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When your answers have been submitted successfully, you will be directed to an online survey about your examination experience. Your participation is critical to future planning so please answer all the questions.

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# American Society of Plastic Surgeons In-Service Examination



AMERICAN SOCIETY OF  
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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 2017.

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for the

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# Section 1: Comprehensive

1. A 75-year-old man who had femoral-popliteal bypass surgery 2 weeks ago has an infection in the proximal groin. A muscle flap to fill the dead space is planned. Which of the following muscle flap options has a type IV Mathes-Nahai (multiple segmental vascular pedicles) vascular anatomy?

- A) Gracilis
- B) Rectus abdominis
- C) Rectus femoris
- D) Sartorius
- E) Vastus medialis

The correct response is Option D.

The sartorius muscle classically has a type IV Mathes-Nahai vascular anatomy, which may limit its arc of rotation. In a recent study, even though the sartorius muscle has multiple segmental pedicles, there tend to be codominant superior and inferior pedicles that could possibly allow for the majority of the muscle to be raised on either the superior or inferior dominant pedicle.

Mathes-Nahai vascular anatomy classification for muscle flaps:

I – Single dominant vascular pedicle

II – Single dominant vascular pedicle with secondary minor vascular pedicles

III – Codominant major vascular pedicles

IV – Multiple segmental vascular pedicles

V – Dominant vascular pedicle with segmental secondary pedicles that can supply muscle if dominant is divided

Type II vascular anatomy is seen with the rectus femoris, vastus medialis, and gracilis muscles. The rectus abdominis has a type III vascular anatomy. Type V would be a latissimus dorsi muscle flap.

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2. A 76-year-old woman with a history of left modified radical mastectomy and radiation therapy comes to the office because of a chronic wound of the left axilla associated with limitation of abduction and exposed rib at the wound base. A photograph is shown. Examination of a biopsy specimen excludes malignancy. In addition to appropriate debridement, which of the following is likely to be most effective in achieving wound closure?
- A) Adjacent tissue transfer
  - B) Left latissimus dorsi myocutaneous flap
  - C) Negative pressure wound therapy
  - D) Radial forearm fasciocutaneous free flap
  - E) Split-thickness skin graft

The correct response is Option B.



The best option to achieve wound closure in this patient is an ipsilateral latissimus dorsi myocutaneous flap. For chronic wounds in an irradiated field, the best option is debridement followed by transfer of healthy, nonirradiated tissue. Negative pressure wound therapy is likely to result in a recurrent chronic wound, albeit a clean one. Split-thickness skin graft would be inappropriate in an irradiated wound bed with exposed bone. Autologous fat grafting can help improve the quality of irradiated tissues in the absence of a wound, and some studies have shown promise in the treatment of superficial radiation ulcers; however, this patient has necrotic rib, and following debridement the wound will be deep and large. Although wound management and fat grafting have been shown to promote healing in isolated cases, this approach is not yet an accepted standard of care. Adjacent tissue transfer will employ irradiated tissue, and is thus prone to necrosis, wound breakdown, and recurrent chronic wound formation. A free flap could be an option, but a forearm flap would not have the volume required for the expected defect. In addition, a free flap is more morbid than a local pedicled flap in this elderly patient.

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3. A 35-year-old woman is scheduled for abdominoplasty with flank liposuction. Regional anesthetic block is planned. The most appropriate location for placement of the anesthetic is between which of the following?
- A) External oblique muscle and internal oblique muscle
  - B) Internal oblique muscle and transversus abdominis muscle
  - C) Skin and external oblique muscle
  - D) Transversalis fascia and peritoneum
  - E) Transversus abdominis muscle and transversalis fascia

The correct response is Option B.

The transversus abdominis plane (TAP) block is a regional anesthetic that blocks sensory afferent nerve fibers that supply the anterior/lateral abdominal wall dermatomes of T6-L1. These sensory nerves travel below the internal oblique muscle in the plane above the transversus abdominis muscle. Traditionally, the technique is performed blindly by placing a needle through the triangle of Petit posteriorly until the needle reaches the TAP. Once the needle is in the appropriate plane, 20 mL of a long-acting local anesthetic, such as bupivacaine, is injected. More recent modifications include the use of ultrasound guidance to optimize precise placement and the use of diluted long-acting multivesicular liposomal bupivacaine (Exparel). Several studies have demonstrated the benefits of a TAP block during abdominal surgery. These benefits include decreased pain, opioid use, and nausea/vomiting, as well as faster return of bowel function. Complications include potential systemic toxicity due to dose of anesthetic delivered/inadvertent intravascular injection and intraperitoneal injection with possible injury to intraabdominal organs such as, the liver or spleen.

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2. Fayeizadeh M, Petro CC, Rosen MJ, et al. Enhanced Recovery after Surgery Pathway for Abdominal Wall Reconstruction: Pilot Study and Preliminary Outcomes. *Plast Reconstr Surg*. 2014 Oct;134(4 Suppl 2):151S-159S.

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4. A 72-year-old man is referred for surgical treatment of a 3-cm, tender red mass on the left elbow. It developed spontaneously over the past 3 weeks, and has not improved with 10 days of oral cephalexin therapy. During incision and drainage, the mass is found to be filled with copious milky white fluid with white solid granules. Pathology shows crystal deposits in the fluid. In addition to wound packing, which of the following is the most appropriate therapy?

- A) Colchicine
- B) Doxorubicin
- C) Fluconazole
- D) Methotrexate
- E) Vancomycin

The correct response is Option A.

This patient has gout and presents with a gouty tophus of the elbow. The red nodule over a joint with milky white fluid is diagnostic. The treatment of choice is an anti-inflammatory agent, and colchicine is the most common. Gout results from an imbalance in purine metabolism, resulting in uric acid crystal deposition in the joints. The great toe is most commonly affected, classically known as podagra. When these nodules occur in the upper extremity, it is easy to misdiagnose them as bacterial in origin. For unknown reasons, gout is more common in men and occurs more frequently after surgery of any type.

Vancomycin would be appropriate for a severe, systemic bacterial infection such as methicillin-resistant *Staphylococcus aureus* (MRSA). In this case, purulent drainage would be expected, rather than the milky fluid with granules that was encountered.

Fluconazole is an antifungal. Methotrexate is used to treat rheumatoid arthritis, not gout. Doxorubicin is an antineoplastic chemotherapy agent and would be used to treat a biopsy-confirmed cancer.

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2. Tsai DM, Borah GL. Implications of Rheumatic Disease and Biological Response-Modifying Agents in Plastic Surgery. *Plast Reconstr Surg*. 2015 Dec;136(6):1327-36.

5. A 3-year-old girl is undergoing tissue expansion of the scalp and forehead for resection of a giant congenital nevus. Which of the following changes is most likely to be observed in the area undergoing expansion?
- A) Increased adipose tissue
  - B) Increased blood flow
  - C) Increased muscle mass
  - D) Thickening of dermis
  - E) Thinning of epidermis

The correct response is Option B.

The most likely change to the area undergoing expansion is increased blood flow. Expansion causes increased angiogenesis and vascularity to the tissues, which improves survival when flaps are rotated or transposed. Tissue expansion also causes 1) thickening of the epidermis and hyperkeratosis (this resolves after removal of the expander); 2) thinning of the dermis (which normalizes after approximately 2 years); 3) thinning and reduced muscle mass (without diminished function); and 4) permanent loss of up to 50% of adipose tissue.

## REFERENCES:

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6. A 45-year-old woman undergoes breast reconstruction with a transverse rectus abdominis musculocutaneous (TRAM) flap. During donor site closure, a size-0 absorbable suture that maintains the greatest strength over time is desired for closure of Scarpa fascia. Which of the following sutures is most appropriate?

- A) Chromic gut
- B) Poliglecaprone (Monocryl)
- C) Polydioxanone (PDS)
- D) Polyglactin (Vicryl)
- E) Polypropylene (Prolene)

The correct response is Option C.

Chromic gut is an absorbable natural monofilament suture whose strength decreases to 50% in approximately 14 days, with near complete loss of strength at approximately 3 weeks.

Polyglactin (Vicryl) is an absorbable synthetic polyfilament suture whose strength decreases to 50% in approximately 2 to 3 weeks, with near complete loss of strength at approximately 1 month.

Poliglecaprone (Monocryl) is an absorbable synthetic monofilament suture whose strength decreases to 50% in approximately 7 to 10 days, with near complete loss of strength at approximately 3 weeks.

Polydioxanone (PDS) is an absorbable synthetic monofilament suture whose strength decreases to 50% in approximately 4 weeks, with near complete loss of strength at approximately 6 weeks.

Polypropylene is a a nonabsorbable synthetic monofilament suture.

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7. A patient presents with an 8-cm linear laceration to the forearm from a bicycle accident. Compared with typical suturing techniques, which of the following outcomes is more likely with a cyanoacrylate glue–only closure?

- A) Dehiscence
- B) Hyperpigmentation
- C) Infection
- D) Keloid scarring
- E) Pain

The correct response is Option A.

While cyanoacrylate glue closures such as Dermabond and Indermil offer the advantages of speed, ease-of-use, and comfort in the closure process, some studies show that the outcomes are unpredictable, especially for longer lacerations. One pediatric groin hernia incision closure showed a 24% dehiscence rate, while a porcine study of 10-cm lacerations showed a 15% dehiscence rate. Glue closures do have a role in smaller, tension-free lacerations, particularly in children or others who may not easily tolerate traditional closure. This simplicity of closure does come with the cost of a higher dehiscence rate, so glue closures may be inappropriate for longer, more complex wounds. When used as an adjunct to a comprehensive subdermal interrupted closure, it appears that the dehiscence rate normalizes. Data are less convincing on long-term scar results, but it does not appear likely that glue closures improve or worsen scarring to any appreciable extent for wounds that achieve primary healing without disruption.

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8. A 45-year-old woman with scleroderma is evaluated because of a 2-year history of severe resting pain in both hands. She does not smoke cigarettes. Despite appropriate medication therapy, she has had no relief of her symptoms. Injection of botulinum toxin type A into which of the following locations is the most appropriate treatment for this patient's Raynaud phenomenon?

- A) Around the stellate ganglion
- B) Intradermal at the wrist
- C) Intradermal in the palm
- D) Perivascular at the wrist
- E) Perivascular in the palm

The correct response is Option E.

Injection of botulinum toxin around the digital vessels in the palm has been shown to decrease pain associated with vasospastic disorders like Raynaud phenomenon. This is a relatively quick, easy, and low-risk method of treating a patient with incapacitating ischemic pain of the hand. The exact mechanism by which botulinum toxin works in this clinical scenario is still under investigation, but some theories suggest an effect on the vessels and/or nerves of the hand through inhibition of sympathetic nerves, sensory nerves (c-fibers), substance P, and/or other signal transduction pathways. Studies show a 75 to 100% reduction in pain and up to 50% healing of chronic ulcers. Approximately 10 units of botulinum toxin is bathed around each of the digital neurovascular bundles in the palm. The most common side effect reported is temporary minor intrinsic hand weakness.

Injecting botulinum toxin in the skin or too proximally in the wrist has not shown the same response as around the digital neurovascular bundles in the palm. Surgical sympathectomies by stripping the adventitia of the digital and wrist vessels have also shown some success in symptom control. Stellate ganglion blocks have also been used for this purpose among others (complex regional pain syndrome); however, local anesthetics, not botulinum toxin, are used to block the ganglion.

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9. A 55-year-old man who recently underwent a cardiac bypass procedure has a sternal infection that requires debridement. The defect is evaluated, and reconstruction using an omental flap is planned. Which of the following vessels provides the blood supply for this flap?

- A) Gastroepiploic
- B) Left gastric
- C) Right gastric
- D) Short gastric
- E) Superior mesenteric

The correct response is Option A.

The omental flap is supplied by the gastroepiploic vessels. Common options for sternal wound reconstruction include the pectoralis major, rectus abdominis, latissimus dorsi, and omental flaps. The use of an omental flap for a mediastinal defect was described in the 1970s; however, muscle flaps became a popular choice for reconstruction in the 1980s. Based on the size of the defect, the omental flap can be used with or without a skin graft. The omentum has angiogenic and immunogenic properties that make it ideal for reconstruction of sternal wound infections.

The omentum is based on the left and right gastroepiploic vessels. In order to increase length, the flap can be based on one set of vessels, usually the right gastroepiploic vessels. The left gastroepiploic vessels are a branch of the splenic vessels; the right gastroepiploic vessels are a branch of the gastroduodenal vessels. Harvest can be performed through either an upper abdominal incision, transdiaphragmatic, or laparoscopically. There is a risk of donor site morbidity such as abdominal wound infections or symptomatic hernias.

The superior mesenteric vessels supply the lower part of the duodenum extending to the middle third of the transverse colon, as well as the pancreas. The left and right gastric vessels supply the lesser curvature of the stomach. The short gastric vessels supply a portion of the greater curvature of the stomach and are branches of the splenic vessels. The left and right gastroepiploic vessels supply the greater curvature of the stomach along with the omentum.

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10. A 23-year-old man comes to the office for post-traumatic cranial reconstruction 6 months after a motor vehicle collision. Physical examination shows a  $5 \times 4$ -cm full-thickness calvarial defect in the left parietal region. A titanium/hydroxyapatite cement cranioplasty reconstruction is planned. Which of the following mechanisms best describes the healing process associated with hydroxyapatite?

A) Endochondral ossification

B) Osteochondrosis

C) Osteoconduction

D) Osteogenesis

E) Osteoinduction

The correct response is Option C.

Restoration of craniofacial contour after infection, tumor resection, or trauma can be quite challenging. Autologous bone grafts have long been considered the gold standard because of their high likelihood of osseointegration/healing, and low risk of rejection or infection. Autologous bone grafts, however, have several drawbacks including unpredictable resorption, donor site morbidity, limited availability, prolonged operative times, and difficulty to contour. As a result, there has been an ongoing search for alternative means of reconstruction with alloplastic material.

The ideal bone substitute should be chemically inert, easily contoured, able to retain a stable shape over time, strong, resistant to infection or foreign body reaction, inexpensive, and capable of osseointegration and tissue ingrowth.

Methylmethacrylate has been used frequently for calvarial reconstruction but suffers several drawbacks, including infection requiring removal of implant, plate fracture, lack of osseointegration, difficulty shaping after polymerization, and necrosis of surrounding tissue due to the exothermic nature of the curing process.

Among the most promising and well-tolerated alloplastic materials for craniofacial skeletal reconstruction are the calcium phosphate-based compounds.

Hydroxyapatite  $[\text{Ca}(\text{PO}_4)_6(\text{OH})_2]$  forms the principal mineral component of bone and constitutes 60% of the calcified human skeleton. Calcium phosphate compounds are bioactive and capable of osteoconduction and osseointegration.

Osseointegration refers to the direct chemical bonding of an alloplast to the bony surface without an intervening fibrous tissue layer. During osteoconduction

(creeping substitution), the alloplast acts as a nonviable scaffold for ingrowth of blood vessels and osteoprogenitor cells from the recipient site. Subsequently, the graft/alloplast is resorbed and replaced with new bone. This mechanism is also associated with the healing of cortical bone grafts.

Hydroxyapatite (HA) cement is a mixture of tetracalcium phosphate and dicalcium phosphate anhydrous, which react in an aqueous environment to form a paste that can be easily applied and sculpted to fit the surgical defect. HA cement sets isothermally, so there is no risk of thermal damage to the surrounding tissues. Additional benefits of HA include “off the shelf” ease of use, maintenance of volume over time, lack of radiologic scatter, and low incidence of infection.

Osteoinduction refers to the direct stimulation of mesenchymal cells at the recipient site by bone morphogenetic protein to differentiate into osteoprogenitor cells. This mechanism of action is associated with the healing of cancellous bone grafts and demineralized bone matrix. Endochondral ossification is the process by which the cartilaginous soft callus covering a fracture is transformed into bone. Osteogenesis is the process by which vascularized bone grafts heal. Viable osteocytes survive the transplantation process and produce new bone at the recipient site. Osteochondrosis refers to a family of ossification disorders in children.

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11. A 50-year-old woman with systemic lupus erythematosus is evaluated because of a nonhealing ulcer of the right lower extremity. It started as a small pustule 3 months ago and steadily worsened to an ulcerative lesion. Examination of a biopsy specimen ruled out malignancy. Cultures have been negative for more than 4 weeks. Debridement of the wound and skin grafting are attempted but result in loss of the graft and development of similar ulcerative areas at the donor site. Which of the following is the most appropriate next step in management?

- A) Bilayer skin substitute
- B) Fasciocutaneous flap
- C) Hyperbaric oxygen therapy
- D) Long-term antibiotic therapy
- E) Systemic corticosteroid therapy

The correct response is Option E.

The most appropriate next therapy option for this patient is systemic corticosteroids. These ulcerative lesions are most likely pyoderma gangrenosum (PG), an ulcerative cutaneous condition of unknown etiology. This condition is most likely associated with other systemic diseases like inflammatory bowel disease, or immunologic diseases. This diagnosis is usually one of exclusion, and one must have a high index of suspicion for ulcerative wounds that are persistent despite adequate workup and treatment. One must be especially aware of PG's association with a condition known as pathergy. This is a phenomenon in which surgical manipulation of the area or distant sites may trigger worsening of the ulcerative condition and/or development of the condition in an area of skin trauma. First-line therapy for PG involves the use of prednisone. Other anti-inflammatory agents, including immunosuppressive agents, and biologic agents have also been used. The prognosis is generally good; however, the disease can recur and residual scarring is common. Because of these factors, the other options are not the most appropriate next steps in the treatment of this patient.

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12. A 73-year-old man has recently undergone Mohs micrographic surgery for a basal cell carcinoma of the nasal sidewall with a resultant 1.5-cm skin-only defect. History includes prior irradiation to the nose for squamous cell carcinoma. The nasal skin has significant radiation skin changes. Which of the following methods of reconstruction is most appropriate for this patient?

- A) Full-thickness skin grafting
- B) Local nasal skin flap
- C) Nasolabial flap
- D) Radial forearm free flap
- E) Split-thickness skin grafting

The correct response is Option C.

The key insight into the proper technique for this patient is the prior use of radiation on his nose. This should prompt the reconstructive surgeon to bring in healthy, well perfused, non-irradiated tissue to the area to be reconstructed whenever possible. Out of all the options presented, nasolabial flap fits this option the best.

Any local nasal flap will leave the surgeon to deal with unpredictable previously irradiated nasal skin. The outcome can be less reliable because of perfusion and possibly unfavorable tissue pliability and mobility.

As was mentioned, this patient's wound bed was previously irradiated. Therefore, any type of skin graft, split- or full-thickness, may result in poor graft survival.

Radial forearm free flap is not indicated in a small defect where regional tissue can be used.

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13. A 24-year-old woman comes to the office requesting facial rejuvenation because of premature aging and extensive cervicofacial skin laxity and skin excess. A congenital cause for this patient's condition is suspected. This patient is a candidate for elective surgery if the cause of her condition is found to be which of the following disorders?

- A) Cutis laxa
- B) Ehlers-Danlos syndrome
- C) Elastoderma
- D) Progeria
- E) Werner syndrome

The correct response is Option A.

Elective aesthetic procedures may be considered in patients with cutis laxa, a genetic disorder with variable inheritance and expressive patterns. The underlying defect is poor elastic tissues due to degeneration of elastic fibers, or a nonfunctioning elastase inhibitor. As a result, patients present with coarse, loose, excess skin throughout the body. In the autosomal dominant form of cutis laxa, the symptoms are confined only to the skin. In the recessive and X-linked forms, there may be other associated conditions such as congenital heart disease, hernias, aneurysms, emphysema, and pneumothorax. Although the effects of cutis laxa worsen with time, there is no underlying issue with wound healing. As a result, surgery may be considered to correct the facial appearance and any functional issues such as ectropion or ptosis.

In the other diseases listed, surgery is contraindicated due to poor/unknown wound healing mechanisms. Ehlers-Danlos syndrome (cutis hyperelastica) includes a group of more than 10 different inherited disorders that all involve a genetic mutation affecting collagen and connective tissue synthesis and structure. The clinical presentation includes skin laxity, hyperextensibility and excessive thinness of the skin, joint hypermobility, and aortic aneurysms. Wound healing is poor and elective procedures should not be performed.

