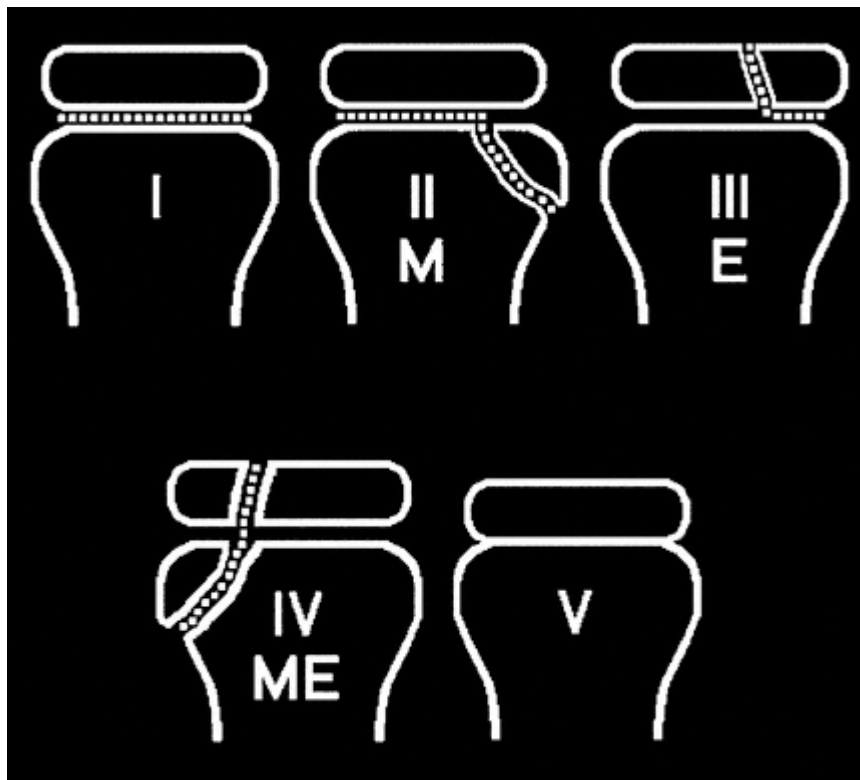
The correct response is Option A.

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This is an extra-octave fracture that does not involve the physis. The fracture line is very close to the physis but is above it. Forty-one percent of pediatric hand fractures involve the physis. Most involve the phalanges, particularly the proximal phalanx. The reason for this high rate is that the collateral ligaments insert into the epiphysis.

All Salter-Harris-type fractures involve the physis. Traditionally, pediatric physeal fractures are described using the Salter-Harris classification system. There are five types of Salter-Harris fractures (see below). Type I fractures are transphyseal. Type II are transphyseal but exit through the metaphysis. Type III are transphyseal fractures that exit the epiphysis and the joint. Type IV fractures traverse both the epiphysis and physis, exiting through the metaphysis. Type V fractures describe crush injuries to the physis.

The joint has not been affected in the fracture described and would therefore not be considered a fracture-dislocation. If it had involved the physis, this extra-octave fracture would likely have been a Salter-Harris Type II fracture, the most common type of fracture in this population.



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190. A 35-year-old woman with a 10-year history of systemic sclerosis is referred to the office for consultation regarding severe flexion contractures of the proximal interphalangeal (PIP) joints of the small and ring fingers of both hands. For the past five months, she has had increasing difficulty performing activities of daily living. Hand therapy has not been effective in alleviating the contractures. Physical examination shows shallow, clean ulcers over the dorsal PIP joints of the small and ring fingers bilaterally. Which of the following is the most appropriate management?
- A) Amputation of the affected digits
 - B) Arthrodesis of the PIP joints
 - C) Capsulotomy of the involved joints
 - D) Split-thickness skin grafting of the ulcers
 - E) Ulnar sympathectomy

The correct response is Option B.

Systemic sclerosis (scleroderma) is a systemic autoimmune disease. Affected patients may suffer from calcinosis, Raynaud phenomenon, esophageal dysfunction, sclerodactyly, and telangiectasia. Patients may develop flexion contractures, most commonly of the PIP joints. The skin over the PIP joint becomes stretched and thinned, leading to local ischemia and ulceration. Surgery should be reserved for severe cases where patients have severe disability or digital ulceration. Arthrodesis of the affected joints in moderate flexion coupled with bone shortening will allow ulcer closure and address the underlying contracture. In cases where there has been compensatory metacarpophalangeal (MCP) hyperextension and loss of mobility at the MCP joint, it may be necessary to perform MCP capsulotomy prior to proceeding with PIP joint arthrodesis.