Elastoderma is a disorder of unknown etiology. Clinical manifestations include pendulous skin laxity initially involving the trunk and extremities that progresses to involve the entire body. Because the effects on wound healing are unknown/unpredictable, elective surgery is not recommended.

Werner syndrome is an autosomal recessive disorder characterized by pigmented, indurated, plaque-containing skin, osteoporosis, muscle atrophy, growth retardation, cardiovascular disease, and diabetes. Small vessel angiopathy and poor wound healing are associated.

Progeria (Hutchinson-Gilford syndrome) is an autosomal recessive disorder of unknown cause. Findings are similar to premature aging and include lax, excess skin, growth retardation, craniofacial abnormalities, and cardiac disease. Wound healing is poor and the disease is associated with premature death.

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14. A 55-year-old man with a history of squamous cell carcinoma undergoes glossectomy and reconstruction with a free radial forearm flap. Intraoperatively, the patient experiences hypotension, and norepinephrine is administered. Which of the following is the most likely effect of this treatment on the outcome of the free flap?

- A) Delayed wound healing
- B) Microvascular thrombosis
- C) Partial flap loss
- D) Total flap loss
- E) No effect

The correct response is Option E.

In patients undergoing free flap reconstruction, the use of vasopressors is typically avoided when possible because of concerns that vasoconstriction of the anastomoses will result in microvascular thrombosis. When feasible, intravenous fluid administration should be attempted first to address hypotension. However, numerous studies have examined the effect of intraoperative vasopressors on free flap reconstructions and have generally not found an increased risk of postoperative complications.

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15. An 8-year-old boy is brought to the emergency department after sustaining injury to the right upper extremity, 3-cm proximal to the antecubital fossa. Which of the following factors is associated with improved functional outcomes following peripheral nerve repair?

- A) Fewer suture strands used in the nerve repair
- B) Higher-tension nerve repair
- C) Increasing time between nerve injury and repair
- D) More proximal nerve injury
- E) Younger patient age

The correct response is Option E.

The repair of peripheral nerve injuries can be affected by several factors. Younger patients tend to have improved outcomes compared with older patients.

Although there is no consensus on the optimal timing for nerve repair, earlier repairs have been shown to have better outcomes than those attempted at later time points. The level at which the injury has occurred can also affect the outcome. The more proximal the injury, the worse the prognosis in terms of motor and sensory return. Moreover, more complete and rapid regain of function occurs in more proximally innervated muscles. Finally, technical aspects of the nerve repair can also affect outcomes. Minimal tension and an increasing number of suture strands crossing the repair site are both associated with improved function.

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16. A 23-year-old man presents 2 years after sustaining full-thickness burns on the anterior neck. He has undergone tissue expansion and local flap reconstruction of the burn defect. He notes webbing and contracture at the margin of one of the prior flap reconstructions. Three identical 60-degree Z-plasties are planned over a total length of 12 cm. The expected gain in scar length is which of the following?

- A) 3 cm
- B) 4 cm
- C) 6 cm
- D) 8 cm
- E) 9 cm

The correct response is Option E.

A 60-degree z-plasty lengthens a scar by 75%. If each z-plasty covers 4 cm of scar, each will lengthen the scar by 3 cm, for a total increase of 9 cm. In contrast, a 30-degree z-plasty lengthens an incision by 25%, and a 45-degree z-plasty lengthens an incision by 50%. To prevent undue tension, angles greater than 60 degrees should be avoided.

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17. A 24-year-old man comes to the emergency department because of a dorsal hand injury. Physical examination shows a 6 × 4-cm full-thickness defect with exposed metacarpal bones. A medial sural artery perforator flap for soft-tissue coverage is planned. From which of the following vessels does the vascular pedicle for this flap originate?

- A) Anterior tibial
- B) Descending genicular
- C) Peroneal
- D) Popliteal
- E) Posterior tibial

The correct response is Option D.

The vascular pedicle for the medial sural artery perforator flap arises from the popliteal vessels.

The medial sural artery flap is a thin, pliable perforator flap that can provide well vascularized soft-tissue coverage, especially for relatively small defects. It is commonly used for head/neck, hand, and lower-extremity defects. The first perforator is frequently found along a line connecting the mid-popliteal area to the medial malleolus at the 8-cm mark from the proximal end. Preoperative planning is facilitated with ultrasound identification of the perforators. Sub-fascial dissection is frequently performed to protect the perforator and blood supply and to allow for a gliding surface for tendon repairs. Donor sites that are narrower than 5 cm can frequently be closed primarily. The main benefit of the medial sural artery perforator flap over an anterolateral thigh flap is the relative thinness of the flap, which can be significant in overweight or obese patients.

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18. A 34-year-old woman comes to the office because of a 6 × 7-cm subcutaneous mass below the left scapula. Biopsy confirms dermatofibrosarcoma protuberans. To minimize recurrence yet maximize the chances of primary closure, which of the following is the most appropriate margin when planning wide local excision?

- A) 5 mm
- B) 10 mm
- C) 20 mm
- D) 40 mm
- E) 50 mm

The correct response is Option C.

Several recent studies have confirmed that a surgical margin of 15 to 20 mm is associated with high rates of recurrence-free survival and primary closure when wide local excision is performed. Marginal excision is associated with higher rates of recurrence, and larger wide local excisions (>20 mm) are associated with similar recurrence-free survival but a much higher need for reconstructive surgery. Mohs micrographic surgery has shown promise, with higher initial clearance rates using smaller margins, but the question specifically addressed surgical margins when planning wide local excision.

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19. A 46-year-old man with type 1 diabetes mellitus is evaluated for an infected foot ulcer. After adequate surgical debridement, a collagen bilayer matrix is used for coverage. Which of the following clinical factors represents the greatest risk for failure of reconstruction?

- A) Anatomic location
- B) Exposed bone
- C) Exposed tendon
- D) Polymicrobial infection
- E) Type 1 diabetes mellitus

The correct response is Option D.

Collagen bilayer matrices have become an important option in the reconstructive ladder for lower extremity wounds. Studies have demonstrated the ability of these dermal regeneration templates to neovascularize and heal into pliable, durable coverage in an attempt to achieve stable wound healing and maintain limb length. Many of these studies were performed in the setting of diabetic wounds with exposed bone or tendon, thus each of these settings does not represent a contraindication. Adequate debridement, including clearance of any polymicrobial infection, is one of the keys to successful reconstruction.

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20. A 32-year-old patient, who was born as a female, identifies as male and requests breast reduction surgery for a masculine appearance. The patient has C-cup breasts with grade 2 ptosis. Which of the following is the most appropriate surgical option?

- A) Liposuction
- B) Periareolar breast reduction
- C) Circumvertical breast reduction
- D) Wise pattern breast reduction
- E) Mastectomy with free nipple graft

The correct response is Option E.

The most appropriate treatment for this patient is a free nipple graft and mastectomy due to breast size and nipple ptosis. Gender dysphoria is a commonly acknowledged disorder, affecting up to 0.3% of the population. Hundreds of patients have undergone subcutaneous mastectomy surgery with a high reported patient satisfaction rate. Smaller-sized patients can achieve excellent results with periareolar mastectomy or donut excision to reduce large areola size. Large patients with ptosis, similar to gynecomastia surgery, require longer scars for skin removal and have good results, but longer scars. One study of outcomes found that patients and surgeons preferred the outcome appearance with free nipple graft and a single inframammary crease scar versus an extended areola incision with scars across the mid chest.

Neither liposuction nor periareolar reduction would adequately reduce the skin envelope and breast tissue. Circumvertical and Wise pattern breast reduction would create a more feminized shape.

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21. A 47-year-old man undergoes split-thickness autografting for the treatment of a forearm burn. Which of the following donor site dressings is most appropriate to optimize wound healing?
- A) Alginate covered with occlusive dressing for 7 days
  - B) Moist gauze covered with occlusive dressing for 7 days
  - C) Petrolatum gauze covered with occlusive dressing for 2 days, then left open to air
  - D) Petrolatum gauze left open to air
  - E) Xenograft left open to air

The correct response is Option A.

To optimize wound healing, a moist wound-healing environment has been shown to be superior to a dry wound-healing environment. Studies on split-thickness skin graft donor sites have not been very well designed, but many studies suggest that a moist dressing is better than a dry dressing, and several review papers support this concept. Although leaving petrolatum gauze open to air is very common and may be the most practical option in certain circumstances, it does not optimize wound healing compared with a moist dressing. The only options listed that provide a moist environment for the duration required for early reepithelialization are gauze covered with occlusive dressing and alginate dressings. Gauze covered with occlusive dressing would not work well, because conventional gauze would stick to the wound and be very difficult to remove without causing significant tissue injury. Alginate dressings are emerging as an excellent option for split-thickness skin graft donor site wounds. They are adaptable, absorptive, nonadhesive, antibacterial, and provide a moist environment for wound healing.

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22. A 12-year-old boy is brought to the office because of penile and scrotal lymphedema. He has had several infections and is dissatisfied with the appearance of his genitalia. Which of the following is the most appropriate next step in management?

- A) Charles procedure
- B) Liposuction
- C) Lymph node transfer
- D) Lymphatic venous anastomosis
- E) Tissue excision and skin grafting

The correct response is Option E.

First-line surgical intervention for penile and/or scrotal lymphedema is resection of the overgrown skin and subcutaneous tissue. Liposuction is generally considered first-line operative treatment for extremity lymphedema but does not have efficacy for penile/scrotal disease. Lymphatic venous anastomosis and vascularized lymph node transfer are microsurgical procedures reserved for early extremity lymphedema and do not have efficacy for penile/scrotal lymphedema. The Charles procedure involves the removal of the entire skin, subcutaneous tissue, and muscle fascia with grafting of the underlying muscle. The Charles procedure is rarely performed and is used only for extremity lymphedema and not penile/scrotal disease.

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23. A 58-year-old woman undergoes removal of round 280-cc silicone gel implants she has had for over 30 years. New silicone gel implants measuring 10 cm in width by 12 cm in height with a 5-cm projection are placed. Compared with her original gel implants, the new implants are more likely to have a higher rate of which of the following complications?

- A) Contracture
- B) Infection
- C) Rippling
- D) Rotation
- E) Rupture

The correct response is Option D.

Breast implant technology has evolved greatly since implants were introduced in the 1960s. Increased cross-linking of silicone polymers (polydimethylsiloxanes) results in a more stable, cohesive form and closer shell-gel interactions. Advantages of these more “form-stable” implants include lower rates of rippling and rupture. They allow for the creation of shaped implants that offer clear advantages for certain patients, such as those seeking a natural upper pole shape transition, and those with wider or taller breast shapes.

The biggest drawback of shaped implants is the need to place them in a precise surgical pocket lest they rotate, causing deformity and potentially requiring reoperation. As long as surgeons follow sound surgical principles of dissecting an appropriate pocket limited to the approximate width of the implant, malrotation rates are low, typically in the 1.5% range. In one study, half of patients with implant rotation improved with manual repositioning and taping for 3 to 6 weeks, while the other half required reoperation.

Infection rates do not vary among implant types.

Shaped implants have textured shells, which have been shown to have lower rates of capsule contracture, particularly in the subglandular position.

Implant rupture rates are also lower in new generation implants, in the 0.7% per year range.

Visible rippling rates are more common in thinner consistency implants, such as saline and older silicone devices.

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24. A 63-year-old man who was in a house fire has burns on 55% of his body including the upper limbs, chest, abdomen, and left leg. He underwent escharotomies and has been resuscitated, but he requires mechanical ventilation because of an inhalation injury. He has an evolving acute kidney injury. A photograph is shown. Immediate excision is planned for management of a suspected fungal infection of the burn wounds. Which of the following is the most appropriate method for initial excision in this patient?

- A) Excision down to fascia without a tourniquet
- B) Excision down to viable tissue using tumescence
- C) Excision down to viable tissue with a tourniquet
- D) Excision down to viable tissue without a tourniquet
- E) Hydrosurgical debridement without a tourniquet

The correct response is Option A.

The best method for initial excision in this critically ill patient is excision down to fascia (fascial excision). Excision down to viable tissue (tangential excision) with or without a tourniquet would result in a large amount of blood loss, which would be a significant physiologic insult for this patient; additionally, it may not eradicate the suspected fungal infection. Tangential excision using tumescence may not result in significant blood loss, but the ability to judge viable from nonviable tissue is compromised, and this approach would have a high likelihood of requiring further debridement to achieve a healthy tissue bed unless performed by extremely experienced burn surgeons. Fascial excision is also much faster than tangential excision, which is an important consideration in this critically ill patient. Hydrosurgical debridement is adequate for superficial burns but has no role in a large flame burn and would result in excessive blood loss and operative time.

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25. A 43-year-old woman comes to the office for consultation regarding abdominoplasty. She says she is concerned about postoperative hypoesthesia of the abdominal wall. Which of the following areas is most likely to have the greatest decrease in sensation after a traditional abdominoplasty in this patient?

- A) Epigastric
- B) Infraumbilical
- C) Lateral abdominal
- D) Mons pubis
- E) Subxiphoid

The correct response is Option B.

The innervation to the anterior abdominal wall comes from the anterior cutaneous branches of the 6th to 12th intercostal nerves. The anterior cutaneous nerves perforate the anterior rectus sheath and are severed during the undermining of the abdominal flap during abdominoplasty. The hypogastric or infraumbilical region becomes the distal-most point for sensory innervation from the surrounding intact lateral cutaneous branches of the intercostal nerves that innervate the lateral anterior abdominal wall. The transverse incision from the abdominoplasty limits innervation from the pubic and thigh regions. The mons pubis should not demonstrate much change in sensation as it lies inferior to the surgical scar.

Patients undergoing abdominoplasty should be made aware of the likely decrease in sensation of this area, including superficial touch, superficial pain, pressure, vibration, and temperature.

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26. A 12-year-old girl develops a 12-mm nodule on her right cheek that grows slowly over 2 months. It is firm to the touch, mildly tender, and slightly bluish. There is no redness, ulceration, or visible punctum. Which of the following is the most likely diagnosis?
- A) Hemangioma
  - B) Keratinous cyst
  - C) Pilomatrixoma
  - D) Sebaceous nevus
  - E) Spitz nevus

The correct response is Option C.

Pilomatrixoma (also known as pilomatrixoma or calcifying epithelioma of Malherbe) is a common, benign calcifying tumor of the hair appendages that mostly occur under the age of 20. Most occur in the head and neck, but the extremities and trunk are also affected. Surgical excision is the treatment of choice. Malignancy is very rare. Intraoperative findings show a calcific, friable mass adherent to the undersurface of the skin. Unlike a keratinous or sebaceous cyst, there is no discrete capsule or punctum (plugged pore). Recurrence is reported in the 1 to 2% range. This benign growth is related to a somatic (non-inherited) gene mutation *CTNNB-1*, that is involved in cell replication of the hair matrix.

Sebaceous nevus presents as a waxy textured skin patch, often present at birth. The scalp is a common site, although it may present elsewhere. Lesions are slow-growing and benign, but over the course of one's lifetime, they have up to a 50% transformation rate to basal cell carcinoma, with squamous cell carcinoma less likely.

Hemangiomas are cutaneous blood vessel proliferations that are bright red or purple in color and are typically present at birth. While they are also common in childhood, they are more superficial in location and have a very different appearance versus pilomatrixomas, which are subepithelial.

Spitz nevi are melanocytic lesions that can occur in children and adults. They can mimic melanoma though they are benign spindle cell lesions. Malignant transformation is not common, though atypical variants exist, therefore excision is recommended. They appear as dark brown or black macules on the skin.

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27. A 45-year-old paraplegic man with a history of type 1 diabetes mellitus comes to the physician because of a stage 3 trochanteric pressure sore. The wound has been adequately debrided, and myocutaneous flap reconstruction is planned. Albumin concentration is 3.8 mg/dL, and hemoglobin A<sub>1c</sub> concentration is 6.3%. Diet includes protein intake of 2.5 g/kg daily. Which of the following factors is most likely to be associated with failure of the reconstruction?

- A) Albumin concentration
- B) Hemoglobin A<sub>1c</sub>
- C) Patient age
- D) Pressure sore location
- E) Protein intake

The correct response is Option B.

Preoperative optimization is essential in patients undergoing pressure sore reconstruction. This includes adequate nutrition (albumin greater than 3.5 g/dL, 1.5 to 3.0 g/kg/day of protein intake, 25 to 35 cal/kg of nonprotein calories daily), eradication of infection, treatment of spasms/contractures, smoking cessation, urinary/stool diversion in select circumstances, and an appropriate postoperative plan of care including pressure off-loading. A multivariate analysis of risk factors for failure of pressure sore flap reconstruction included hemoglobin A<sub>1c</sub> greater than 6%, younger age, albumin concentration less than 3.5 g/dL, and ischial location. In this patient, the primary risk factor for failure of reconstruction would be a high hemoglobin A<sub>1c</sub>.

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28. A fair-skinned 55-year-old man is evaluated because of an irregular dark lesion on his back. Patient history includes frequent sunburn. On examination, the lesion is 8 mm in size, dome-shaped, dark, and has the appearance of a blood blister. The border of the lesion does not appear irregular. A biopsy of the lesion shows a well circumscribed proliferation of atypical melanocytes extending vertically throughout the dermis. There is no lateral extension of the intra-epidermal component. Which of the following is the most likely melanoma subtype?

- A) Acral lentiginous
- B) Desmoplastic
- C) Lentigo maligna
- D) Nodular
- E) Superficial spreading

The correct response is Option D.

The most likely subtype of melanoma in this patient is nodular. Nodular melanomas are the second most common subtype (10 to 20%) and are commonly seen in the trunk, head, and neck with a slightly increased incidence in men. Upon invading the dermis, these lesions have a rapid vertical growth phase compared to the radial growth phase of the superficial spreading subtypes. These lesions are often dark and dome-shaped and have the appearance of a blood blister. They have increased metastatic potential. Histologic examination shows a sharply circumscribed epidermal component and extensive dermal proliferation with atypical melanocytes.

The superficial spreading subtype is characterized by lateral spreading of malignant melanocytes in the epidermis. This is the most common subtype and exhibits a prolonged radial growth phase before developing a vertical component. These lesions occur usually on sun-exposed skin and often arise in preexisting nevi. They appear flat and become irregular or raised with growth. Lentigo maligna is a rare form of melanoma with low malignant potential. They often arise from lentigo maligna lesions and grow slowly in a radial fashion before a vertical phase. They are more common in older women and have a strong correlation to sun exposure. They are often present in the face, head, and neck as large, tan lesions with convoluted patterns.

Acral lentiginous melanoma is more common in dark-skinned patients and is often found on the palms, nail bed, and soles of the feet. These lesions are aggressive and frequently metastasize. Desmoplastic melanoma is also a rare subtype with aggressive local growth; however, these lesions rarely metastasize. They are similar in appearance histologically to spindle cell tumors and are confused with common nevi, Spitz nevi, or hemangiomas.

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29. A 72-year-old man undergoes composite mandibular resection followed by fibula osteocutaneous free flap reconstruction. Patient history includes squamous cell carcinoma of the oropharynx. The morning after surgery, ischemic compromise of the flap is noted. Urgent exploration of the microvascular anastomosis is performed. Which of the following causes of flap compromise is most likely to result in failure of salvage attempts?

- A) Arterial thrombosis
- B) Hematoma
- C) Pedicle kinking
- D) Venous thrombosis

The correct response is Option A.

Arterial thrombosis is associated with lower flap salvage rates than venous thrombosis or mechanical causes. Bui et al. demonstrated salvage rates of 40%, 71%, and 90% for arterial thrombosis, venous thrombosis, or hematoma, respectively. Selber et al. demonstrated a similar tendency toward flap failure after arterial thrombosis. They also documented a 92% flap salvage rate for mechanical causes of ischemia, compared with 64.9% for vessel thrombosis. Mechanical or extrinsic causes of flap ischemia are generally easy to correct and are less likely to be associated with vessel injury. It is postulated that arterial thrombosis is more likely to be associated with endothelial injury than venous thrombosis.

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30. A 25-year-old man comes to the office after sustaining a deep laceration to the elbow. Physical examination shows decreased function of the ulnar nerve, and the patient is taken for operative exploration and repair. Following proximal and distal dissection, a 1-cm gap between the proximal and distal nerve ends persists. Which of the following is the most appropriate next step in management?

- A) Nerve transfer
- B) Nerve transposition
- C) Polyglycolic acid nerve conduit
- D) Primary repair
- E) Sural nerve grafting

The correct response is Option B.

Principles of microsurgical nerve repair include the use of meticulous and atraumatic technique with adequate magnification, microsurgical instruments, and sutures. A primary repair is performed whenever possible, provided that the repair is tension-free in order to maximize perfusion to the repair site.

In this patient, a 1-cm nerve gap in the ulnar nerve was present even after mobilizing the proximal and distal nerve ends. In this situation, the ulnar nerve may be transposed anteriorly, which would shorten the distance between the nerve ends and allow for primary repair.

Nerve transfers are indicated in very proximal nerve injuries where a proximal stump is unavailable for primary repair or grafting, or when a very long nerve gap is present where there would be a concern that target muscle denervation might occur prior to nerve regeneration.

Polyglycolic acid nerve conduits are bioabsorbable tubes through which nerve regeneration occurs. They represent an option for nerve reconstruction without any associated donor site morbidity when a nerve gap is present in order to achieve a tension-free repair.

Although primary nerve repair is preferable to the use of a graft/conduit, doing so in the setting of this patient's 1-cm nerve gap would not result in a tension-free repair.

Autologous nerve grafting, such as with the sural nerve, is an option for nerve reconstruction when a nerve gap is present in order to achieve a tension-free repair.

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31. A 2-year-old boy with a history of omphalocele presents for correction of a 5-cm abdominal bulge with a 3-cm widened scar over the bulge. Which of the following is the most appropriate next step in management of the bulge?
- A) Anterior component separation
  - B) Interposition acellular dermal matrix placement
  - C) Interposition prosthetic mesh placement
  - D) Tensor fascia lata flap
  - E) Tissue expander placement

The correct response is Option A.

For most patients with omphaloceles less than 5 cm in diameter, a single operation involving a traditional anterior component separation from costal margin to iliac crest is sufficient to reduce the omphalocele and reapproximate the rectus diastasis. Extended component separations are typically only needed when the omphalocele is large and accompanied by a diaphragmatic hernia. Once the abdominal wall defect extends past 5 cm in diameter, a staged procedure involving the placement of tissue expanders and subsequent flap advancement must be considered. Autologous tissue options, such as the tensor fascia lata flap, may be needed for larger defects that can not be managed with component separation. While prosthetic or biologic mesh placement is used to correct large abdominal wall defects, it is typically used only after autologous options have failed or are not available.

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32. Following a skin-sparing mastectomy, a 39-year-old woman undergoes deep inferior epigastric perforator (DIEP) flap breast reconstruction. To augment flap sensation, the anterior sensory branch of the fourth intercostal nerve is coapted to which of the following nerves within the DIEP flap?

- A) Genitofemoral
- B) Iliohypogastric
- C) Ilioinguinal
- D) Intercostal
- E) Lateral femoral cutaneous

The correct response is Option D.

The third, fourth, and fifth intercostal nerves are responsible for innervation of the majority of the breast. The anterior branch of the fourth intercostal nerve provides most erogenous sensation to the nipple. Sensation to the lower abdomen arises from segmental cutaneous branches of the intercostal nerve, which travel through the rectus abdominis muscle. T10 provides sensation to the dermatome, including the periumbilical region, and is most commonly used. The iliohypogastric nerve provides sensation to the lateral gluteal region. The ilioinguinal nerve provides sensation to the upper medial thigh. The genitofemoral nerve provides sensation to the upper anterior thigh and mons pubis. The lateral femoral cutaneous nerve provides innervation to the lateral thigh and is not used for this purpose.

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33. A 58-year-old Caucasian farmer comes to the office because of several pink scaly macules on his cheeks and nose. Biopsy of one of the lesions shows pleomorphic keratinocytes within the basal layer of the epidermis and hyperkeratosis, consistent with actinic keratosis. If left untreated, which of the following is the likelihood that these lesions will become malignant?

- A) 0%
- B) 10%
- C) 30%
- D) 50%
- E) 70%

The correct response is Option B.

The patient has actinic keratoses (AKs). AKs are common in people with significant sun exposure and are a response to ultraviolet radiation. The likelihood of malignant transformation to squamous cell carcinoma (SCC) is approximately 10%.

There are various treatment modalities for AKs, including cryotherapy, 5-fluorouracil (5-FU), photodynamic therapy, superficial glycolic peels, and imiquimod. Cryotherapy with liquid nitrogen is commonly used for isolated lesions, while the other therapies are more commonly used for diffuse disease.

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34. A 27-year-old man who is right-hand–dominant and works as a manual laborer comes to the emergency department for evaluation 6 hours after inadvertently incurring a high-pressure latex paint injection to the volar aspect of his left index finger. Which of the following is the most appropriate management?
- A) Admission to the hospital and intravenous administration of antibiotics
  - B) Operative exploration
  - C) Radial gutter splint with follow-up in 3 days
  - D) Topical application of acetone
  - E) Warm compresses, elevation, and observation

The correct response is Option B.



Emergent incision and drainage is mandatory for high-pressure paint gun injuries. Although clinically these may appear benign and/or superficial, there is often significant underlying injury. Even small amounts of material can lead to compartment syndrome, poor perfusion, and closed space infections resulting in tissue necrosis and ultimately, amputation. History is critical, but plain films may be used to confirm the diagnosis, as both latex and the less common oil-based paints are easily seen. Grease may be radiolucent or radiopaque, depending on lead

content. The most commonly injected materials are paint and grease but can also include paint solvents and fuel oil.

Nearly all reported cases involved male occupational injuries and injury to the non-dominant second or third digit, as in this case. These machines can generate pressures of 2,000 to 12,000 pounds per square inch (psi), which far exceeds the 100 psi needed to break the skin. These extreme pressures can propel injected material through the skin and subcutaneous tissues down to the bone or along fascial planes, tendon sheaths, and neurovascular bundles.

The overall rate of amputation was 30% and particularly related to the location of injury and type of material injected. Optimal time for wide surgical debridement was within 6 hours of injury. Other studies have documented an amputation rate of approximately 40% when surgery is performed within 6 hours, and an amputation rate of 57% when surgery is delayed beyond 6 hours. The amputation risk is as high as 87% without treatment or if treatment is further delayed.

None of the other interventions listed are appropriate for this type of emergent injury.

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35. A 53-year-old man presents with a calvarial defect following neurosurgical extirpation of a tumor. Polymethylmethacrylate reinforced by wire mesh is used for the cranioplasty. The use of saline irrigation during the curing of the biopolymer serves which of the following purposes?

- A) Dilutes toxic byproducts of polymerization
- B) Dissipates thermal energy
- C) Irrigates subclinical bacterial colonization
- D) Provides an aqueous catalyst for polymerization
- E) Reduces the dielectric constant of the substrate

The correct response is Option B.

Polymethylmethacrylate polymerization is an exergonic or exothermic reaction. The heat generated can cause injury or necrosis of the surrounding soft tissues and bone. Saline irrigation is an effective method of heat dissipation during this process. The toxic byproducts of polymerization include cyanide gas in small amounts that are dissipated by normal operating room ventilation or suction. Water is not a necessary cofactor for the polymerization process. Reduction of bacterial burden is a rationale for irrigation in general but does not play a specific role in this clinical setting. The dielectric constant of the substrate is elevated or unchanged by the irritant and this is unlikely to have an effect on the polymerization process.

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36. A 7-year-old boy is evaluated because of new nodular lesions on his skin. Patient history includes a jaw cyst, pits in the hands and feet, and a treated medulloblastoma. Biopsy is planned. Which of the following is the most likely diagnosis?

- A) Basal cell carcinoma
- B) Melanoma
- C) Merkel cell carcinoma
- D) Sebaceous adenocarcinoma
- E) Squamous cell carcinoma

The correct response is Option A.

The patient has basal cell nevus (Gorlin) syndrome. It is an autosomal dominant genetic condition affecting 1 in 56,000. Males and females are equally affected. It is caused by a mutation in the *PTCH1* gene. Clinical characteristics include multiple basal cell carcinomas, odontogenic cysts of the mandible, facial dysmorphism, and skeletal abnormalities of the vertebrae, skull, and ribs. 5 to 10% of patients will develop medulloblastoma. The other malignancies are not associated with Gorlin syndrome.

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37. A 53-year-old man is undergoing revision of mandibular reconstruction. An iliac crest osteocutaneous free flap is planned. Which of the following is the main advantage of this flap compared with a free fibula osteocutaneous flap?

- A) Bone length
- B) Minimal donor site morbidity
- C) Pedicle length
- D) Reliability with multiple osteotomies
- E) Vertical height

The correct response is Option E.



There are many choices for bone grafts, both vascularized and nonvascularized. In this clinical scenario, there is no question that a vascularized bone graft is indicated, given the irradiated field, anterior location, and >6-cm defect.

The choice of vascularized bone grafts include the free fibula, free iliac crest, free scapula, and free radius bone grafts. All have their pros and cons individually, although collectively, vascularized bone free flaps provide 40% more strength, 56% more stiffness, higher complete arthrodesis rate, and superior functional outcomes.

The free fibula flap would be the most common choice for this situation given its long pedicle (6 to 10 cm), the large amount of usable bone (22 to 24 cm), minimal donor site morbidity, ability to accept dental implants, and reliable skin flap (skin island survival rates approaching 100% due to increased anatomical understanding and improvements in harvest techniques). However, its disadvantage is that it doesn't have the vertical height of the free iliac crest.

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38. A 63-year-old man is evaluated because of a 1.6-cm pigmented lesion on his right shoulder. Excisional biopsy shows superficial spreading malignant melanoma with a Breslow depth of 3 mm. Evidence of distant metastases to which of the following tissues on further staging carries the poorest prognosis for this disease?

- A) Liver
- B) Lung
- C) Lymph nodes
- D) Subcutaneous tissue

The correct response is Option A.

The American Joint Committee on Cancer (AJCC) revised TNM staging of melanoma in 2010. Three subgroups of distant metastases are distinguished: skin and soft-tissue metastases (best prognosis), lung metastases (intermediate prognosis), and other visceral metastases such as liver and brain (worst prognosis). Elevated lactate dehydrogenase in either of the first subgroups up-stages to the last subgroup.

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39. A 35-year-old man is brought to the emergency department for penile amputation at the base of the shaft. The amputated part has been appropriately transported with the patient. Revascularization of which of the following vessels will result in the highest probability of successful replantation?

- A) Bulbar artery and vein
- B) Cavernosal artery and vein
- C) Deep dorsal arteries and vein
- D) Internal pudendal artery and vein

The correct response is Option C.

The most important vessels to anastomose in this clinical scenario are the deep dorsal arteries and vein. There are two deep arteries and one deep vein. There is a superficial dorsal vein as well, but no superficial dorsal artery runs with it. The vascular supply of the penis is from the internal iliac system, not the external iliac system. The internal pudendal artery comes off the anterior division of the internal iliac artery and is the main blood supply to the penis. It branches into the bulbar, cavernosal, and dorsal penile arterial branches. The other vessels listed are all involved in the blood supply to the penile structure, but are too small, less accessible, or too proximal for replantation purposes. The deep dorsal vessels alone can adequately revascularize the whole penile structure.

The steps in replantation include: formation of a suprapubic urinary diversion, urethral anastomosis over a Foley catheter, corporal body coaptation by approximating the tunica albuginea, microsurgical anastomosis of the dorsal vessels and coaptation of the dorsal nerves, and skin closure.

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40. A 30-year-old woman comes to the office for rhinoplasty. Diced cartilage grafting is planned. Which of the following techniques will result in the lowest viability of the cartilage graft?
- A) Leaving unwrapped
  - B) Wrapping in oxidized cellulose polymer (Surgicel)
  - C) Wrapping with acellular dermal matrix
  - D) Wrapping with fascia

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option B.

A large number of animal, as well as clinical, studies are now pointing to the suboptimal viability of diced cartilage when wrapped with oxidized cellulose polymer (Surgicel).

Good viability has been seen when the cartilage is not wrapped, wrapped with fascia, or wrapped with acellular dermal matrix (AlloDerm).

Clinically, the data seem to be more nuanced. The use of diced or crushed cartilage is predicated on reducing the noted long-term complications of larger cartilage grafts (warping and prominence or visibility). The clinical data may be favoring use of fascia for wrapping, if using anything at all. AlloDerm may be another promising option.

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41. A 22-year-old man who is a wheelchair-bound paraplegic is evaluated because of a recurrent pressure sore. The patient has had previous surgeries to repair a left trochanteric pressure sore and a large midline sacral pressure sore. A photograph is shown. The most appropriate treatment is debridement followed by coverage with which of the following?

- A) Adjacent skin advancement
- B) Gluteal fasciocutaneous flap
- C) Posterior thigh musculocutaneous flap
- D) Split-thickness skin graft
- E) Tensor fascia lata flap

The correct response is Option C.



In this patient, a posterior thigh flap consisting of the biceps femoris, semitendinosus, and semimembranosus muscles and overlying skin is the most appropriate treatment option. Advantages of this flap include a reliable vascular supply (first perforating branch of profunda femoris artery), a generous amount of skin, fat, and muscle to obliterate the dead space after ulcer excision, and the ability to re-advance the flap in the event of ulcer recurrence. Additionally, a posterior thigh flap preserves other donor sites such as the medial thigh, lateral thigh, and gluteal muscles for secondary problems or the inevitable pressure sore in another location. The chief disadvantage of the posterior thigh flap is its upward mobility, as maximal movement is 10 to 12 cm. For extensive ischial defects, a second flap or another flap option may be necessary. Generally, this flap is limited to non-ambulatory patients due to the harvest of multiple knee flexors. Transfer of the biceps femoris alone has been described for small defects in ambulatory patients. The posterior thigh flap is a Mathes/Nahai Type II muscle, with a primary dominant pedicle (first perforating branch of the profunda femoris artery) with smaller

segmental distal pedicles. These segmental secondary pedicles can typically be divided with little effect on flap survival. It is recommended that the origin and insertion of the muscles be divided to maximize flap mobility and minimize tension at the inset site. These flaps can be designed as a V-Y configuration or designed in a rotational configuration as shown in the perioperative photograph.

The temptation to perform a primary closure should be resisted, as pressure sores by definition indicate a soft tissue deficiency. Simply pulling tissues together over a bony prominence will very likely fail because of wound tension and dehiscence. In this patient, this was already attempted previously with a predictable outcome. Skin grafts have very limited success in this location because of a lack of bulk and resistance to pressure and shearing forces. The gluteal fasciocutaneous flap is based on the inferior gluteal artery and is a good option in the ambulatory patient with an ischial pressure sore. In this case, however, the pedicle is not available owing to the previous gluteal V-Y flap used to repair the sacral pressure sore. In cases when a gluteal fasciocutaneous flap has been utilized previously, the posterior thigh musculature may still be used in the face of a recurrent ischial pressure sore; however, a skin graft would be required.

The tensor fascia lata (TFL) flap is the first-line choice for trochanteric pressure sores and has already been used in this patient. The TFL has been described for ischial pressure sores, but only after more reliable flaps have been exhausted. Because the distal 6 to 8 cm of the TFL are unreliable, flap delay or pre-transfer expansion are recommended prior to transfer for an ischial reconstruction.

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42. While performing a cranioplasty on a 6-year-old girl, the plastic surgeon accidentally drops the bone graft on the floor. Which of the following is the most appropriate next step?
- A) Change the wound classification from 1 to 4
  - B) Decontaminate with triple antibiotic solution lavage and reuse the graft
  - C) Discard the graft and use an alloplastic material
  - D) Steam sterilize and reuse the graft
  - E) Wash with chlorhexidine and reuse the graft

The correct response is Option B.

In this circumstance, the surgeon should wash the graft with sterile triple antibiotic solution (0.1% gentamicin, 0.1% clindamycin, 0.05% polymyxin) and consider reusing it. This graft is not easily re-harvestable, and therefore reusing it is a reasonable alternative. Triple antibiotic solution is readily available and nontoxic to the bone graft, unlike iodine and chlorhexidine. Studies have shown that iodine does not have the antimicrobial effectiveness of other antimicrobials. Studies also show that while chlorhexidine is most effective in eradicating the microorganisms from the graft, its detrimental effect on corticocancellous bone prevents its use in this clinical scenario. If the dropped graft were skin, cartilage, or composite tissue, chlorhexidine would be the ideal antimicrobial.

Discarding the graft is not the ideal alternative given the extremely low likelihood of infection if reused after appropriate decontamination. In this clinical scenario, alloplastic materials are contraindicated due to the patient's age. One should change the wound classification from 1 to 3, not 4. Steam sterilization is not used for such grafts in such an acute setting and this technique would potentially harm the graft.

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43. The plastic surgeon is called to the neonatal unit to evaluate a newborn with a myelomeningocele. There is an intact 4 × 4-cm sac at the lumbosacral area with minimal fluid oozing from the area. Early operative repair is indicated for which of the following reasons?
- A) To decrease the need for cerebrospinal fluid shunt placement
  - B) To decrease the need for folic acid supplementation
  - C) To improve motor function return
  - D) To prevent bacterial meningitis
  - E) To prevent cerebrospinal fluid leakage

The correct response is Option D.

The major indication to repair a myelomeningocele defect in the early postnatal period is to prevent infection and bacterial meningitis. Great care is taken to keep the sac sterile and hydrated. Further cardiac, orthopedic, and urologic workup is often necessary, as well as evaluation for hydrocephalus. Although improvement in the return of motor function with early repair has not been shown, neurogenic bladder prognosis is improved. Leakage of cerebrospinal fluid is commonly observed regardless of timing of closure. Although folic acid supplementation has been shown to decrease the neural tube defects and myelomeningocele formation, postnatal supplementation has not been shown to be effective.

Approaches to surgical therapy for the treatment of these defects have seen a shift toward prenatal, fetal reconstructive surgery. A recent study by Adzick et al. in the *New England Journal of Medicine* examined the use of prenatal surgery versus postnatal surgery. In this randomized trial, the authors found a decreased need for cerebrospinal fluid shunt placement and improved motor function outcomes.

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44. Which of the following best describes the immediate mechanism of skin graft survival following placement onto the recipient wound bed?
- A) Dermal contraction
  - B) Encapsulation
  - C) Inosculation
  - D) Revascularization
  - E) Serum imbibition

The correct response is Option E.

Serum imbibition describes the earliest stage of skin graft healing. Immediately after placement onto the wound, the graft becomes edematous and may increase its mass up to 30 to 40%. Plasma leaks from recipient bed capillaries and venules and fills the space between the wound bed and the graft. Fibrinogen within the plasma settles out and forms a fibrin bond, which helps anchor the graft to the wound. The graft passively absorbs nutrients from the underlying serum by diffusion during the first 48 hours. Metabolism within the graft becomes anaerobic and the pH level falls to 6.8. The metabolic demands of the graft also fall, with ATP levels falling 70% and glucose levels falling 80%.

Revascularization and inosculation describe the second stage of skin graft healing. These processes began shortly after graft placement, but it takes approximately 4 to 5 days for the graft to become vascularized, with maximal flow developing by day 29. Revascularization refers to direct ingrowth of new blood vessels into the graft from the underlying wound bed. Inosculation describes a process by which blood vessels from the underlying wound bed connect with existing vessels in the skin graft. More recent evidence suggests that both of these processes play a role in the development of vascularization within the skin graft: existing vasculature within the skin graft undergoes some level of degeneration. However, the acellular basal lamina persists and provides a conduit for the ingrowth of a new vascular tree from the host wound bed.

Primary contraction of a skin graft occurs immediately after harvest and is due to the recoil of elastic fibers within the dermis. Grafts with a larger amount of included dermis (e.g., full-thickness grafts) have greater primary contraction. Secondary contraction refers to contraction after the wound heals. This process is mediated by myofibroblasts and occurs more frequently in grafts with a thinner dermal

component (e.g., split-thickness grafts). A larger dermal component appears to suppress proliferation of myofibroblasts within the wound. Encapsulation refers to the development of a fibrous scar capsule around a foreign device such as a breast implant.

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45. A 50-year-old woman with a history of scleroderma is evaluated because of a 1.5-cm lesion on her right cheek. Patient history includes basal cell carcinoma excision at the same site 3 years ago. A punch biopsy shows basal cell carcinoma (micronodular subtype). Which of the following is the most appropriate indication for Mohs micrographic surgery in this patient?
- A) Histologic subtype
  - B) History of scleroderma
  - C) Location of lesion
  - D) Recurrence of lesion
  - E) Size of lesion

The correct response is Option D.