Amputation of the affected digits will reduce hand function (grip strength) and risks poor healing and infection.

Capsulotomy of the PIP joints is not appropriate because it does not address the underlying flexion contracture and deformity will persist.

Split-thickness skin grafting of the ulcers does not address the underlying pathophysiology, and the ulcers will recur.

Ulnar sympathectomy is a treatment for Raynaud phenomenon and does not address the issue of interphalangeal joint flexion contracture.

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191. A 63-year-old woman comes to the office because she has sharp pain in the thumb of the dominant right hand at the level of the basilar joint that has been increasing for the past two years. A radiograph of the right hand is shown. In the natural progression of this disease, which of the following pathologic processes is most likely to appear first?

- A) Decreased vascularity from the recurrent branch of the radial artery to the scaphoid
- B) Disruption of the abductor pollicis longus tendon
- C) Formation of osteophytes in the first metacarpophalangeal joint
- D) Laxity of the volar anterior oblique (beak) ligament
- E) Synovitis of the abductor pollicis longus and extensor pollicis brevis tendons

The correct response is Option D.

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The clinical history and radiograph show classic arthritis of the basilar joint of the thumb. The basilar joint of the thumb is the second most common joint affected by arthritis. One third of postmenopausal women have radiographic evidence of arthritis. The basilar joint of the thumb, the second most common site of arthritis, comprises four articulations among the trapezium, scaphoid, trapezoid, and thumb metacarpal. The anterior oblique (beak) ligament is the primary stabilizer of the trapeziometacarpal joint of the thumb. Laxity of this ligament is generally the first sign in basilar joint arthritis. This laxity is generally followed by articular damage in the palmar articular surface of the scaphoid, which can progress to osteophyte formation and complete loss of the scaphoid articular surface. The radiograph shows a normal sesamoid bone at the first metacarpophalangeal joint. Vascularity of the scaphoid is supplied by a recurrent branch of the radial artery. Trauma to the radial aspect of the wrist can cause fractures of the scaphoid, which may have delayed healing because of disruption of blood supply.

Preiser disease, or avascular necrosis, is not shown on the radiograph. When evaluating patients with pain at the base of the thumb, consideration of the scaphoid and scaphoid nonunion should always be taken into account. De Quervain disease is irritation of the abductor pollicis longus and extensor pollicis brevis tendons as they go through the first dorsal compartment of the wrist. The clinical scenario described does not support this diagnosis.

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192. An 18-year-old man comes to the office for follow-up examination because he has a four-month history of tripping with numbness and tingling of the right leg and foot. He underwent arthroscopic anterior cruciate ligament (ACL) grafting five months ago after he dislocated the right knee and ruptured the ACL during a football game. Physical examination shows weakness of dorsiflexion of the foot. Decreased sensibility to light touch over the lateral aspect of the right leg is noted. Which of the following is the most likely cause of his symptoms?

- A) Compartment syndrome
- B) Compression of the common peroneal nerve
- C) Laceration of the deep peroneal nerve
- D) Laceration of the superficial peroneal nerve
- E) Neurapraxia of the tibial nerve

The correct response is Option B.

Compression of the common peroneal nerve is the third most common nerve compression syndrome (carpal tunnel syndrome is first and cubital tunnel syndrome is second) and the most common nerve compression syndrome in the lower extremity. Knee dislocations are a common cause of common peroneal nerve compression. The patient described has a chronic injury that has not caused complete paralysis or loss of sensibility. The initial injuries would likely cause scar tissue around the knee but are not sharp in nature. Compression of the common peroneal nerve would result in weakness in the anterior compartment muscles caused by slowing of conduction in the deep peroneal nerve and paresthesias to the superolateral foot caused by slowing of conduction in the superficial peroneal nerve.

Compartment syndrome is caused by elevation of interstitial pressure (>30 mmHg) in the closed fascial compartment that results in microvascular compromise often secondary to a crushing injury or a high-force trauma. As duration and magnitude of interstitial pressure increase, myoneural function is impaired and necrosis of soft tissues eventually develops. Symptoms of an anterior compartment syndrome include extreme pain out of proportion to the injury and painful plantar flexion of the foot and toes.