Mohs micrographic surgery is a surgical technique in which tumor excision and microscopic examination of tissue margins are performed by the same surgeon. Use of a beveled excision and careful mapping of the peripheral and deep margins of horizontal frozen sections allow for comprehensive examination of all the borders of the excised tissue, resulting in excellent cure rates. In addition to the high cure rate, Mohs surgery is a tissue-sparing procedure that is an important advantage in cosmetically and functionally sensitive areas and contrasts with traditional approaches in which a set margin of excision is performed.

Indications for Mohs surgery include recurrent basal cell carcinomas (BCC) and squamous cell carcinomas (SCC), locations prone to recurrence ("H-zone" of the face: inner canthus, nasolabial fold, nose, periorbital, temple, upper lip and periauricular regions, retroauricular, and chin), at/near critical structures (e.g., eye, lip), large tumors (>2 cm), ill-defined tumor margins, aggressive histology (BCC - morpheaform infiltrative, basosquamous, perineural; SCC - poorly differentiated, invasive, perineural), and special hosts (immunosuppressed, basal cell nevus syndrome, xeroderma pigmentosum). Therefore, in this patient, the primary indication for Mohs surgery would be the recurrent nature of her BCC.

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46. A 2-week-old premature male twin develops a red, rapidly enlarging lesion of the posterior trunk. Which of the following is the most important factor suggesting a diagnosis of infantile hemangioma?
- A) Growth of the lesion
  - B) Location of the lesion
  - C) Patient gender
  - D) Premature birth
  - E) Twin gestation

The correct response is Option A.

Infantile hemangioma is the most common tumor of infancy. These lesions typically present between 2 weeks and 2 months of life and have a predictable clinical course, including rapid proliferation during the first 9 months of life (proliferative phase), followed by gradual involution until 3.5 years of age. Infantile hemangiomas most commonly occur in the skin, but can also occur in other sites, with the liver being the most common extracutaneous site. For cutaneous lesions, most are located in the head and neck, followed by the trunk, and then by the extremities. >95% of infantile hemangiomas are diagnosed by history and physical examination; <5% require imaging or biopsy for diagnosis. The onset of a red lesion at 2 weeks of age followed by rapid growth is pathognomonic for infantile hemangioma. The tumor affects both sexes, but is 3 to 4 times more common in females. Infantile hemangioma is also more frequent in premature infants and twins who are low birth weight. Some infantile hemangiomas can ulcerate during the proliferating phase.

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47. A 42-year-old woman presents for fat grafting from the abdomen to the upper breast poles under intravenous sedation. Patient history includes implant-based breast reconstruction. She receives 1 g of intravenous cefazolin in the preoperative holding area. Ten minutes later, she has onset of generalized hives, flushing, and swelling of the lips. She reports dyspnea and has audible wheezing. The most appropriate next step is administration of epinephrine by which of the following routes?
- A) Intradermal injection
  - B) Intramuscular injection
  - C) Intravenous bolus
  - D) Intravenous infusion
  - E) Subcutaneous injection

The correct response is Option B.

This patient meets the diagnostic criteria for anaphylaxis, manifested by acute onset of generalized hives and swelling along with either respiratory compromise or hypotension. Intramuscular injection of epinephrine, 0.3 to 0.5 mg, preferably in the mid-outer thigh, is the initial treatment in adults. Other treatments include administration of supplemental oxygen and rapid normal saline infusion. Absorption of epinephrine after subcutaneous injection may be too slow to reverse anaphylaxis. Bolus injections of epinephrine should be avoided because of the risks of dosing errors and overdose. Epinephrine infusion can be considered for anaphylaxis that is refractory to intramuscular injections, but it is not a first-line choice. Subcutaneous or intradermal injection would result in delayed absorption.

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48. A 25-year-old obese man is evaluated because of new onset of inflamed nodules involving the bilateral axillae. A diagnosis of hidradenitis suppurativa is made. Which of the following is the most appropriate initial medication for treatment of this patient's condition?
- A) Botulinum toxin type A
  - B) Clindamycin
  - C) Cyclosporine
  - D) Etanercept
  - E) Prednisone

The correct response is Option B.

Hidradenitis suppurativa is a chronic inflammatory skin disease. Also known as acne inversa, it is characterized by recurrent nodules and abscesses, typically of apocrine gland-bearing skin.

This patient has mild hidradenitis, with an initial presentation of a few abscesses without sinus tracts or cicatrization/scarring.

Clindamycin applied topically is often used as a first-line therapy for mild hidradenitis. In a randomized, placebo-controlled trial, patients treated with twice-daily topical application of 1% clindamycin solution were found to have significantly less disease burden, and the treatment was well tolerated with few side effects.

Although there have been reports of the use of botulinum toxin in the treatment of hidradenitis, its role and efficacy in this setting are currently unclear.

Etanercept is a TNF-alpha inhibitor. Although some TNF-alpha inhibitors, particularly infliximab, have shown efficacy in patients with moderate-to-severe hidradenitis, data are conflicting with regard to Etanercept.

Prednisone is occasionally used to calm the inflammatory process in severe hidradenitis. However, it does not prevent formation of new lesions and is rarely used for long-term therapy in patients with hidradenitis because of possible adverse effects.

A few case reports have described improvement with cyclosporine in refractory cases of hidradenitis. However, it is typically not used for initial medical treatment of hidradenitis, and duration of use is often limited by adverse effects.

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49. A 40-year-old man comes to the office for evaluation of a nonhealing scaphoid fracture. History includes bone grafting for avascular necrosis of the proximal pole, but there is evidence of nonunion. Carpal collapse and humpback deformity are also noted. Reconstruction with a vascularized medial femoral condyle flap is scheduled. Which of the following arteries provides the blood supply to this flap?

- A) Descending genicular artery
- B) Lateral circumflex femoral artery
- C) Medial circumflex femoral artery
- D) Peroneal artery
- E) Profunda femoris artery

The correct response is Option A.

The descending genicular artery supplies the medial femoral condyle flap. The descending genicular artery is a branch of the superficial femoral artery. This corticoperiosteal flap has been used with increasing frequency for small bony defects and the treatment of nonunion. A cutaneous component can also be harvested based on a saphenous artery branch.

The anterolateral thigh flap is based off the lateral femoral circumflex artery perforators. The gracilis muscle flap is based off vessels from the medial circumflex femoral artery; perforator flaps can also be designed based off this vascular system. The profunda femoris supplies the posterior thigh flap. The peroneal artery provides the vascular supply to the fibula flap.

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50. A 58-year-old woman is evaluated for squamous cell carcinoma of the posterior vagina. Wide local excision of the vagina with flap reconstruction is planned. Which of the following flap options is most likely to provide a reconstruction that is sensate immediately after surgery?

- A) Gracilis myocutaneous
- B) Oblique rectus abdominis myocutaneous
- C) Pedicled anterolateral thigh perforator
- D) Pudendal thigh (Singapore)
- E) Vertical rectus abdominis myocutaneous

The correct response is Option D.

The pudendal thigh flap is an axial patterned flap based on terminal branches of the superficial perineal artery. The superficial perineal nerve follows the course of this artery and becomes the posterior labial nerve to provide sensation to the proximal skin paddle. The superficial perineal nerve arises from the pudendal nerve. In a series of 19 patients who underwent pudendal thigh flap reconstruction, all reported sensation. The gracilis myocutaneous flap may provide some pressure sensation from cutaneous branches of the obturator nerve, although this is inconsistent. The anterolateral thigh perforator flap and vertical or oblique rectus abdominis myocutaneous flap may be neurotized to provide sensation; however, this would not result in immediate sensation.

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# Section 2: Hand and Lower Extremity

51. A 55-year-old man comes to the office because of an exposed knee prosthesis. Repair with a gastrocnemius flap is planned, using the entire muscle for reconstruction of the anterior knee defect and hardware coverage. The biomechanical consequence of using this flap is most likely to be observed by which of the following motions?
- A) Dorsiflexion
  - B) Foot eversion
  - C) Foot inversion
  - D) Leg extension
  - E) Plantar flexion

The correct response is Option E.

The most appropriate answer is plantar flexion. The gastrocnemius muscle originates as two heads off the femur. The medial head comes off the medial condyle of the femur, just above the condyle and the lateral head comes off just above the lateral condyle. The muscle inserts onto the posterior calcaneus via the calcaneal tendon. This is the common tendon shared with the soleus muscle. Because of this fact, both heads can be harvested and the patient still maintains 75% of plantar flexion strength. The function of the gastrocnemius muscle is to plantar flex the foot and also flex the leg at the knee. Plantar flexion is the only biomechanical consequence listed above, although minimal. The blood supplies to the gastrocnemius muscle are from the sural branches of the popliteal artery and are independent. The medial head is the larger of the two and will have a larger arc of rotation. The innervation is via separate branches to each head off the tibial nerve.

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52. A 33-year-old woman comes to the office because of volar numbness of the right thumb, index, long finger, and palm for the past 4 months. Medical history includes no abnormalities. Physical examination shows weakness of the palmar abduction of the thumb and interphalangeal joint flexion of the thumb. Percussion tenderness over the volar aspect of the wrist does not reproduce symptoms. Passive flexion of the wrist does not reproduce symptoms. Which of the following is the most likely diagnosis?
- A) Anterior interosseous syndrome
  - B) Carpal tunnel syndrome
  - C) Cubital tunnel syndrome
  - D) Posterior interosseous syndrome
  - E) Pronator syndrome

The correct response is Option E.

Pronator syndrome is a compression neuropathy of the median nerve in the proximal forearm. Paresthesias in the palm and the median nerve–innervated fingers of the thumb along with weakness of the flexor pollicis longus muscle are classic findings in pronator syndrome. Pronator syndrome can be differentiated from carpal tunnel syndrome by sensory symptoms and numbness occurring in the palm, which is innervated by the palmar cutaneous branch of the median nerve. This branch comes off the proper median nerve proximal to the carpal tunnel. Findings of weakness of the flexor pollicis longus muscle and often the flexor digitorum profundus muscle to the index finger are often seen in pronator syndrome. Anterior interosseous syndrome is a motor-only compression of the median nerve in the proximal forearm; sensory findings are not present. Cubital tunnel syndrome or ulnar nerve compression at the elbow presents with sensory findings in the small and ring fingers and may also affect the interosseous muscles. Posterior interosseous syndrome affects the extensor muscles in the forearm and is not the pathologic lesion described in the scenario.

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53. A 30-year-old woman comes to the office because of a mass of the dorsum of the wrist for the past 5 months. She reports that the mass occasionally gets larger and then gets smaller. Physical examination shows the mass is mildly tender and transilluminates. From which of the following articulations is this lesion most likely to arise?

- A) Pisotriquetral
- B) Radioscaphoid
- C) Scapholunate
- D) Scaphotrapezial
- E) Thumb carpometacarpal (CMC)

The correct response is Option C.

The mass in question is most likely a dorsal ganglion cyst of the wrist. Sixty to 70% of ganglion cysts are found in the dorsal aspect of the wrist. Dorsal wrist ganglion cysts usually communicate with the joint by a stalk. This stalk usually originates at the scapholunate interval, but it can also rarely arise from other aspects of the dorsal wrist joint.

Thirteen to 20% of ganglia are found on the volar aspect of the wrist, and they usually arise from the radioscaphoid, scapholunate, scaphotrapezial, or metacarpotrapezial joint, in decreasing order of frequency.

Ganglia arising from the flexor tendon sheath of the hand account for approximately 10%.

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54. An 18-year-old woman is evaluated for multiple masses over the face, trunk, and upper extremities. Biopsy shows a diagnosis of neurofibromas. Which of the following conditions are most likely associated with this patient's condition?
- A) Café au-lait spots and multiple enchondromas
  - B) Learning disabilities and meningiomas
  - C) Lipomas and Lisch nodules
  - D) Macrocephaly and scoliosis
  - E) Optic glioma and microcephaly

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option D.

Neurofibromatosis type 1 (NF1) is a multisystem genetic disorder that is characterized by café-au-lait spots, axillary freckling, skeletal dysplasias, and the growth of both benign and malignant nervous system tumors, such as benign neurofibromas. Other signs and symptoms may include high blood pressure, bone abnormalities, scoliosis, optic nerve tumors, Lisch nodules, learning disabilities, attention deficit hyperactivity disorder, larger than average head size (macrocephaly), and short stature.

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55. A 24-year-old man comes to the office because of an open wound and osteomyelitis of the right elbow after sustaining a fracture of the olecranon during a fall 1 month ago. Use of the lateral arm flap for coverage of the defect is planned. Which of the following is the arterial supply to the lateral arm flap?

- A) Medial collateral
- B) Posterior radial collateral
- C) Posterior ulnar collateral
- D) Radial
- E) Ulnar

The correct response is Option B.

The posterior radial collateral artery is a branch from the profunda brachial artery, which is off the brachial artery. A second branch is the anterior radial collateral artery but this is variable and of small caliber so does not contribute to the vascular supply. The posterior radial collateral artery interconnects with the radial recurrent artery off the radial artery. This will allow for reverse pedicle design. The middle or medial collateral artery is a branch off the posterior radial collateral artery in 61.5% and off the profunda brachial artery in 38.5%. It can be used as an elongated lateral flap by converting a Y to a V.

The radial, ulnar, and posterior ulnar collateral arteries are not appropriate. The radial artery supplies the radial forearm flap, a fasciocutaneous flap. The ulnar artery supplies a fasciocutaneous flap as well. The posterior ulnar recurrent artery supplies the flexor carpi ulnaris flap, which is a muscle or musculocutaneous flap.

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56. A 68-year-old man presents 3 months after undergoing reconstruction of a large mandibular defect following tumor resection with a right fibula osteocutaneous flap. Postoperatively, immediate footdrop is noted. Which of the following is the most appropriate next step in management?

- A) Clinical observation, conservative management, and re-evaluation in 3 months
- B) Exploration of the peroneal nerve, neurolysis, and primary repair if transected
- C) Exploration of the sural nerve, neurolysis, and primary repair if transected
- D) Exploration of the tibial nerve, neurolysis, and primary repair if transected

The correct response is Option B.

It is recommended that the proximal 4 to 8 cm of the fibula be preserved in order to prevent knee instability and to avoid injury to the peroneal nerve. In large resections, more fibula length is required and the fibular head is often useful in the reconstruction. The common peroneal nerve is formed by the lateral division of the sciatic nerve. The peroneal nerve wraps around the lateral surface of the biceps femoris tendon and fibular head and courses into the anterolateral portion of the leg. The common peroneal nerve trifurcates into the superficial peroneal nerve, the deep peroneal nerve, and the recurrent articular branch. The deep peroneal nerve innervates the anterior compartment muscles of the leg, and provides ankle dorsiflexion. Injury to the common or deep peroneal nerve can result in footdrop or weakened dorsiflexion. Given that this patient had a large resection, the footdrop is indicative of a peroneal nerve injury. Exploration is warranted. The tibial nerve is a branch of the sciatic nerve and runs in the popliteal fossa to pass below the arch of the soleus muscle. The sural nerve is a sensory nerve in the calf. Injury to the tibial or sural nerve would not cause a footdrop.

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57. During embryonic limb development, limb bud outgrowth is controlled by which of the following families of signaling proteins?

- A) Bone morphogenetic proteins
- B) Fibroblast growth factor
- C) Retinoic acid
- D) Sonic hedgehog (SHH)
- E) Wingless-type proteins

The correct response is Option B.

The most appropriate answer is fibroblast growth factor. Limb bud development begins at the fourth week of gestation via an outgrowth of lateral plate somatic mesoderm covered by ectoderm. The lower limb bud forms a few days after the upper limb and is formed opposite of the L3-5 vertebrae. The cells at the tip of the limb bud ectoderm thicken to form the apical ectodermal ridge (AER). Fibroblast growth factor 10 (FGF10) from the mesenchyme induces the formation of the AER, which produces FGF8. This signaling induces mitosis of the underlying cells leading to limb elongation.

A group of mesenchymal cells on the posterior of the limb bud form the zone of polarizing activity (ZPA). Cells from the ZPA secrete sonic hedgehog protein, which acts as a short range signaling molecule. The ZPA is responsible for the anteroposterior axis formation of the limb bud.

Retinoic acid, a derivative of vitamin A, plays a role in the proximal-distal development of the limb but is not the primary signaling molecule. The precise mechanism and action of retinoic acid is debated. A retinoic acid gradient is necessary for normal limb development. Retinoic acid may act as an inhibitor of FGF8, which then allows forelimb budding to occur. Retinoic acid is not thought to be involved in hindlimb formation.

During limb development, the digits are initially connected by tissue that regresses via apoptosis. Apoptosis of interdigital tissue is dependent on BMP signaling under the influence of sonic hedgehog from the ZPA.

Proteins from the wingless type family, especially Wnt7a, are responsible for the dorsal-ventral patterning of the overlying ectoderm. The presence of Wnt7a is necessary to dorsalize the limb.

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58. A 25-year-old man comes to the office 48 hours after "jamming" the right index finger while playing volleyball. The patient reports pain and swelling around the proximal interphalangeal (PIP) joint that prevents him from flexing the digit. Examination does not show malrotation or angulation of the fingertip, but range of motion is limited at the PIP joint because of pain. X-ray studies are shown. Which of the following is the most appropriate next step in management?

- A) Arthrodesis of the PIP joint
- B) Dorsal block splinting
- C) Dynamic traction reduction
- D) Hemi-hamate arthroplasty
- E) Splint immobilization for 4 weeks

The correct response is Option C.

Dislocations of the proximal interphalangeal joint may be treated with splinting, typically dorsal block splinting, and early motion. In the setting of a volar dislocation, where injury to the central slip is suspected, splinting for 3 to 6 weeks in extension may be necessary. Splinting alone is inadequate treatment for fracture dislocations where the middle phalanx remains subluxed dorsally compared with the proximal phalanx condyles. This particular injury requires reduction prior to splinting or other methods of maintaining the joint congruity. Fracture/dislocations of the proximal interphalangeal joint that can be reduced and maintained with joint flexion can be successfully treated with either dorsal block splinting or percutaneous pinning as a dorsal block. Injury patterns amenable to this treatment typically involve <40% of the volar articular surface. The lateral radiograph demonstrates a comminuted fracture of 50 to 60% of the volar articular surface of the middle phalanx with the presence of a centrally depressed fragment; which is too large for a hemihamate graft. The AP radiograph shows comminution extending obliquely as well as in the sagittal plane, suggesting a pilon-type injury. This pattern of injury would not be reduced adequately with dorsal blocking alone. Complex fractures/dislocations of the base of the middle phalanx prove challenging to treat. Keys to success involve reduction of the dorsally dislocated middle phalanx base, restoration of articular congruity, and provision of early motion.

One useful approach to these injuries involves application of a dynamic traction device. Commercial devices are available; however, a construct composed of pins and rubber bands, described by Suzuki, allows creation of a dynamic traction device with materials available at any hospital. Outcomes from this treatment can achieve anywhere between 70 to 90% of the motion of the uninjured joint. When unstable, simple fracture/dislocations of the proximal interphalangeal joint can be treated with open reduction and internal fixation. Multiple techniques have been employed including dorsal, palmar, and midlateral approaches. Screws, cerclage wires, and even miniplates have been used. The lateral radiograph demonstrates this with the depressed articular fragment in the volar half of the joint surface. When severe comminution destroys enough of the volar half of the middle phalanx base so as to make restoration of stability unlikely, an osteochondral graft from the dorsum of the hamate between the little and ring finger metacarpal bases can be harvested and used to replace the lost articular surface. Use of this procedure requires the presence of a dorsal articular segment with some stability, to which the graft may be affixed. The AP radiograph demonstrates fracture lines extending through the dorsoradial articular surface of the middle phalanx, making hemi-hamate grafting difficult if not

impossible. Arthrodesis is reserved as a salvage repair after attempts at primary repair have failed.

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2. Janssen SJ, Molleman J, Guitton TG. What middle phalanx base fracture characteristics are most reliable and useful for surgical decision-making? *Clin Orthop Relat Res*. 2015 Dec;473(12):3943-50.

59. A 20-year-old man comes to the office because of an enlarging mass of the humerus. Examination of a specimen obtained on biopsy shows osteosarcoma. Which of the following locations is most likely metastatic in this patient?

- A) Brain
- B) Colon
- C) Digit
- D) Liver
- E) Lung

The correct response is Option E.

The most common site of osteosarcoma metastasis is the lung. The tumor is most commonly found in the upper extremity proximal humerus. Osteosarcoma is the most common malignant bone tumor. It is most commonly found in childhood and rarely in the hands at that time. The incidence in the hand is 0.18%. In patients over 40 years of age, the proximal phalanx and metacarpals are involved.

Symptoms often begin 3 to 12 months prior to diagnosis and include pain and swelling. Radiographs show a sunburst pattern with periosteal elevation at Codman's triangle. Treatment includes wide excision or amputation and neoadjuvant chemotherapy.

Malignant tumors of bone are rare, occurring in 1/5000 tumors.

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3. Marulanda GA, Henderson ER, Johnson DA, et al. Orthopedic surgery option for the treatment of primary osteosarcoma. *Cancer Control.* 2008 Jan;15(1):13-20.
4. Vander Griend RA. Osteosarcoma and its variants. *Orthop Clin North Am.* 1996 Jul;27(3):575-81.

60. A 25-year-old man who is a graduate student comes to the office for evaluation of the right ring finger 4 weeks after sustaining an axial impact. A diagnosis of soft-tissue mallet finger is noted. Which of the following is the most appropriate treatment in this patient?

- A) Arthrodesis
- B) Orthosis
- C) Pinning in extension
- D) Tendon grafting
- E) Terminal tendon repair

The correct response is Option B.

Most of these injuries even after a month will respond to splinting of the DIP joint in extension for 6 weeks. Any residual extension lag is largely an aesthetic concern and rarely will require further treatment. The operative treatment of soft-tissue mallet injury may lead to unacceptable complications while splinting may lead to skin irritation but little else.

The preferred treatment at 4 weeks is closed reduction and splinting. Surgical treatment may be considered for more chronic injury greater than 3 months. Pinning in extension may be appropriate for a small subgroup of patients with work-related inability to wear an orthosis (such as surgeons).

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2. Suh N, Wolfe SW. Soft tissue mallet finger injuries with delayed treatment. *J Hand Surg Am*. 2013 Sep;38(9):1803-5.

61. A 73-year-old man comes to the office for evaluation of an 8-cm mandibular defect with commensurate skin loss 6 weeks after sustaining a gunshot wound to the face. Reconstruction with a free fibula composite flap with skin paddle is planned. Which of the following arteries is the most common origin for blood supply to the skin paddle?

- A) Anterior tibial
- B) Peroneal
- C) Popliteal
- D) Posterior tibial
- E) Sural

The correct response is Option B.

The skin paddle of the free fibula flap receives its vascular supply from the peroneal, posterior tibial vessels, or from both. While a majority (95.8%) of the skin paddles receive their blood supply from the peroneal septocutaneous perforators, a few receive vascular contribution from both peroneal and posterior tibial systems, a few from only the posterior tibial system, and finally, a few from the popliteal artery.

The anterior tibial and sural arteries do not typically contribute to the skin paddle of the free fibula graft.

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2. Yadav PS, Ahmad QG, Shankhdhar VK, et al. Skin paddle vascularity of free fibula flap—A study of 386 cases and a classification based on contribution from axial vessels of the leg. *Indian J Plast Surg*. 2012 Jan;45(1):58-61.

62. A 36-year-old man undergoes rehabilitation following scapholunate ligament repair. Initial range of motion in therapy is planned to allow wrist movement while minimizing the movement between the scaphoid and lunate bones. Which of the following wrist movements is most likely to achieve this goal?
- A) Neutral wrist extension to neutral wrist flexion
  - B) Radial deviation in extension to radial deviation in flexion
  - C) Radial deviation in extension to ulnar deviation in flexion
  - D) Ulnar deviation in extension to radial deviation in flexion
  - E) Ulnar deviation in extension to ulnar deviation in flexion

The correct response is Option C.

The most appropriate motion is from radial deviation in extension to ulnar deviation in flexion.

The dart-thrower's motion, moving from radial deviation in extension to ulnar deviation in flexion, minimizes the movement between the scaphoid and lunate.

Studies have shown that during movement in this axis, from radial deviation and extension to ulnar deviation and flexion, the bones of the proximal carpal row (scaphoid, lunate, triquetrum), remain practically stationary, and motion occurs primarily through the midcarpal joint. As a result, this is felt to be the primary mechanical axis of movement in the wrist. Rehabilitation with movement in the dart-thrower's axis will limit movement between the bones of the proximal carpal row and allow wrist range of motion while minimizing stress on a scapholunate repair.

Simulation of radioscapulohamate fusion results in preservation of the dart-thrower's motion, confirming this concept.

The remaining motions listed result in greater intercarpal movement of the proximal row.

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2. Crisco JJ, Coburn JC, Moore DC, et al. In Vivo Radiocarpal Kinematics and the Dart Thrower's Motion. *J Bone Joint Surg Am.* 2005;87(12):2729-40.
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63. A 60-year-old man sustained Zone II laceration to the left long finger, which severed both flexor tendons. A photograph is shown. Primary repair was performed with a 3-0 cruciate core suture within 2 weeks of injury. He is scheduled to undergo rehabilitation with active motion protocol. Compared with passive motion protocols, an active motion protocol is most likely to present which of the following risk factors and outcomes?

- A) Equal risk of rupture and equal final range of motion
- B) Higher risk of rupture and decreased final range of motion
- C) Higher risk of rupture and increased final range of motion
- D) Lower risk of rupture and decreased final range of motion
- E) Lower risk of rupture and increased final range of motion

The correct response is Option C.

Many techniques for primary flexor tendon repair have been described. All methods involve a core suture to bear the load of the repair with or without an epitendinous suture. Multiple studies have shown that more strands crossing the repair site and/or larger diameter of each strand increases the strength of the repair. Two-strand repairs cannot withstand early active rehabilitation protocols; repairs of four strands or greater, including a cruciate repair as done in the patient above, can tolerate an early active motion rehabilitation protocol.

Trumble and Seiler's studies compare passive motion protocols and active motion protocols to each other for risk of rupture and incidence of decreased range of motion at final measurement. Both studies identified active motion protocols incurred a higher occurrence of rupture but a lower incidence of decreased range of motion compared with the passive protocols.

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64. A 54-year-old right-hand–dominant man comes to the office because of a 1-year inability to fully extend the right thumb after sustaining a laceration. Medical history includes no abnormalities. The patient reports being unable to grasp large objects. Hand and wrist x-ray studies show no abnormalities. An extensor pollicis longus (EPL) tendon injury is suspected. Exploration is planned. Which of the following additional interventions is the most appropriate next step in management?

- A) Primary four-strand repair of the EPL tendon
- B) Repair of the EPL tendon with a palmaris longus tendon interposition graft
- C) Tenorrhaphy of the extensor pollicis brevis tendon and EPL tendon
- D) Transfer of the extensor indicis proprius to the EPL tendon
- E) Transfer of the palmaris longus tendon to the EPL tendon

The correct response is Option D.

Extensor indicis proprius (EIP) transfer is the most common procedure for the treatment of chronic ruptures of the extensor pollicis longus (EPL) tendon. The EPL tendon is prone to rupture from synovitis and friction at Listers tubercle. Since these are identified months after the original injury, primary repair is not possible secondary to retraction of the tendon and/or atrophy of the tendon ends. The EIP is the preferred tendon for the transfer because it has an appropriate direction and excursion compared with the EPL. This tendon transfer has demonstrated excellent outcomes in previous studies. Tenorrhaphy of the EPL to the extensor pollicis brevis tendon would not allow full thumb extension.

Given the chronicity of this injury, sufficient myostatic contracture has occurred to render tendon interposition grafting inferior to EIP tendon transfer.

## REFERENCES:

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2. Lee JH, Cho DW. A new method to control tendon tension in the transfer of the extensor indicis proprius to extensor pollicis longus rupture. *Ann Plast Surg.* 2015;75:607-609.



65. A 28-year-old, right-hand–dominant woman is brought to the emergency department after sustaining a severe crush injury to the right upper extremity during a rollover motor vehicle collision. Examination shows multiple digit amputations and comminuted fractures of the distal radius and ulna. After multiple debridements, the limb is unsalvageable. Which of the following is the shortest stump length distal to the elbow that is required when fitting a prosthesis to maintain native elbow motion?

- A) 3 cm
- B) 8 cm
- C) 13 cm
- D) 18 cm
- E) 23 cm

The correct response is Option B.

The minimum stump length required for prosthesis fitting is 5 to 10 cm distal to the elbow.

Major upper extremity amputations are defined as amputations at or proximal to the wrist joint. Data from 2005 estimate that upper extremity amputations account for 34% of the 1.6 million people living in the US with limb loss, and 41,000 of these

were considered major amputations. Limb salvage is always the goal of the initial surgical management; however, the decision to amputate is made when limb salvage will result in a less functional outcome for the patient.

The ideal stump has adequate length, durable soft tissue, minimal edema, and a tapered shape with minimal scar tissue that is not directly over the bony prominence. Muscle preservation is important for the potential use of a myoelectric prosthesis.

In order to preserve elbow function and allow for fitting of a prosthesis, at least 5 cm of a bony stump is required. Although shorter transradial stumps do not allow for pronation and supination, preservation of elbow function is felt to be worthwhile functionally. Transfer of the biceps tendon to the ulna should be considered in shorter transradial stumps to decrease the risk of developing a flexion contracture at the elbow.

Amputations at least 10 cm proximal to the wrist or at the junction of the middle and distal 1/3 are felt to be ideal in terms of muscle coverage, stability of prosthesis fit, and forearm rotation, but not required. More distal stumps can be problematic in terms of soft-tissue coverage over bone and limb-length discrepancy to accommodate the wrist unit of the prosthesis.

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66. A 30-year-old woman comes to the office because of burning pain in the left wrist 5 months after discharge from the hospital. During her visit, a catheter was inserted in the left radial artery for arterial line monitoring in the intensive care unit. On examination, point tenderness and Tinel sign are noted over the volar radial aspect of the forearm, just ulnar to the radial artery, and overlying the flexor carpi radialis tendon. Which of the following is the most likely nerve of origin for the suspected condition?

- A) Anterior interosseous
- B) Median
- C) Musculocutaneous
- D) Radial
- E) Ulnar

The correct response is Option C.

The neuroma is of the lateral antebrachial cutaneous nerve, which innervates the area in question, over the volar forearm, including the skin overlying the flexor carpi radialis (FCR) tendon. The lateral antebrachial cutaneous nerve is the continuation of the musculocutaneous nerve in the forearm.

The dorsal radial sensory nerve innervates the skin overlying the dorsal and radial aspects of the wrist and does not innervate the skin overlying the FCR tendon. Therefore, the radial nerve is not appropriate.

The ulnar and median nerves are not appropriate, as they give off sensory contributions in the palm and fingers. The anterior interosseous nerve is mainly a motor nerve in the forearm, finally sending off branches to the volar capsule of the wrist.

## REFERENCES:

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67. A 60-year-old man comes to the office because of a 20-year history of rheumatoid arthritis. Which of the following is the most likely thumb deformity in this patient?

- A) Boutonnière
- B) Clinodactyly
- C) Gamekeeper's thumb
- D) Swan-neck
- E) Thumb-in-palm

The correct response is Option A.

Boutonnière deformity is the most common deformity in rheumatoid arthritis thumbs. Swan-neck deformity is the second most common deformity. The pathophysiology begins with metacarpophalangeal (MCP) joint synovitis which stretches the dorsal joint structures. The extensor pollicis brevis (EPB) tendon insertion is disrupted leading to a flexion deformity. Next, the extensor pollicis longus (EPL) tendon subluxes volar early causing flexion of the proximal phalanx. Early treatment includes synovectomy and extensor reconstruction and late treatment the MCP joint arthrodesis. Swan-neck deformity begins with carpometacarpal (CMC) joint synovitis causing bony erosion of the joint. The CMC joint will dorsiflex and radially subluxate causing an adduction contracture of the first metacarpal leading to hyperextension of the MCP joint. Gamekeeper's thumb occurs from ulnar collateral ligament weakness. Thumb-in-palm deformity is seen in patients with cerebral palsy. Thumb clinodactyly is a congenital disorder.

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68. A 65-year-old woman comes to the office because of pain at the base of the right thumb. Which of the following is the most appropriate plain x-ray study view for visualizing thumb basal joint subluxation?

- A) Bett view
- B) Brewerton view
- C) Eaton stress view
- D) Roberts view
- E) Standard lateral view of the thumb

The correct response is Option C.

The Eaton stress view is done with the radial borders of the thumb distal phalanges pressed together. It is a posteroanterior view and assesses laxity of the basal joint as demonstrated by subluxation of the thumb metacarpal on the trapezium.

The Brewerton view is taken with the fingers flat on the x-ray plate with the metacarpophalangeal joints flexed 65 degrees beam angled from a point 15 degrees to the ulnar side of the hand. It shows the metacarpal head and is useful for demonstrating degenerative disease or occult fractures.

Bett (or Gedda) view is characterized as a true lateral view of the trapeziometacarpal joint, perpendicular to the plane of the hand. It is performed as a posteroanterior view, with the hand pronated 30 degrees and the axis of the imaging tube angled 25 degrees distally. The view isolates the trapeziometacarpal joint and is useful for evaluating metacarpal base fractures (Bennett's fracture).

Roberts view is done with the wrist hyper-pronated and the dorsum of the thumb flat on the plate with an AP view. It is used to evaluate degeneration of the trapeziometacarpal joint but does not show subluxation as the stress view does.

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69. A 29-year-old man is brought to the emergency department because of a deep laceration of the medial right arm at the elbow. Examination shows complete loss of ulnar nerve function to the right hand. During exploration in the operating room, complete transection of the ulnar nerve at the elbow with a 3-cm nerve gap after debridement is noted. Which of the following procedures is most likely to result in the earliest recovery of intrinsic muscle function in this patient's hand?

- A) Anterior interosseous nerve transfer
- B) Cable grafting with nerve allografting
- C) Cable grafting with sural nerve grafting
- D) Primary repair with the elbow in flexion
- E) Ulnar nerve transposition and primary repair

The correct response is Option A.



The most appropriate answer is transfer of the anterior interosseous nerve to the motor branch of the ulnar nerve in the distal forearm. Ulnar nerve injuries are especially debilitating with loss of grip and claw hand deformity. High ulnar nerve injuries are considered to be anything proximal to the innervation of the flexor carpi ulnaris and flexor digitorum profundus muscles at or near the elbow. This includes the elbow, upper arm, and brachial plexus.

The prognosis for recovery of intrinsic hand function is poor in high ulnar nerve injuries 30 to 35 cm proximal to the hypothenar eminence. This is due to the length of time required for nerve regeneration, and the motor endplate degeneration that occurs during this time. High ulnar nerve injuries will exceed the approximately 18-

month window for regeneration in order to achieve meaningful muscle recovery.

The theory behind nerve transfer surgery is to take an expendable donor nerve and use the fascicles to restore function to a more critically injured nerve. The anastomosis for an AIN-to-ulnar nerve transfer is 8 to 10 cm proximal to the wrist crease and greatly decreases the amount of distance and therefore time required for reinnervation of intrinsic hand muscles. Although the anterior interosseous nerve contains 75% of the axons of the deep motor branch of the ulnar nerve, meaningful recovery of intrinsic muscle function can be expected. The anastomosis for the transfer can be done in an end: end or end: side technique. End-to-side nerve transfer is indicated in partial nerve injuries or lower nerve injuries where primary repair of the injured nerve is possible and one can expect some contribution of nerve fibers from the native nerve.

Primary repair of any nerve injury under tension or that requires extreme joint flexion is not indicated. This results in tension at the repair site, internal scarring, possible flexion contracture, and a poor result. Anterior transposition of the ulnar nerve may be performed in some instances but is reported to gain only 1 cm of length from the proximal nerve. This is not enough to bridge the gap in this scenario.

Any attempt at primary repair of a nerve injury with a 3-cm gap would require nerve grafting. In a mixed nerve, multiple cables of nerve graft are recommended in an attempt to topographically reconnect the sensory and motor fascicular bundles. The current gold standard for nerve repair in adults is autograft. The most common donor nerves are the sural nerve and medial antebrachial cutaneous nerve.

Processed nerve allograft has become a viable alternative to autograft nerve. The allograft nerve is processed and decellularized but maintains the microstructure of the nerve tissue including the fascicular anatomy and microvasculature. The allograft is rapidly revascularized without the donor site morbidity associated with autograft. The RANGER study has demonstrated S3 and M4 or above recovery in 86% of repairs using allograft nerve in gaps up to 5 cm. This question specifically asks about the most rapid recovery of motor function, which should occur with a nerve transfer.

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70. A 22-year-old man comes to the office because of injury to the right index finger flexor tendons in Zone II. During open repair, which of the following flexor tendon pulleys arise from volar plates?

A) A1, A2, and A3

B) A1, A3, and A4

C) A1, A3, and A5

D) A2 and A4

E) A4 and A5

The correct response is Option C.

The flexor tendons are bound within a fibro-osseous sheath, with pulleys essential to prevent bowstringing (and consequent poor force transfer). The pulley system includes both annular and cruciate pulleys. Pulleys A2 and A4 attach to bone. Pulleys A1, A3, and A5 are attached to the volar plates at their respective joints. The strength of pulleys, in order from strongest to weakest, are the A2, A1, and A4 pulleys. The pulleys attached to bone have a higher breaking strength compared with those attached to the volar plates.

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71. A 3-month-old male infant is evaluated for polydactyly and mirror hand. Which of the following is the most likely genetic anomaly in this patient?

- A) Engrailed-1 (EN1)
- B) Fibroblast growth factor-2 (FGF2)
- C) LIM homeobox transcription factor 1-beta (LMX1B)
- D) Sonic hedgehog (SHH)
- E) Wingless type (WNT)

The correct response is Option D.

This patient presents with polydactyly and mirror hand. The most likely genetic anomaly is in sonic hedgehog (SHH).

Limb development is controlled by signaling pathways that are located within 3 different signaling centers. These control the proximal-distal, anterior-posterior, and dorsal-ventral axes of limb development.

The limb develops in a proximal-distal direction, from shoulder to wrist, which is controlled by the apical ectodermal ridge (AER), a thickened layer of ectoderm over the limb bud. Fibroblast growth factors secreted within the AER signal the underlying mesoderm to differentiate. Disruption of the AER results in truncation of the limb.

Growth in the anterior-posterior (radioulnar) axis is determined by the zone of polarizing activity (ZPA). This is located in the posterior margin of the limb bud. The sonic hedgehog protein (SHH) acts to signal development of the limb into radial and ulnar aspects. Alterations in this pathway can result in mirror duplication.

Dorsal-ventral limb development is signaled by the Wnt signaling pathway, which produces a transcription factor, Lmx-1 that induces the development of dorsal structures. In the ventral portion of the limb, the Engrailed-1 gene product blocks the Wnt pathway, leading to ventralization.

A variety of other transcription factors encoded by Hox and T-Box genes also govern limb and organ development, and alterations in these can give rise to various developmental differences.

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72. Which of the following is most likely an open fracture?

- A) Barton
- B) Colles
- C) Epiphyseal
- D) Salter-Harris III
- E) Seymour

The correct response is Option E.

The Seymour fracture in children displaces through the epiphysis with the nail matrix interposed between the fragments. It is always an open fracture.

The Salter-Harris classification is the most commonly used method to describe the five most frequent patterns of pediatric fractures involving the physis. The classification helps explain the mechanism of injury and anticipate the consequences of the fracture upon subsequent growth. A Salter-Harris III fracture is epiphyseal but is not necessarily open.

Colles and Barton fractures are seen in the distal radius.

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73. A 52-year-old man comes to the office because of swelling of the left hand and drainage from a puncture wound sustained 2 days ago while reaching under a trailer to retrieve his cat. A photograph is shown. The patient reports that his hand began to swell within hours of the injury. Medical history includes hypertension, poorly controlled type 2 diabetes mellitus, and a 10-year history of alcoholism. Temperature is  $39.5^{\circ}\text{C}$  ( $103.2^{\circ}\text{F}$ ), and blood pressure is 92/60 mmHg. Serum glucose concentration is 580 mg/dL. On initial surgical exploration of the hand and wrist, the interosseous and thenar muscles are necrotic, and purulence extends into the carpal tunnel. Which of the following surgical interventions is the most appropriate next step in management?