The superficial peroneal nerve travels in and supplies the muscles of the lateral compartment of the leg. This nerve can be injured during an open reduction and internal fixation of a fracture of the ankle. A laceration of this nerve would not cause foot drop. The deep peroneal nerve travels in and supplies the muscles to the anterior compartment. Laceration of this nerve would cause foot drop but not decreased sensibility to the leg.

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A neurapraxia of the tibial nerve at the level of the knee would affect the plantar flexors of the foot and toes. A tibial nerve injury would also cause planar foot paresthesias, which is the opposite of what the patient described is experiencing.

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193. An 18-year-old man is brought to the emergency department after being involved in a motor vehicle collision in which a car rolled onto his dominant right forearm. Physical examination shows a crush injury to the right forearm. Radiographs show no fractures. Urgent decompression of the hand and forearm and debridement of soft tissue are performed because of rapidly progressive compartment syndrome. A photograph of the patient's forearm 10 days after the procedure is shown. Which of the following is the most appropriate next step in management?

- A) Coverage with a random abdominal flap
- B) Coverage with a scapular free flap
- C) Full-thickness skin grafting
- D) Intraoperative skin expansion and closure with a local flap
- E) Split-thickness skin grafting

The correct response is Option E.

Split-thickness skin grafts allow for large defects to be covered with skin that will contract with time. In fasciotomy defects following crush injuries, the extremity remains swollen for an extended time. As the swelling subsides, the split graft will contract. A full-thickness graft would not contract as well and would require a large donor site defect for this sizable area.

Burying the forearm in an abdominal flap would yield a very bulky forearm and prevent physical therapy to the extremity while it is attached to the abdomen.

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A free flap is unnecessary, as there are no exposed structures (nerve, tendon, or bone) that require vascularized coverage. Under different circumstances, the scapular free flap provides a fairly large surface area of thin skin.

The defect in the patient described is too large for intraoperative skin expansion and would put the underlying structures under pressure.

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194. A 45-year-old man who is employed as a construction worker comes to the office because of pain in the small and ring fingers of the nondominant left hand. He says the pain worsens and the fingers become blotchy on exposure to cold. He has smoked one pack of cigarettes daily for 30 years. Examination shows subungual hemorrhages in the small finger and a digital brachial index of 0.4. Arteriography shows segmental occlusion of the ulnar artery at the wrist. Which of the following is the most appropriate management of this patient's condition?

- A) Administration of a calcium channel blocker
- B) Intraarterial thrombolysis/fibrinolysis
- C) Resection and reconstruction of segmental ulnar artery
- D) Smoking cessation
- E) Stellate ganglion block

The correct response is Option C.

Hypothenar hammer syndrome (HHS) describes digital ischemic symptoms secondary to either occlusion or aneurysmal dilation of the ulnar artery adjacent to the hamate. Although typically related to activities that involve repetitive trauma (eg, use of vibrating tools) to the palm, evidence exists to suggest that the condition arises in vessels with preexisting abnormalities, even in the absence of trauma.

In cases of critical digital ischemia with characteristic segmental occlusion on arteriography, optimal treatment involves resection of the diseased segment and reconstruction. Reversed vein graft represents the standard bypass conduit; however, as in coronary artery bypass grafting, arterial conduits (inferior epigastric artery) have been suggested as better matched in size and less prone to aneurysmal dilation later.

Calcium channel blockers and sympathetic blockade may alleviate vasospastic responses in the patent vessels distal to the occlusion. These interventions may be combined with surgical therapy and can be considered as primary interventions in patients with less symptomatic hands and a digital brachial index less than 0.7.

Intraarterial thrombolysis should not be used in the setting of the chronic, occlusive disease of HHS.

Smoking has been associated with HHS, but cessation alone in the setting of severe ischemia will not reverse the changes.

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195. A 45-year-old man is brought to the emergency department two hours after sustaining an avulsion injury to the thumb of the dominant right hand while roping a horse. The amputated part (shown) is too badly damaged for replantation. Two hours later, the patient says he has increasing pain in the forearm. On physical examination, firmness of the forearm is noted. Active extension of the fingers is limited to 120 degrees, 60 degrees less than on initial evaluation. Loss of sensation to pinprick over the entire hand is noted. Which of the following is the most appropriate next step in management?

- A) Administration of corticosteroids
- B) Application of cold compresses
- C) Carpal tunnel release
- D) Elevation of the arm
- E) Forearm fasciotomy

The correct response is Option E.