- A) Wide debridement of dorsal hand and wrist
- B) Wide debridement of volar and dorsal hand and wrist
- C) Transmetacarpal amputation
- D) Mid-forearm amputation
- E) Transhumeral amputation

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option D.

This patient has necrotizing fasciitis with clinical evidence of sepsis and progression into the distal forearm. The mortality rates for this entity are from 23 to 76%; this patient's age and added comorbidity place him on the higher side of this range. The presence of necrotic hand muscles makes preservation of the hand untenable, especially in light of the patient's symptoms and comorbidities. The virulent organisms that cause this condition, in this case Group A *Streptococcus*, spread rapidly along tissue planes and involvement is universally much more extensive than the physical findings would suggest. The presence of necrotic muscle tissue is a relatively late finding and suggests that the infection has progressed well beyond that anatomical level at which it is found. Failure to recognize this truth leads to inadequate treatment, continued progression of the infection, and death. In this patient, there was clinical and histologic evidence of necrotic fascia as far as the distal forearm. Even after mid-forearm amputation, he required further daily debridement and shortening of the stump. Transhumeral amputation is overly aggressive given the present findings.

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74. A 53-year-old woman comes to the office because of pain of the dorsum of the left wrist and thumb for the past 3 months. The patient reports that pain occurs with activity. Physical examination shows pain is increased with passive wrist ulnar deviation with the thumb held in the palm and during resisted extension of the thumb metacarpophalangeal (MCP) joint. Axial loading of the thumb does not reproduce pain. An x-ray study is shown. Which of the following is the most likely diagnosis in this patient?

- A) Basal joint arthritis
- B) de Quervain tenosynovitis
- C) Intersection syndrome
- D) Scaphotrapezial arthritis
- E) Stenosing tenosynovitis

The correct response is Option B.

Pain in the dorsal radial aspect of the wrist can be caused by a variety of conditions; a thorough history and physical examination are key to elucidating the correct diagnosis. In the scenario presented, the patient has a positive Finkelstein test along with reproduction of the pain with resistance to the extensor pollicis brevis muscle. These are classic findings of de Quervain tenosynovitis. The patient's physical examination points to the first dorsal compartment of the wrist as a source of pathology rather than basal joint or scaphotrapezial arthritis. Radiographs have not been shown to correlate with symptomatology in basilar joint arthritis. Intersection syndrome is a tendinopathy between the intersection of the tendons of the first and second dorsal compartments. The pain of intersection syndrome is generally found more proximally in the forearm and is also increased with resisted wrist extension. Digital flexor tenosynovitis or trigger finger is an inflammatory tendinopathy of the flexor pollicis longus tendon and pain is generally reproduced with resisted thumb flexion.

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75. A 30-year-old man undergoes evaluation of a stab wound to the left upper extremity. A photograph is shown. Examination shows that the injured nerve is completely transected. Supination is weak, and he cannot flex his elbow in a supinated position. Which of the following areas is most likely to be insensate?

- A) Dorsal little finger
- B) Index finger pad
- C) Posterior arm
- D) Radial forearm
- E) Thumb pad

The correct response is Option D.

The patient has an injury to the musculocutaneous nerve. This nerve provides motor axons to the brachialis, biceps brachii, and coracobrachialis. Patients with a musculocutaneous nerve transection cannot flex the elbow when supinated; the brachioradialis would provide some elbow flexion in a pronated position. The biceps brachii is the strongest supinator of the forearm, so patients with this injury have weak supination. The musculocutaneous nerve also provides sensory axons to the lateral brachial and lateral antebrachial cutaneous nerves. Patients with transection of this nerve would be insensate on the lateral arm and the radial side of the forearm.

Sensation to the posterior arm is provided by the posterior brachial cutaneous nerve, a branch of the radial nerve.

Sensation to the thumb pad is provided by the median nerve.

Sensation to the dorsal little finger proximally is provided by the dorsal sensory branch of the ulnar nerve and distally by the ulnar and radial proper digital nerves, branches of the ulnar nerve.

Sensation to the index finger pad is provided by the median nerve.

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76. A 25-year-old postpartum woman comes to the office because of a painful mass of the left little finger. The patient reports that the swelling began during her teen years but enlarged rapidly and became painful during the third trimester of her recent pregnancy. Physical examination shows the mass is soft and compressible. The patient reports that the mass becomes firm if the hand is dependent. Which of the following is the most appropriate method of treatment in this patient?

- A) Arterial embolization
- B) Oral propranolol therapy
- C) Pulsed-dye laser therapy
- D) Surgical excision
- E) Observation

The correct response is Option D.

In this patient, observation would be inappropriate. Small, painless lesions can be safely observed, but symptoms such as pain or loss of function warrant intervention. In this patient, who has a painful venous malformation, observation would be inappropriate. Pulsed-dye laser therapy provides effective treatment for cutaneous vascular lesions. Although the image does show a bluish discoloration over the lesion in the small finger, the skin is largely uninvolved. This venous vascular malformation represents a deeper lesion that would be unaffected by laser therapies directed at the skin. Surgical excision remains the mainstay for treatment of symptomatic low-flow vascular malformations such as this one. The patient description presents a classic picture (soft, compressible, swelling with dependency, rapid growth with hormonal changes). Sclerotherapy may be combined with surgical excision for larger or more diffuse lesions. In this patient, the small, localized lesion can be approached by surgical excision alone. Arterial embolization can decrease the size of high-flow vascular malformations and decrease blood loss during surgical excision. The presentation of this lesion is most consistent with a low-flow, venous malformation (soft, compressible, swelling with dependency). As there is no arterial feeding vessel, this lesion would not be amenable to arterial embolization. Propranolol would be appropriate treatment for infantile hemangioma but is not appropriate for venous malformation.

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77. A 40-year-old man is brought to the emergency department because of a grade IIIB open fracture of the right distal aspect of the tibia and fibula sustained during a motorcycle collision. The plastic surgeon is consulted after initial debridement and external fixation of the fracture. Examination shows a 10-cm open wound of the right medial ankle with complete transection of the tibial nerve. The tibia fracture is comminuted but without marked bone loss. The foot is well perfused, but single-vessel run-off through the anterior tibial artery is noted. Which of the following is the most appropriate management of this patient's condition?

- A) Debridement and free muscle flap without nerve repair
- B) Debridement, tibial nerve repair, and coverage with a bilaminar acellular dermal regeneration template
- C) Debridement, tibial nerve repair, and coverage with a free fasciocutaneous flap
- D) Debridement, tibial nerve repair, and coverage with a pedicled reverse sural fasciocutaneous flap
- E) Primary below-knee amputation

The correct response is Option C.

The answer is debridement with repair of the tibial nerve and coverage with an anterolateral thigh (ALT) free flap. This patient is presenting with a grade IIIB open fracture of the distal tibia and fibula with an open medial wound. Traditionally, lower extremity injuries with an insensate plantar foot were considered unsalvageable. However, more recent data have demonstrated that an insensate foot by itself should not be considered a contraindication to limb salvage if repair is otherwise possible. Studies have shown equivalent long-term outcomes with limb salvage and primary amputation and that half of the patients with tibial nerve injuries will regain plantar sensation within two years post-injury. This vignette describes a situation in which one could reasonably expect a successful outcome.

The size and location of the wound are most amenable to coverage with a microvascular free flap. In this instance, a fasciocutaneous flap will provide adequate soft-tissue coverage with minimal donor morbidity and potentially better long-term outcome if secondary bone grafting or hardware revision is required.

The reverse sural fasciocutaneous is a versatile flap that can be used for reconstruction of many different wounds of the distal lower extremity. The flap is a

neurocutaneous flap supplied by the vascular axis of the sural nerve as well as distal peroneal artery perforators. In this case, the peroneal artery was damaged from the trauma and the pedicle of the flap is in the zone of injury, making it an inappropriate choice for reconstruction when better options are available.

The use of biologic materials such as bilaminar acellular dermal regeneration templates have been used successfully to cover wounds with exposed vital structures such as bone, tendon, and nerve. However, its use is best suited for smaller wounds or in patients in whom microvascular reconstruction is contraindicated or not desired. This patient required soft-tissue coverage over a major nerve repair and a comminuted fracture with internal hardware. A microvascular free flap would be the method of choice in this patient when feasible.

As stated previously, up to fifty percent of patients with tibial nerve injuries will recover plantar sensation after nerve repair. Nerve repair should be attempted to improve the overall outcome.

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78. A 49-year-old man comes to the office because of dull, aching pain over the dorsum of the foot. Nerve study shows no abnormalities of the nerves around the knee but chronic denervation in the extensor digitorum brevis at the dorsum of the foot. Which of the following nerves is most likely to be entrapped?

- A) Anterior tibial
- B) Deep peroneal
- C) Lesser saphenous
- D) Medial plantar
- E) Medial sural

The correct response is Option B.

The deep peroneal nerve emerges from the leg anterior compartment musculature, from beneath the extensor retinaculum of the ankle. The nerve gives off a motor branch to the extensor digitorum brevis, and then terminates into the first web space of the foot, after running beneath the tendon of the extensor hallucis brevis. Entrapment of this nerve, as it exits the extensor retinaculum of the ankle, can manifest itself as pain, weakness, or numbness or tingling over the dorsum of the foot.

The saphenous nerve innervates the cutaneous region over the anterior-medial aspect of the distal leg and ankle.

The medial sural nerve innervates the cutaneous region over the posterior lateral aspect of the lower leg.

The tibial nerve innervates the plantar surface of the foot. It divides into the medial and lateral plantar nerve over the plantar aspect of the foot. The medial and lateral plantar nerves innervate the cutaneous aspect of the plantar foot and the intrinsic musculature of the foot.

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79. A 62-year-old man comes to the office because of an open ankle fracture with exposed hardware. Use of a sural artery flap for reconstruction is planned. Which of the following veins must be harvested within the flap?

- A) Anterior tibial
- B) Lesser saphenous
- C) Peroneal
- D) Popliteal
- E) Posterior tibial

The correct response is Option B.

The sural artery flap is a cutaneous flap located on the posterior aspect of the lower leg. The flap is based on the arteries that accompany the lesser saphenous vein and sural nerve; the vein and nerve must be included in the flap. The axial pattern flap can cover defects around the knee and upper third of the leg. The reverse flow flap was first introduced by Masquelet in 1992 and is a workhorse flap for pedicle reconstruction of the lower third defects in the leg. The anterior tibial, posterior tibial, popliteal, and peroneal veins do not contribute to the vascular anatomy of this flap.

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2. Xie XT, Chai YM. Medial sural artery perforator flap. *Ann Plast Surg*. 2012 Jan;68(1):105-10.

80. A 30-year-old man is brought to the emergency department because of ring avulsion of the right ring finger with complete amputation through the proximal phalanx. Which of the following factors is most likely to influence survival of the replanted finger in this patient?

- A) Associated fracture of the middle phalanx
- B) Level of amputation
- C) Need for skin graft
- D) Number of dorsal veins repaired/grafted
- E) Patient history of cigarette smoking

The correct response is Option D.

The only factor that correlated with survival in the reported series and reviews is the repair and/or grafting of two or more dorsal veins. Reports that did not compare groups recommend repairing at least two dorsal veins of replanted digits.

Smoking, level of amputation, need for skin grafting, and associated fractures were not found to have any effect on survival of digits that had ring avulsion injuries.

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81. An otherwise healthy 30-year-old man is brought to the office because of a slow-growing mass on the volar base of the left ring finger. There is no history of trauma. The patient reports no pain or discomfort. Examination shows a 1.0-cm midline mass that is located immediately distal to the metacarpophalangeal flexion crease. The mass is firm, nonpulsatile, and does not transilluminate. The mass does not move with finger flexion or extension. X-ray study shows no abnormalities. Which of the following is the most likely diagnosis?

- A) Digital lipoma
- B) Fibrosarcoma
- C) Ganglion cyst
- D) Giant cell tumor of tendon sheath
- E) Neurilemmoma

The correct response is Option D.

The clinical scenario describes a lesion that is midline and overlies the flexor tendon sheath. The two most likely diagnoses in this scenario are ganglion cyst and giant cell tumor of tendon sheath. Both of these lesions tend to present as a ball-like lesion as described. These entities are usually distinguished on the basis of a transillumination test: light will pass through the mass if it is a ganglion cyst (since it is fluid) and will not if it is a giant cell tumor (or other solid masses). Since light was not transmitted through this lesion, and given the characteristic and location of the lesion, it is most likely to be a giant cell tumor of tendon sheath. Fibrosarcoma is extremely unlikely and would almost never present as a midline spherical mass on the palmar surface of the finger. Neurilemmoma is a relatively rare neural tumor that arises from the nerve sheath; on the volar aspect of the finger, it would present more laterally in the path of the digital nerve. Digital lipoma can appear as a midline mass, but this entity is very uncommon.

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2. Lanzinger WD, Bindra R. Giant cell tumor of the tendon sheath. *J Hand Surg Am*. 2013;38:154-157.

82. A 44-year-old, right-hand–dominant man comes to the office because of a painless deep mass on the dorsum of the dominant hand. Biopsy shows myxoinflammatory fibroblastic sarcoma. Which of the following factors is most associated with the need for flap coverage and local recurrence?

- A) Digital involvement
- B) Dorsal versus palmar location
- C) Patient age
- D) Transverse biopsy incision
- E) Treatment with radiation therapy

The correct response is Option D.

Sarcomas are rare tumors in the hand. The dorsum and mid palm are most commonly involved. Tumor types are most commonly epithelioid, malignant fibrous histiocytoma, and synovial sarcoma. The performance of a "suboptimal" biopsy incision (using a site or incision that cannot be incorporated into a standard limb salvage incision or amputation flap) is predictive of the need for flap reconstruction and local recurrence. The other factors listed may encourage a plastic surgeon to consider flap coverage but are not predictive in large series. A transverse incision in the extremities is considered "suboptimal."

The importance of this knowledge is that surgeons must carefully consider the placement of incisions and the use of inadequate excisions when approaching unknown hand masses.

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83. A 45-year-old woman comes to the office because of a split in the nail plate following a previous crush injury to the left index finger. The patient desires improvement in the appearance of the nail. A photograph is shown. Which of the following is the most appropriate treatment?
- A) Application of topical phenol
  - B) Excision/repair of the nail bed
  - C) Nail plate avulsion
  - D) Oral antifungal therapy
  - E) Split-thickness skin grafting

The correct response is Option B.



The most appropriate method of treatment is excision and repair of the nail bed.

The anatomy of the nail consists of a nail plate, nail fold, and a nail bed. The nail bed is the soft tissue beneath the nail plate, which is composed of the germinal matrix proximally and the sterile matrix distally. Most nail plate growth (90%) is provided by the germinal matrix. In cases of trauma, adherence between the nail fold dorsally and nail bed volarly can result in synechiae, interfering with nail growth and resulting in a longitudinal split in the nail. It is important to prevent adherence of dorsal and palmar elements by splinting the nail fold open during the healing phase. This can be accomplished by replacement of the nail plate if available, or using a piece of foil from the suture packet. This patient presents with a split nail deformity after previous trauma. There is scarring between the nail fold and the nail bed, resulting in a longitudinal split with inability to allow for growth of the nail plate in the central portion. Proper treatment consists of excision of the nail bed scar,

with repair of the nail bed. Splinting of the nail fold during the healing period will prevent recurrent scarring of the dorsal fold to the palmar surface. In cases where there is significant scar tissue and inability to close the resultant defect after excision, grafting of the nail bed may be required. A split graft of the sterile matrix can be performed if the deficit is only present distally. If the germinal matrix is involved, a full-thickness graft is needed.

Avulsion of the nail plate alone will not eliminate the scarring at the proximal nail fold.

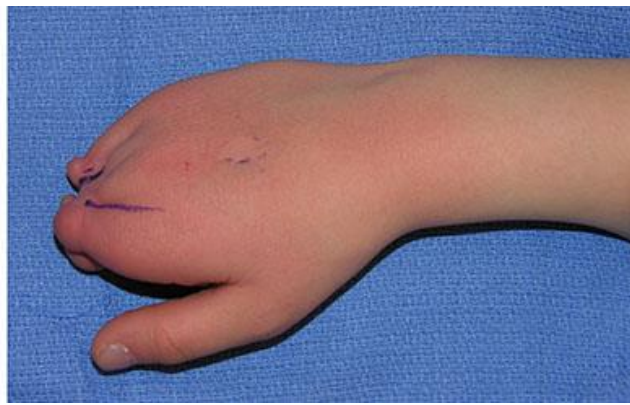
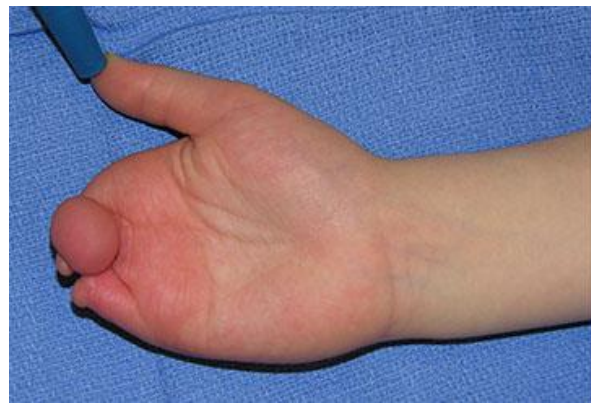
Oral antifungal therapy is useful in treatment of fungal onychomycosis.

Complete excision of the nail bed and split-thickness skin grafting can be used in nail ablation, but would result in absence of the nail and not yield a more cosmetic appearance.

Topical phenol application has been used for nail matricectomy, but can produce irregular tissue destruction and would result in loss of the nail.

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84. A 3-year-old boy is scheduled to undergo the first stage of separation of syndactyly of the right hand. Photographs are shown. Which of the following anatomical structures is most likely to limit how far the digits can be separated proximally?

- A) Artery
- B) Extensor tendon
- C) Flexor tendon
- D) Nerve
- E) Vein

The correct response is Option A.



Digital veins, due to their larger number and relative redundancy, do not normally limit which tissues can be separated to what level. Division of one branch of the digital artery is not normally a problem when only two digits are involved in syndactyly; the digital artery on the unaffected side is normally sufficient to perfuse the digit. For a central digit when three or more digits are involved, dissection must either stop at the bifurcation of the artery, or revascularization, such as with a vein graft, must be done.

The digital nerve often exists as a single unit at least partially down the length of the joined fingers, but it can be separated into two proper digital units with intrafascicular dissection to a level proximal to the neo-web space.

Flexor and extensor tendons are not involved in syndactyly.

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85. A 10-year-old boy is brought to the office because of the findings shown in the photograph. Which of the following is the most likely diagnosis?

- A) Amniotic band syndrome
- B) Axillary web syndrome
- C) Poland syndrome
- D) Popliteal pterygium syndrome
- E) Waardenburg syndrome

The correct response is Option C.

The patient has Poland syndrome with an unusual axillary web. The defining clinical feature is underdevelopment or absence of the sternal head of the pectoralis major muscles (seen in the photograph), but the deformity can lead to other anomalies such as absence of the nipple, the areola, or portions of the anterior chest wall. Cardiac anomalies may also be present. The ipsilateral extremity and hand are often smaller or hypoplastic, and this finding can be subtle or pronounced. The fingers are typically shorter and smaller than the contralateral side, and there may be webbing

between the fingers. In severe forms, the central fingers are mere vestiges.

The other choices do not fit with this clinical photograph. Amniotic band syndrome usually leads to amputation or severe constriction of the hand or digits; this is not seen here. Waardenburg syndrome is a genetic condition that causes hearing loss and pigmentation changes to the hair, skin, and eyes. Popliteal pterygium syndrome is a condition associated with cleft lip/palate, webs of the popliteal space, and syndactyly of the toes or fingers. The axillary web seen here is not a described feature. Axillary web syndrome, or cording, is an acquired web that usually follows axillary node dissection in the treatment of breast cancer. This does not fit the clinical scenario.

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86. A 26-year-old man comes to the office for evaluation after sustaining an open injury to the right knee during a motorcycle collision 2 weeks ago. Physical examination shows a 2-cm defect over the patella. A medial gastrocnemius flap is planned to close the defect. Which of the following is the dominant vascular supply to this muscle?

- A) Anterior tibial
- B) Inferior geniculate
- C) Medial sural
- D) Posterior tibial
- E) Superior geniculate

The correct response is Option C.

The gastrocnemius flap is the primary flap used to cover soft-tissue defects of the upper third of the tibia and knee. The gastrocnemius muscle is a bipennate muscle located on the posterior surface of the lower leg. The muscle originates from the medial and lateral condyles of the femur and inserts into the Achilles tendon. The dominant blood supply of the muscle is the medial and lateral sural arteries, which are branches of the popliteal artery. Generally only one head of the gastrocnemius flap is harvested to cover soft-tissue defects. The muscle alone is generally taken and is covered with a split-thickness skin graft for lower extremity reconstructions. The geniculate arteries primarily supply the bone around the knee joint.

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87. A 30-year-old man is evaluated after sustaining multiple gunshot wounds to the right leg and thigh. X-ray study shows no retained foreign bodies and no fractures. On physical examination, the patient's foot is warm, with palpable pulses at the ankle. He is able to extend the toes, dorsiflex the ankle, and evert the ankle. He is unable to flex his toes. He has normal sensation to the dorsum of his foot and medial-most part of the instep and lateral-most midfoot/hindfoot. Which of the following nerves is most likely injured in this patient?

- A) Common peroneal nerve
- B) Femoral nerve
- C) Saphenous nerve
- D) Sural nerve
- E) Tibial nerve

The correct response is Option E.

Gunshot wounds can create a range of nerve injuries from contusion to transection. Electrodiagnostic testing can be very helpful in later diagnosis and intraoperatively during nerve reconstruction but will not demonstrate changes in the nerve on the day of injury. EMG/nerve conduction testing will not demonstrate changes in findings until 2 to 6 weeks after injury. An accurate sensory and motor examination is the best initial step to identify abnormalities that can be tracked over time.

The common peroneal nerve provides motor axons to the anterior and lateral compartment muscles. It also provides sensory axons to the dorsal foot, primarily via the terminal branches of the superficial peroneal nerve. Its only branch above the knee is to the lateral knee joint capsule.

The saphenous nerve receives the terminal branches of the femoral nerve. It provides sensation to the medial-most plantar surface of the instep.

The femoral nerve provides sensation to the thigh via cutaneous nerve branches as well as motor axons to the quadriceps muscle. Its terminal sensory fibers reach the foot via the saphenous nerve.

The sural nerve is a terminal branch of the tibial nerve. It provides motor axons to the gastrocnemius muscle and sensory fibers to the lateral-most forefoot and midfoot dorsally and lateral-most midfoot and hindfoot plantarly.

The tibial nerve provides sensation to the majority of the plantar surface of the foot via the medial and lateral plantar nerves. It also provides motor axons to the muscles of the deep posterior compartment, including the toe flexors. For the patient in this scenario, the tibial nerve is injured distal to the takeoff of the sural nerve.

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Left Thumb Stress View



Right Thumb Stress View

88. A 50-year-old man who is a biathlete comes to the office because of weakness and pain when gripping or pinching with the left hand. Medical history includes a sprain to the left thumb with forced radial abduction 1 year ago. Physical examination shows a difference in stability of the right thumb and the left thumb during stress testing. Photographs are shown. Which of the following is the most appropriate treatment for this patient's metacarpophalangeal (MCP) joint injury?

- A) Direct repair of the collateral ligament
- B) Graft reconstruction of the collateral ligament
- C) Occupational therapy for strengthening of the adductor muscle
- D) Placement of a short opponens splint for 6 weeks
- E) Transfer of the extensor indicis proprius tendon to the adductor insertion

The correct response is Option B.



Injuries to the ulnar collateral ligament (UCL) of the thumb metacarpophalangeal joint (skier's thumb Injury) can be successfully treated with 4 weeks of immobilization provided that the injury results in either no instability, or limited ( $<30$  to  $35$ -degree laxity under load, or  $<10$  to  $15$ -degree difference from the contralateral UCL under load) instability. The photographs provided show  $40$  to  $45$  degrees of laxity, which differs substantially from the contralateral ( $<10$  degrees) thumb. Treatment of this injury requires operative intervention. Incomplete injuries, or injuries with only mild symptomatic laxity, may benefit from occupational therapy. The adductor muscle provides a stabilizing force across the metacarpophalangeal joint and has been a target for treating mild injuries that result in some degree of instability. This would be insufficient for treating this complete rupture. In a similar fashion to strengthening the adductor muscle, addition of another force directed at providing ulnar adduction at the metacarpophalangeal joint has been proposed. As in the case of adductor strengthening, however, this would be inadequate to treat the complete rupture apparent in the clinical photos. When encountered acutely, unstable, complete ruptures of the ulnar collateral ligament of

the thumb metacarpophalangeal joint are optimally treated with operative repair. Four to six weeks following the injury, direct repair may be difficult if not impossible. In this patient, the presentation for treatment occurs one year after the initial injury, making repair of the UCL extremely unlikely. On operative exploration in this patient, only a shortened stump of UCL remained attached to the metacarpal head. Chronic unstable injuries of the thumb metacarpophalangeal (MCP) joint ulnar collateral ligament (UCL) may be symptomatic via weakened grip and pinch as well as pain. Treatment in this setting will be dictated by patient needs and by the status of the joint. Patients requiring mobility and lacking arthritic degeneration at the MCP joint are candidates for UCL reconstruction. Reconstruction will typically be accomplished by use of a tendon graft, either palmaris or plantaris, placed through bone tunnels and secured through one of multiple methods (interference screws, periosteal sutures, bone anchors). Given this patient's presentation one year out from the initial injury, reconstruction is the best option.

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89. A 30-year-old man comes to the office because of stage IV heel pressure ulcer of the right foot. Reconstruction with a medial plantar artery flap is performed. The pedicle for this flap derives from which of the following arteries in the lower extremity?

- A) Anterior tibial
- B) Dorsalis pedis
- C) Lateral plantar
- D) Peroneal
- E) Posterior tibial

The correct response is Option E.

The medial instep flap (or medial plantar artery flap) is an ideal choice for coverage of a heel defect in a patient with adequate peripheral vasculature. This flap is based on the medial plantar branch of the posterior tibial artery. This vessel lies between the abductor hallucis and flexor digitorum brevis muscles.

The lateral plantar artery supplies the lateral aspect of the sole and digits but does not supply the medial instep. The anterior tibial artery and dorsalis pedis supply the dorsum of the foot and digits and are not involved in this flap. The peroneal artery is used in a fibular flap but not in the foot.

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90. A 63-year-old woman comes to the office because of progressive pain of the right ring finger over the past 4 months. Physical examination shows the ring finger is held in a flexed position with the metacarpophalangeal and proximal interphalangeal joints each at a 45-degree angle. Tenderness over the palm with active digital flexion is noted. The patient reports that when she wakes in the morning, the ring finger is generally fixed in a flexed position, and she has to physically straighten the finger with her other hand. Over the past month, the finger has remained flexed. Medical history includes type 2 diabetes mellitus and hypertension. Which of the following is the most likely diagnosis in this patient?

- A) Central slip rupture
- B) de Quervain tendinitis
- C) Digital stenosing tenosynovitis
- D) Dupuytren contracture
- E) Ulnar nerve compression at the elbow

The correct response is Option C.

Stenosing tenosynovitis, or trigger finger, is an inflammatory tendinopathy of the digital flexor tendons. It can present with pain, stiffness, and occasionally a mass in the palm. Long-standing stenosing tenosynovitis may occasionally lead to a flexion contracture of the finger after proper treatment is not performing. Dupuytren disease is a flexion contracture of the digits and palm due to contracture of the palmar fascia. Dupuytren disease is a progressive condition and the patient would not be able to passively extend her finger. de Quervain tenosynovitis is a tendinitis affecting the tendons of the first dorsal compartment resulting in pain over the dorsal wrist and thumb. Ulnar nerve compression at the elbow may affect the intrinsic muscles causing a claw deformity and contracture of the ring finger. Commonly, the little finger is also affected, and the patient would have symptoms of paresthesia or numbness in the ulnar innervated fingers. Central slip rupture would cause a Boutonnière deformity with flexion at the PIP and hyperextension at the DIP.

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91. A 60-year-old man with type 2 diabetes mellitus comes to the office because of a diabetic ulcer on the sole of the right foot. Treatment of the ulcer with a medial plantar artery flap is planned. Against which of the following muscles is the arterial perforator located?

- A) Adductor hallucis
- B) Flexor hallucis
- C) Lumbrical
- D) Plantar interosseous
- E) Quadratus plantae

The correct response is Option B.

The medial plantar artery flap is elevated starting at the plantar aspect, deep to the muscular fascia. The perforator is identified between the flexor hallucis and abductor hallucis muscles. The perforator is then dissected toward its origin on the medial plantar artery in the intermuscular space.

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92. A 32-year-old, right-hand–dominant man is brought to the emergency department 3 hours after sustaining an avulsion injury to the left thumb. The avulsed digit was immediately placed on ice and transported with the patient. Photographs are shown. Replantation fails; the necrotic digit is removed and the wound closed. The carpometacarpal (CMC) joint is disarticulated. Which of the following is the most appropriate method of reconstruction in this patient?
- A) Great toe to thumb transfer
  - B) Metacarpal lengthening
  - C) Osteoplastic reconstruction
  - D) Pollicization of index finger
  - E) Web deepening

The correct response is Option D.

This patient has a proximal thumb avulsion with disruption of the carpometacarpal (CMC) joint. In this scenario, the best reconstructive option (besides successful replantation) is pollicization of the index finger. Reconstruction after thumb amputation, as with congenital deficiencies, depends largely on the length of the remaining skeletal structure. One can lose most of the distal phalanx and still retain good overall thumb function. Amputations that involve the proximal phalanx or the metacarpal suffer from deficient bone length and procedures that add length, like distraction, toe to thumb, or osteoplastic reconstruction. When the entire metacarpal

is absent, the aforementioned procedures will not be effective. Pollicization will restore thumb length and provide very good function.

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93. A 57-year-old man comes to the office because of a rectourethral fistula that developed after he underwent radiation treatment for prostate cancer. Reconstruction with a pedicled muscle-only gracilis flap is performed. From which of the following directions does the medial femoral circumflex artery pedicle enter the gracilis muscle?

- A) Anterior
- B) Inferior
- C) Lateral
- D) Medial

The correct response is Option C.

The gracilis muscle is a useful flap for perineal reconstruction. It was first described for use in rectourethral fistula repair by Ryan et al. in 1979. The gracilis muscle is the most superficial of the adductor group and can easily be found in the mid thigh, traversing between the pubic tubercle and medial femoral condyle. Its blood supply is from the profunda femoris as a direct branch or terminal branch of the medial femoral circumflex. There are multiple additional minor pedicles along the muscle's length (Mathes and Nahai type II). The dominant pedicle enters the muscle approximately a handbreadth below the inguinal crease. It enters the deep aspect of the muscle (ie, from lateral to medial) making dissection of the superficial muscle safe and easy.

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94. A 25-year-old woman comes to the office because of nerve compression of the right upper extremity. Electromyography and nerve conduction studies are planned. Which of the following is the most likely indicator of motor axon loss in this patient?

- A) Absent polyphasic waveforms
- B) Decreased distal motor latency
- C) Fibrillation potentials
- D) Increased amplitude
- E) Increased conduction velocity

The correct response is Option C.

Specific electrodiagnostic criteria indicate axonal loss: nerve conduction study amplitudes are decreased, conduction velocity is slowed, distal latency is prolonged, and fibrillation potentials and polyphasic waveforms are present.

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95. A 45-year-old man is evaluated for unstable plantar scar 3 years after undergoing skin grafting for a traumatic amputation at the tarsometatarsal joints. A photograph is shown. An anterolateral thigh flap is planned for coverage of the resultant plantar defect. Which of the following coaptations is most likely to allow for sensory recovery of the flap?
- A) Lateral femoral cutaneous nerve to a deep peroneal nerve branch
  - B) Lateral femoral cutaneous nerve to a superficial peroneal nerve branch
  - C) Lateral femoral cutaneous nerve to a tibial nerve branch
  - D) Medial femoral cutaneous nerve to a deep peroneal nerve branch
  - E) Medial femoral cutaneous nerve to a tibial nerve branch

The correct response is Option C.

The medial femoral cutaneous nerve provides sensation to the anteromedial, not the anterolateral, thigh flap.

Achieving durable results after reconstruction of defects on the weight-bearing surface of the foot is challenging for two main reasons: flap donor sites (other than the medial plantar artery flap) do not have the specialized skin structures of the sole of the foot and are thus less durable than native foot skin; a transferred flap will always be less sensate than native, uninjured plantar foot skin. Flaps are thus more vulnerable to trauma because they cannot feel, and they are less able to tolerate trauma because they lack the native characteristics of plantar skin.

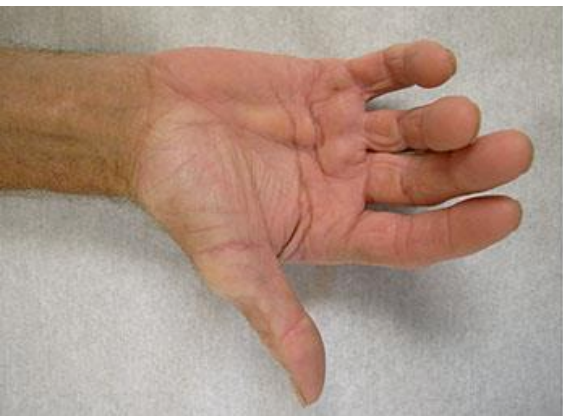
Coapting the sensory nerve of a flap to the native sensory nerve of the recipient area will allow a flap to recover some sensibility, and thus it may be more able to tolerate weight bearing. The sensory innervation to the anterolateral thigh flap is the lateral femoral cutaneous nerve. The sensory innervation to the plantar midfoot is the medial plantar nerve, a terminal branch of the tibial nerve.

The superficial peroneal nerve provides sensation to the dorsal foot.

The deep peroneal nerve provides sensation to the dorsal foot.

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96. A 55-year-old, right-hand–dominant man who is a machinist comes to the office because of inability to fully extend the right ring finger. Photographs are shown. The patient reports that his symptom began 5 years ago and has worsened progressively. Examination shows a 45-degree flexion contracture of the right ring finger (PIP) joint during attempts at full extension. All other joints demonstrate full extension, and the patient can create a complete fist during flexion. Regarding treatment options for this patient, which of the following interventions is most likely to provide the longest relief of his symptom prior to recurrence?

- A) Collagenase injection and manipulation
- B) Limited fasciectomy
- C) Percutaneous aponeurotomy with lipografting
- D) Percutaneous needle fasciotomy
- E) Radiation therapy and splinting

The correct response is Option B.

Radiotherapy has been proposed as a potential treatment to slow or stop progression of Dupuytren contractures (palmar fibromatosis). A prospective study of radiotherapy revealed no greater efficacy than observation as an intervention for slowing the disease process. There is no evidence to suggest radiotherapy for correction of an established contracture.

Rijssen and colleagues established quantitative criteria for recurrence, using an increase of total passive flexion contracture of 30 or greater, compared to the 6-week follow-up values in previously treated joints. After 5 years, their recurrence rate

following percutaneous needle fasciotomy was 85%; 21% for limited fasciectomy; and 32% of joints successfully treated with Clostridial collagenase. Percutaneous aponeurotomy with lipografting is an experimental technique which has shown some promise with correction of contractures and prevention of recurrence, but the evidence is level 4, with no controlled studies looking at this technique, in comparison to other established techniques.

Although limited fasciectomy provides the greatest degree of initial correction for Dupuytren contractures, as well as the longest period prior to recurrence, the costs associated with the procedure are by far the highest. When comparing the QALY costs of three interventions (limited fasciectomy, percutaneous needle fasciotomy, and collagenase injection), limited fasciectomy yielded the highest cost per QALY. The authors emphasize that this does not indicate limited fasciectomy is an inappropriate intervention—only that it is relatively the most expensive.

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97. A 50-year-old man who is homeless is brought by ambulance to the emergency department. His blood alcohol concentration is 325 mg/dL. Examination of the right hand and forearm shows absent palpable pulses at the radial and ulnar arteries. Compartment pressure is 55 mmHg. Which of the following nerves is most likely irreversibly affected in this patient?

- A) Lateral antebrachial
- B) Medial antebrachial
- C) Median
- D) Radial
- E) Axillary

The correct response is Option C.

The most appropriate answer is median. Pathophysiology of Volkmann's contracture begins with the deep and central muscles, which include flexor digitorum profundus and flexor pollicis longus. The next affected is the middle layer, which includes flexor digitorum superficialis and pronator teres and then the wrist flexors. Lastly, the extensor forearm is affected.

In terms of nerve sensitivities, beginning at 30 mmHg, there are decreased conduction velocities. At 50 mmHg, there is no conduction. After 8 hours, there is irreversible damage.

The median nerve is affected before the ulnar nerve. The radial nerve is dorsal and not in the deep compartment. Both antebrachial nerves are superficial. The axillary nerve does not go to the forearm.

Alcohol is a clear comorbidity in this patient and therefore the timing is unknown. The pulselessness in this case indicates a late finding of compartment syndrome. Pain out of proportion along with paraesthesias and pressure is an early sign. Other late signs include pallor and paralysis.

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98. A 35-year-old man comes to the office because of a painless enlargement of the right index finger for the past 6 months. An x-ray study is shown. Curettage of the lesion and grafting with demineralized bone matrix are planned. Which of the following is the most likely outcome of this procedure in this patient?

- A) Distant metastasis
- B) Local recurrence of the lesion within 2 years
- C) Pathologic fracture and extension to surrounding soft tissue
- D) Regional nodal metastasis
- E) Uneventful healing without recurrence

The correct response is Option E.

Uneventful healing without recurrence is most likely in this patient. The bone lesion pictured in the x-ray is characteristic of an enchondroma. Enchondromas are benign chondrogenic tumors arising from aberrant cartilaginous foci within the medullary canal. Chondroblasts are thought to escape from the physis and proliferate in the metaphysis.

Enchondromas are the most common bone tumor found in the hand (approximately 90%). They are found mostly in the proximal phalanx, middle phalanx, and metacarpal. Enchondromas are benign, expansile, and locally destructive lesions. They are usually asymptomatic and discovered incidentally on radiographs taken for another reason. Pain is more frequently associated with a malignant tumor such as a chondrosarcoma or a pathologic fracture from cortical thinning. Typical radiographic features are a well-circumscribed, radiolucent lesion that may be expansile or purely lytic with popcorn stippled calcification.

Smaller asymptomatic lesions can be observed. Larger lesions that are potentially unstable or symptomatic are treated by curettage with or without bone grafting. Many authors recommend the addition of autologous or allograft bone following tumor excision. However, there are studies showing no benefit to adding bone graft or bone graft substitute. There is no consensus on the treatment of lesions involving a pathologic fracture. Stable fractures should be treated with immobilization and allowed to heal prior to treating the enchondroma secondarily. Unstable fractures can be safely treated with curettage and fracture fixation in a single stage.

Enchondromas are benign and complete resection is curative. Recurrence of a lesion after surgery may suggest that the lesion is actually a low-grade sarcoma. The risk of malignant transformation in a solitary enchondroma is approximately 1%.

Pathologic fractures are relatively common, especially in the hand. These occur with minor trauma when the lesion has resulted in significant cortical thinning but expansion of the tumor into the surrounding soft tissue does not occur.

The potential for malignant transformation is greatly increased in multiple enchondromatosis, such as Ollier disease and Mafucci syndrome. Ollier disease is a nonhereditary form of multiple enchondromatosis associated with skeletal dysplasia. Mafucci syndrome is characterized by multiple enchondromatosis and cutaneous hemangiomas. The risk of malignant transformation to chondrosarcoma or

osteosarcoma in these cases is up to 30%. Low-grade chondrosarcomas have a low metastatic potential.

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99. A 44-year-old man comes to the office because of a palpable mass of the right dorsoradial distal forearm. The patient reports that the mass has been growing slowly over the past 2 years. On examination, the mass is nontender. Excisional biopsy shows the mass is well encapsulated and separates easily from within the fibers of the dorsoradial sensory nerve, as the nerve emerges from beneath the brachioradialis tendon. Which of the following cells is the most likely origin of this mass?

- A) Adipose
- B) Giant
- C) Glial
- D) Spindle
- E) Tendon

The correct response is Option C.