The patient described has a case of impending compartment syndrome. The cardinal signs of evolving compartment syndrome are

- pain disproportionate to the injury
- palpably swollen compartments
- pain on passive stretching of the involved muscles
- diminished perception of simple touch
- decreased strength of the involved muscles
- hypesthesia or anesthesia

A significant amount of forearm hemorrhaging can occur after avulsion injuries such as the one shown in the photograph. The surgeon must suspect compartment syndrome and proceed to

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surgery. None of the other treatment modality options listed are adequate in light of the severity of symptoms.

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196. A 36-year-old man comes to the office for follow-up examination four months after undergoing revision amputation at the distal interphalangeal joint of the left long finger to repair a partial traumatic amputation injury. Since undergoing the procedure, the patient has had difficulty making a fist. Physical examination shows extension of the proximal interphalangeal (PIP) joint when the metacarpophalangeal (MCP) joint is actively flexed. The patient has full active and passive range of motion of the PIP joint when the MCP joint is extended. Radiographs show no abnormalities. Which of the following is the most appropriate next step in management?

- A) Dynamic flexion splinting
- B) Fusion of the PIP joint
- C) Injection of a corticosteroid into the area of the A1 pulley
- D) Surgical release of the lumbrical
- E) Tenolysis

The correct response is Option D.

The patient described has a lumbrical plus deformity. This deformity occurs following amputation when proximal migration of the profundus tendon results in contracture of the lumbrical muscle. This contracture can result in tightness of the lumbricals, which produces paradoxical extension of the PIP joint during active flexion of the MCP joint. The lumbrical muscle is a component of the intrinsic extensor mechanism, which is responsible for MCP flexion and PIP extension. The lumbrical plus deformity is treated most appropriately by division of the lumbrical tendon.

Dynamic flexion splinting is occasionally used for extension contractures of the PIP joint caused by joint stiffness. Fusion of the PIP joint is indicated for cases of arthritis. Injection of a corticosteroid is appropriate if the patient has active triggering at the level of the A1 pulley. Tenolysis is used when flexor tendon adhesions are suspected (when passive joint motion is greater than active joint motion).

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197. A 7-year-old girl is brought to the office by her parents because she has a deformity of the left hand. Medical history is unknown because the patient was recently adopted. She is otherwise healthy. Examination of the right hand shows no abnormalities. Her parents say that she is able to play with her toys with both hands and can pick up small objects with the left hand. A photograph of the hands is shown. Which of the following is the most appropriate option for surgical reconstruction?

- A) Distraction lengthening of the thumb
- B) Microvascular transfer of second and third toes to the index and long finger positions
- C) Microvascular transfer of second and third toes to the small and ring finger positions
- D) Transfer of toe phalangeal epiphysis to the index and long finger positions
- E) No surgical reconstruction

The correct response is Option E.

Congenital hand deformities present a challenge to the patient, parents, and the reconstructive surgeon. Transverse arrest or congenital amputations may present as a failure of formation or arrest of development of the limb. Operative indications for this group of patients are often limited but are driven by the function of the child. The patient described is a very functional child who uses her limb for complex grasping activities; therefore, no surgery is indicated. Distraction lengthening of the thumb is not appropriate for the patient described since it may impede pulp-to-pulp opposition of the radial and ulnar digits. Microvascular transfer of one or two toes may be a worthwhile procedure in children with no opposable digits and no functional use of their hand. However, in the patient described, this procedure is not appropriate because

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function is already satisfactory. Toe epiphysis nonvascular transfers have been indicated in congenitally short digits, but for the patient described there are no normal phalanges to warrant this procedure.

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198. A 35-year-old man sustains a laceration of the volar aspect of the left index finger at the level of the mid phalanx while using a knife. There is smooth flexion and extension of the proximal interphalangeal and distal interphalangeal joints. Examination of the fingertip shows good color and capillary refill. Two-point discrimination is 5 mm on the ulnar aspect of the fingertip but is absent on stimulation of the radial aspect. On exploration, a laceration involving 45% of the cross-sectional area of the flexor digitorum profundus (FDP) tendon is noted. The radial digital nerve and artery are transected. The ulnar neurovascular bundle is intact. In addition to repair of the radial digital nerve, which of the following is the most appropriate management?
- A) Immediate protected mobilization
 - B) Repair of the FDP tendon with core and epitendinous sutures and splint immobilization for two weeks followed by protected mobilization
 - C) Repair of the FDP tendon with core sutures and splint immobilization for two weeks followed by protected mobilization
 - D) Repair of the FDP tendon with epitendinous sutures and splint immobilization for four weeks followed by protected mobilization
 - E) Splint immobilization for four weeks followed by protected mobilization

The correct response is Option A.

Tendon lacerations of less than 60% of the cross-sectional area of the tendon do not require repair. Attempts to repair the tendon may weaken it. Triggering may occur if the distal or proximal cut edge of the tendon catches on adjacent pulleys. If triggering occurs, trimming the cut edges of tendon, partial or complete pulley release, and repair of the flexor sheath can be performed. In cases of persistent triggering that persists despite these measures, the tendon can be repaired. In the absence of triggering, the tendon does not require treatment. Protected mobilization is performed to promote tendon gliding and strengthening. Despite early recommendations for several weeks of immobilization following digital nerve repair, the outcomes of digital nerve function following immediate protected mobilization are not statistically different than those managed with immobilization.

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199. A 28-year-old man who is an amateur motorcycle stunt driver comes to the emergency department because he has progressively worsening pain and numbness in the left hand three hours after injuring the left wrist in a motorcycle misadventure. Radiographs of the wrist are shown. He has previously fractured both scaphoids in similar accidents. The scaphoid fractures are not united. An operating room is not available for at least six hours. Which of the following is the most appropriate next step in management?

- A) Closed reduction
- B) Contrast arthrogram
- C) Contrast MRI
- D) Injection of corticosteroid into the left wrist
- E) Plaster splinting

The correct response is Option A.

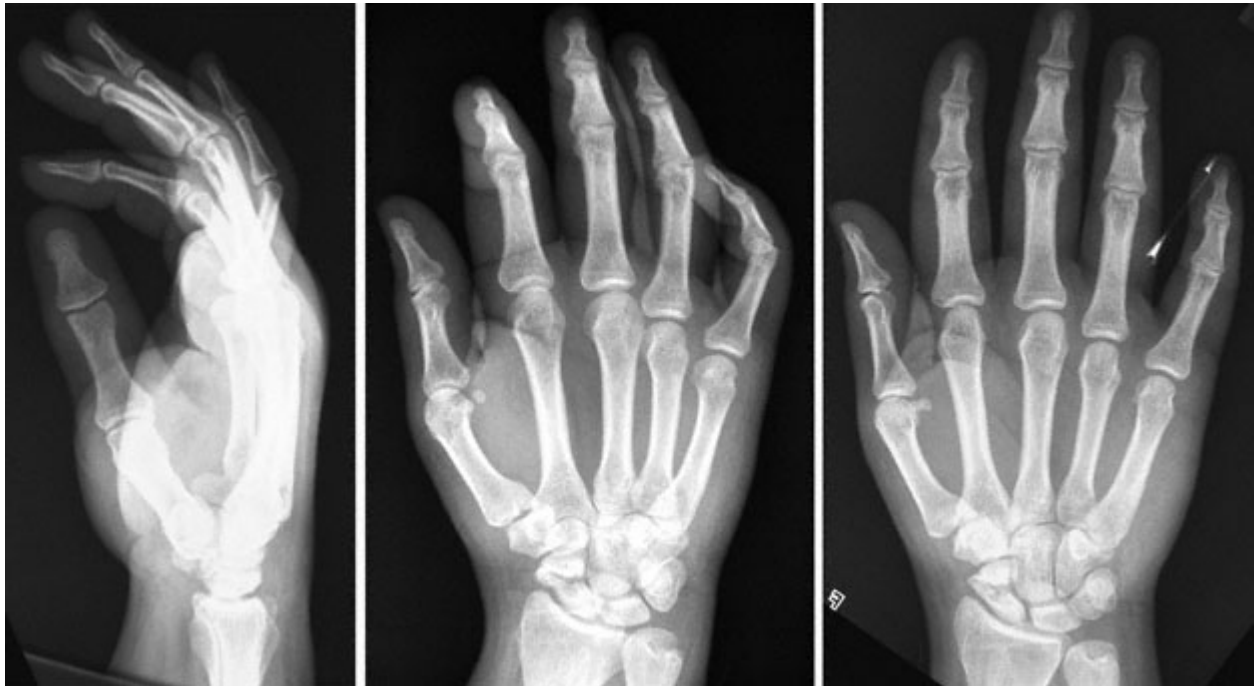
The patient described has a closed right dorsal perilunate, transscaphoid, transulnar styloid fracture-dislocation. In the scenario described, with no immediate operating room availability and with worsening pain and numbness, the most appropriate treatment is closed reduction followed by splinting, which can be performed in the emergency department under conscious

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sedation. When an operating room becomes available, the injuries to ligament and bone can be open repaired or reconstructed.

The critical element is reduction to alleviate the numbness and pain. Splinting follows successful reduction. None of the other options listed addresses correction of the dislocation. The injection of corticosteroid, arthrogram, and MRI are not required for operative management.

Postoperative radiographs are shown.



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200. A 24-year-old man has defects over the dorsal aspect of the proximal phalanges of the index and long fingers after sustaining a grinder injury. The extensor tendon of the index finger is denuded of peritenon over a 1-cm-diameter area extending from the metacarpophalangeal joint to the proximal interphalangeal joint. A skin graft is planned to reconstruct the defect over the long finger. Which of the following flaps is most appropriate to reconstruct the defect over the index finger?
- A) Adipofascial turndown
 - B) Cross-finger
 - C) Dorsal thumb metacarpal transposition
 - D) Reverse posterior interosseous artery
 - E) Reverse radial forearm

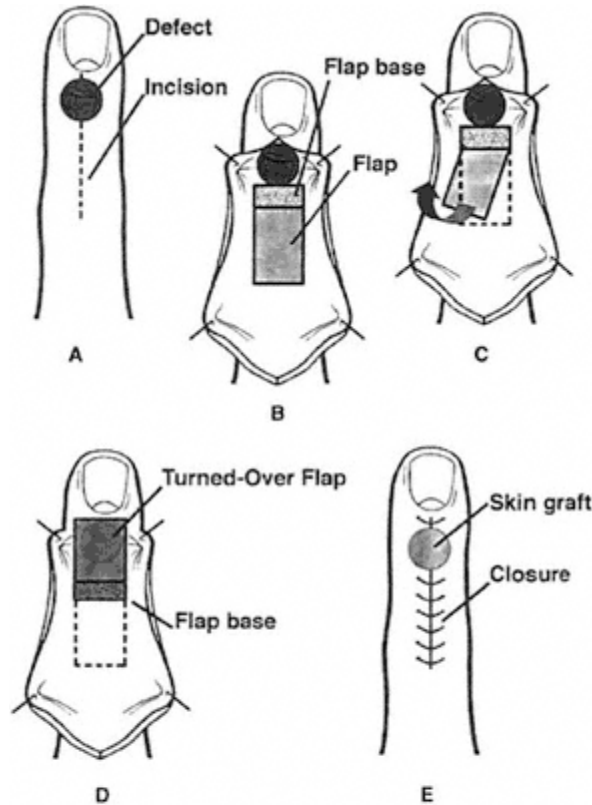
The correct response is Option A.

Small, dorsal defects of the fingers can be reconstructed via a number of local flaps; as in many other parts of the body, adipofascial turnover flaps have been developed for the upper extremity, hand, and fingers. Advantages of these flaps include almost limitless donor sites, single stage reconstruction, and minimal donor site morbidity.

For coverage of dorsal digital defects, adipofascial turnover flaps are designed with the base of the flap proximal to the defect. The flap itself is designed to be 2 to 4 mm wider than the skin defect with a base-to-length ratio of 1:1.5 to 1:3. A longitudinal incision over the center of the flap allows dissection of the flap from the overlying skin. The adipofascial flap is then elevated from proximal to distal from the underlying paratenon. Elevation stops approximately 0.5 to 1 cm proximal to the defect to create the base of the flap; the flap is then turned over into the digital defect and covered with a split-thickness skin graft (see the figure below).

Given the damage to the adjacent long finger, a cross-finger flap would not be possible. A transposition flap from the dorsal thumb may suffice for first web resurfacing but will not adequately reach the dorsal index finger.

Both the posterior interosseous artery and radial-artery–based flaps are capable of resurfacing sizable defects on the hand and fingers; however, the added morbidity of harvesting these flaps does not warrant their use when a more suitable local flap is available.



Figures reproduced with permission from Al-Qattan MM. De-epithelialized cross-finger flaps versus adipofascial turnover flaps for the reconstruction of small complex dorsal digital defects: a comparative analysis. *J Hand Surg [Am]*. 2005;30:549-557.

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Thank you for your participation.

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