The mass is most consistent with a neurilemmoma or Schwann cell tumor. These are benign, encapsulated tumors of the nerve sheath. Their cells of origin are glial, likely Schwann cells. These masses usually arise from the side of or from within the nerve. Symptoms can be vague and manifest as a dull ache or as symptoms consistent with nerve compression.

A lipoma derives from adipose cells, but these generally do not originate from the substance of the nerve. Tumors consisting of tenocytes are essentially unheard of, but giant cell tumors originate from the tendon sheath and are usually intimately involved with the tendon sheath and thus unlikely to be found within the fibers of a nerve.

Pathology of spindle cells which form muscle, are usually seen in the setting of sarcoma or carcinoma. In general, they are usually found in a subcutaneous, peritendinous, and intramuscular plane. They are taken with margins and are unlikely to shell cleanly out of their soft tissue of origin.

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100. A 19-year-old man is brought to the emergency department because of pain and swelling of the left lower extremity after it was pinned beneath a large granite stone for 2 hours. On physical examination, the left leg is swollen, tense, and erythematous; a palpable pulse is noted. X-ray studies are negative for fracture. The patient reports marked pain that is uncontrolled by increasing doses of narcotics. Pain on passive movement of the ankle and toes is noted. Which of the following is the most appropriate next step in management?

- A) Angiography
- B) Compression wrap
- C) CT scan
- D) Duplex ultrasonography
- E) Fasciotomy

The correct response is Option E.

The most appropriate next step is fasciotomy.

The patient is exhibiting signs of compartment syndrome after sustaining a significant crush injury to the lower extremity. Signs and symptoms of compartment syndrome include pain with passive stretch, increased pressure on palpation, paresthesias, paralysis, pallor, and pulselessness.

Early recognition and treatment are necessary to prevent permanent damage. The pressure within the muscles increases, and prevents blood flow to the area and capillary exchange of nutrients. Fasciotomy is recommended if compartment pressure exceeds 30 mm Hg, or if the difference between intracompartmental pressure and diastolic blood pressure is less than 30 mm Hg. If left untreated, ischemic necrosis to the muscles can result, causing permanent disability.

Compartment pressures can be measured by a handheld manometer, or the method of Whitesides with an arterial line setup. Operative fasciotomy is indicated to release the compartment pressures and prevent tissue loss and muscle necrosis. Loss of pulse typically occurs later in the spectrum of findings.

Angiography would be useful in evaluating vasculature and blood flow to the lower extremity. Typically pain with passive stretch does not occur in cases of arterial insufficiency.

Duplex ultrasound is used to look for deep venous thrombosis, which can be a source of pain and swelling in the lower extremity. This is more typical in the postoperative period or after prolonged immobilization. In this case, the mechanism of injury would prompt urgent fasciotomy.

Compression wrap and elevation are used in treatment of venous stasis and lymphedema, which is unlikely to be the cause of swelling in this case of acute trauma.

CT scan can provide better detailed imaging, but would not be indicated in this situation and would delay treatment.

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# Section 3: Craniomaxillofacial

101. A 6-year-old boy is brought to the office because of a draining sinus in the midline of the neck. His mother reports that the drainage developed after he had an upper respiratory infection a few weeks ago. Physical examination shows a palpable mass in the mid third of the neck that moves upward when the patient protrudes his tongue. Which of the following is the most likely diagnosis?
- A) Infected sebaceous cyst
  - B) Infected thyroid gland
  - C) Lymph node
  - D) Thyroglossal duct cyst
  - E) Type II branchial cleft cyst

The correct response is Option D.

During embryologic development, the thyroid gland descends from the foramen caecum to the midline of the neck. The tract in descent is typically absorbed but sometimes remains. This can be secondarily infected from infections of the head and neck. Rarely, the thyroid gland does not fully descend into its position in the midline neck.

Diagnosis of this mass over other types of midline mass include elevation of the mass on tongue protrusion. This is because of the remaining attachment to the base of the tongue.

Lymph nodes can present in the midline, but they are infrequent at the level of the hyoid and typically do not drain percutaneously. A type II branchial cleft cyst presents laterally, not in the midline. Infected sebaceous cysts can drain in any hair-bearing area, but do not move with protrusion of the tongue.

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102. A 57-year-old man undergoes superficial parotidectomy. Facial nerve neuropraxia results in gustatory sweating and which of the following additional symptoms?

- A) Anosmia
- B) Base of tongue dysgeusia
- C) Hyperlacrimation
- D) Migraine headache
- E) Synkinesis

The correct response is Option C.

Hyperlacrimation, or Bogorad syndrome, is a known complication after Bell palsy or other injury and insults to the facial nerve. Similar to Frey syndrome, the predominant theory for this form of gustatory hyperlacrimation is due to aberrant facial nerve regeneration. Epiphora in general can also occur due to poor “pumping mechanisms” in the eyelids as well as prolonged ectropion and conjunctival show after facial nerve injury. However, hyperlacrimation during gustatory activity is a specific and definable pathology. Treatment for this syndrome includes subtotal lacrimal gland resection, botulinum toxin type A, and various forms of enlarging the lacrimal tract.

Synkinesis is a common event after facial nerve regeneration, when the nerve improperly fires and there is lack of typical mimetic muscle coordination. The anterior portion of the tongue taste buds are innervated by facial nerve fibers from the chorda tympani to the lingual nerve, but the base of the tongue is innervated by cranial nerves IX and X. Anosmia is loss of smell that occurs through cranial nerve I injury or obstruction and can lead to taste disturbances. Migraine headaches can be associated with a variety of syndromes and need to be differentiated from other forms of headaches. Ramsay Hunt syndrome can lead to facial nerve dysfunction and facial pain, but this pain is not associated with facial nerve regeneration or migraine headaches.

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103. A 16-month-old male infant is brought to the physician because of congenital anomalies of both feet. The dorsal and plantar aspects are depicted in the photographs shown. Which of the following is the most likely diagnosis?

- A) Apert syndrome
- B) Crouzon syndrome
- C) Jackson-Weiss syndrome
- D) Pfeiffer syndrome
- E) Saethre-Chotzen syndrome

The correct response is Option A.

Syndromic craniosynostosis often presents with findings in the hands and feet, sometimes referred to as acrocephalosyndactyly.

Apert syndrome is unique for having bilateral symmetric complex syndactylies involving nearly all digits, of both the hands and feet.

Crouzon syndrome usually has normal hands and feet.

Jackson-Weiss can have foot anomalies, such as short metatarsals.

Pfeiffer syndrome usually has broad thumbs and toes.

Saethre-Chotzen syndrome may have incomplete single syndactylies, but otherwise does not typically have extremity findings.

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104. A 14-year-old boy is brought to the office for evaluation because of recurrent, severe nosebleeds that require visits to the emergency department. Dermatologic examination shows no skin discolorations. Neurologic examination shows no abnormalities. Family history includes frequent nosebleeds. A diagnosis of hereditary hemorrhagic telangiectasias (HHT) is suspected. A mutation of which of the following genes is most likely in this patient?

A) *ENG*

B) *KRIT1*

C) *PIK3CA*

D) *PTEN*

E) *RASA1*

The correct response is Option A.

In patients with hereditary hemorrhagic telangiectasia (HHT), also known as Osler-Weber-Rendu disease, characteristic abnormal arteriovenous shunting is noted in the mucosae of the naso- and oropharynx, and pulmonary, GI/hepatic, and CNS systems. They are at risk for bleeding and anemia, and even stroke (CNS manifestation). Several genes have been associated with HHT, including the endoglin gene, *ENG*. *ACVRL1* and *SMAD4* may also be associated.

*RASA1* mutation has been associated with capillary malformations with or without AVMs. Oval, macular port-wine staining on the skin is a common finding.

*PTEN* mutation has been associated with Bannayan-Riley-Ruvalcava syndrome, an autosomal dominant condition that presents with macrocephaly, genital lentiginosis (speckled penis), and GI polyps. A subset of patients may develop arteriovenous anomalies (arteriovenous malformations and arteriovenous fistulae).

*KRIT1* mutation is an autosomal dominant condition associated with cavernous malformation in the brain (venous malformation, no fast-flow component). Affected patients are at risk for cerebral hemorrhage. Cutaneous manifestations are hyperkeratotic vascular malformations (slow-flow malformations).

CLOVES (congenital lipomatous overgrowth, vascular malformations, epidermal nevi, spinal/skeletal anomalies/scoliosis syndrome) syndrome can occur as a result of a mutation in *PIK3CA*. It is an overgrowth syndrome where vascular

malformations can also occur. Patients with CLOVES syndrome should have a spinal MRI to screen for CNS AVM. They may also have other slow-flow vascular malformations.

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105. A 35-year-old woman is evaluated for long-standing facial nerve palsy. The proximal stump of the facial nerve is not available for use in reconstruction. In addition to gracilis muscle transfer, the surgeon is considering cross-facial nerve graft or using the masseter nerve. Which of the following factors regarding masseter nerve use is often cited as a disadvantage to cross-facial nerve grafting?

- A) Decreased excursion of the gracilis muscle
- B) Decreased smile symmetry
- C) Less spontaneity in smiling
- D) Requirement of a craniofacial osteotomy for harvest
- E) Significant, permanent weakness in chewing function

The correct response is Option C.

Use of the masseter nerve as the motor source for a gracilis free tissue transfer to restore smile is a single-stage procedure with many advantages over the more traditional use of cross-facial nerve grafting when the proximal stump of the facial nerve is not available for use. Its popularity has increased recently, particularly because it is a single-stage surgery and morbidity is minimal. Use of the masseter nerve, however, requires the patient to clench the jaw to smile, and is much less spontaneous than with cross-facial nerve grafting.

Less excursion of the gracilis muscle graft is incorrect. The masseter nerve is an excellent motor nerve and allows for powerful contraction of the transferred muscle.

Significant, permanent weakness in chewing function is incorrect because harvest of the masseter nerve is partial, and generally results in minimal donor site morbidity.

Craniofacial osteotomy is incorrect because while the masseter nerve is in proximity to the zygomatic arch, an osteotomy is not frequently needed to reach the nerve.

Decreased smile symmetry is incorrect because smile symmetry is comparable with both techniques.

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106. An 18-year-old man comes to the office for evaluation because of swelling of his chin. A panoramic x-ray study (Panorex) is shown. Which of the following types of cyst is the most likely diagnosis?

- A) Dentigerous
- B) Gingival
- C) Periapical
- D) Primordial
- E) Residual

The correct response is Option A.

This radiograph is most consistent with a dentigerous cyst.

Dentigerous cysts are the second most common and develop in the dental follicle of an unerupted tooth. On radiograph there is usually a lucency attached at an acute angle to the tooth. The mandibular and maxillary third molars are the most commonly affected.

Odontogenic cysts are epithelial lined cysts that are defined by location and histologic characteristics.

Periapical cysts are the most common and usually form from necrotic pulp after a tooth infection. They usually present as a radiologic lucency at the apex of the tooth.

A gingival cyst is a superficial cyst in the gingiva. A primordial cyst develops instead of a tooth. This is a rare cyst.

A residual cyst may result from a retained periapical cyst after teeth have been removed.

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107. A 4-year-old boy undergoes evaluation of a large congenital melanocytic nevus of the scalp affecting 40% of the surface area. Results of a recent biopsy in the center of the lesion showed diffuse areas of severe dysplasia. Which of the following is the most appropriate management?

- A) Serial excision, linear closure
- B) Single-stage excision, latissimus dorsi musculocutaneous free flap, skin grafting
- C) Single-stage excision, rotational flap closure
- D) Tissue expansion, excision, closure
- E) Observation

The correct response is Option D.

This patient's congenital nevus involves 40% of his scalp and has areas of severe dysplasia. Although the lifetime risk of malignant transformation in giant nevi as a whole is approximately 4%, the presence of biopsy-proven severe dysplasia at this young age mandates a more aggressive approach to management than observation. Complete removal of the nevus with reconstruction of the scalp is recommended to prevent malignant conversion. Although serial excision is useful and often preferred for moderate sized lesions, this nevus is far too big to completely excise and close in that fashion. Moreover, the intervals between stages would require more time than tissue expansion, and with the degree of dysplasia present in this patient, this is risky. Similarly, it is dubious if a nevus this size could be successfully excised and closed in one stage using only rotational flaps. In addition, this would alter the direction of the hair. The use of a free flap is far too extreme in the absence of a frank malignancy (which this is not) and would leave this child with a large bald area. The best option is tissue expansion, followed by complete excision and closure, which was successfully employed in this case.

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108. Which of the following is the most common complication of a fracture to the temporal bone?

- A) Cerebrospinal fluid leak
- B) Facial nerve injury
- C) Hearing loss
- D) Meningitis
- E) Temporomandibular joint ankylosis

The correct response is Option A.

Cerebrospinal fluid leak is the most common complication of a temporal bone injury. The majority of these will resolve spontaneously within a week. If they persist longer, then there is higher risk for meningitis, but this is not common. Facial nerve injury is the second most common injury and prognosis is dependent on the severity and delay of onset. Incomplete nerve loss or delayed onset is associated with a better prognosis for recovery. Hearing loss is the third most common complication seen with this fracture. Temporomandibular joint ankylosis is an unlikely sequela of this type of injury.

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109. A 58-year-old man undergoes a left hemimandibulectomy. Reconstruction with an osteocutaneous free flap harvested from the ipsilateral pelvis is planned. The vascular pedicle supplying this flap is based on which of the following arteries?

- A) Ascending branch of the lateral circumflex femoral artery
- B) Deep circumflex iliac artery
- C) Deep inferior epigastric artery
- D) Descending branch of the geniculate artery
- E) Peroneal artery

The correct response is Option B.

The deep circumflex iliac artery arises from the external iliac artery and is the blood supply to the iliac crest osteocutaneous flap. This flap can be harvested either as a bone-only or an osteocutaneous free flap. It is often used in hemimandibular reconstruction because the natural curvature of the iliac crest closely resembles the shape of the hemimandible. A portion of the internal oblique muscle, based on the ascending branch of the deep circumflex iliac artery, can also be included with this flap.

The descending branch of the geniculate artery is the blood supply to the medial femoral condyle flap. The ascending branch of the lateral circumflex femoral artery is the blood supply to the tensor fascia lata flap. The peroneal artery is the blood supply to the fibula flap. The deep inferior epigastric artery is the blood supply to the rectus abdominis myocutaneous flap.

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110. A 10-year-old boy is brought to the physician after sustaining a nondisplaced fracture of the mandibular body in a fall. Soft diet is recommended. Two days later, he is brought back to the office and reports pain in the right mandibular lateral incisor when drinking cold liquid. The base of the defect appears yellow and is tender when probed. Examination shows a lingual fracture of the tooth crown. On the basis of these findings, which of the following is the deepest layer of exposed tooth?

- A) Cementum
- B) Dentin
- C) Enamel
- D) Pulp cavity
- E) Root canal

The correct response is Option B.

This patient has a fracture of the tooth crown that extends through the dental enamel into the deeper parts of the tooth. This is evidenced by the sensitivity to touch and cold, a finding not characteristic of a fracture limited to the enamel. The yellow color to the base of the fracture indicates exposed dentin, which resides just under the hard outer enamel layer of the tooth. If the fracture had extended deeper into the pulp cavity, the area where the vessels and nerves reside, the base of the fracture would appear as a blood-filled cavity. These injuries often challenge the viability of the tooth and often require drilling and packing of the pulp space (root canal). The fracture described is of the crown and there is no indication that it involves the root of the tooth or the surrounding structures. Cementum is a bone-like covering of the tooth root and would not be affected by this injury.

The Ellis classification provides a useful system of categorizing these injuries. There are 9 categories:

Ellis I: enamel fracture. The tooth is non tender and treatment is smoothing of the rough surfaces and, possibly, application of a filling or amalgam.

Ellis II: fracture of the enamel and dentin. Tooth is tender to air, cold, and probing and the base of the defect often appears yellow.

Ellis III: involves the enamel, dentin, and the pulp space. The tooth is sensitive as in Ellis II, but the base of the defect appears red or bloody.

Ellis IV: a nonviable tooth.

Ellis V: luxation of the tooth.

Ellis VI: tooth avulsion.

Ellis VII: displacement without fracture.

Ellis VIII: fracture of entire crown.

Ellis IX: fracture of deciduous teeth.

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111. A 6-month-old infant is brought to the clinic for evaluation of an expanding vascular cutaneous lesion that partially obstructs the visual axis. The presence of which of the following histologic markers is most likely to confirm the diagnosis of infantile hemangioma in this patient?

- A) Fibroblast growth factor receptor 3 (FGFR-3)
- B) Glucose transporter 1 (GLUT-1)
- C) Transforming growth factor beta (TGF-B)
- D) Tumor necrosis factor 1 (TNF-1)
- E) Vascular endothelial growth factor (VEGF)

The correct response is Option B.

GLUT-1 is a specific marker for infantile hemangioma and is often used by pathologists to confirm the diagnosis.

VEGF and TGF-B are incorrect, because while these markers may often be present in hemangiomas, they are not as specific as GLUT-1 in confirming the diagnosis of hemangioma.

Staining for FGFR-3 is not routinely used in confirming the diagnosis of hemangioma. FGFR-3 mutations are implicated in a number of syndromes, including Muenke syndrome, epidermal nevus, and achondroplasia.

Staining for TNF-1 is also not routinely used in confirming the diagnosis of hemangioma.

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112. A 35-year-old woman undergoes surgical resection of a left parotid gland malignancy. The facial nerve was resected with the tumor, leaving a 5- to 7-cm gap between the proximal nerve stump and the distal nerve branches. Which of the following is the most appropriate treatment?

- A) Cable nerve grafting
- B) Cross-facial nerve grafting
- C) Hypoglossal nerve to facial nerve transfer
- D) Innervated gracilis muscle free flap reconstruction
- E) Nerve repair with a conduit

The correct response is Option A.

When a facial nerve has been divided or resected, the best outcomes for regaining function are usually obtained from direct repair, or cable nerve grafting when too great a distance for direct repair separates the nerve ends.

While autologous nerve grafts from “expendable” donor nerves, such as the great auricular nerve or sural nerve, have long been the gold standard, nerve repair using biologic or synthetic nerve conduits has also produced reasonable results, in some series equivalent to cable nerve grafts. Conduit nerve repair has the advantage of having no donor site morbidity. However, the length of the gap between the proximal and distal cut nerve ends is usually limited to less than 3 cm for the best chances of nerve recovery.

When direct repair or cable nerve grafting is not possible—for example, when the nerve has been resected very proximally up to the intracranial portion of the nerve—cross-facial nerve grafting between redundant branches of the normal contralateral nerve and the distal facial nerve stumps of the paralyzed side can produce reasonable results with spontaneous symmetrical facial movement. Performing a nerve transfer from a donor nerve, such as the masseteric (V), spinal accessory (XI), or hypoglossal (XII) nerve can provide facial tone and symmetry at rest, and, in some cases, volitional movement with training. A temporary nerve transfer to these nerves is sometimes performed as a “babysitter” procedure while awaiting axonal growth through cross-facial nerve grafts.

When nerve repair or nerve transfers from the contralateral face or donor nerves are not feasible, such as after motor endplate degeneration has occurred in the facial muscles, innervated free muscle flap transfers can restore facial movement to the lower face. Muscles commonly used for facial reanimation include the gracilis, pectoralis minor, serratus anterior, and latissimus dorsi, because of their thinness, good excursion, and low donor site morbidity. In addition to a microvascular anastomosis, an epineural nerve repair is performed either to a cross-facial nerve graft or to a donor cranial nerve such as the masseteric nerve.

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113. A 2-year-old boy is referred for evaluation of an abnormal frontal prominence that his parents report has become more noticeable during the past year. A photograph is shown. He is otherwise healthy and is meeting all developmental milestones. A CT scan obtained at the request of his pediatrician shows closure of the metopic suture with ectocortical thickening; no other abnormalities are noted. Which of the following is the most appropriate next step in management?

- A) Endoscopic suturectomy and postoperative helmet therapy
- B) Fronto-orbital advancement
- C) Spring-mediated frontal distraction
- D) Total calvarial remodeling
- E) Observation

The correct response is Option E.

This patient has a metopic ridge and would not be correctly classified as having the phenotype associated with pathologic metopic closure—trigonocephaly. Consequently, observation is the only correct answer. Thickening of the metopic suture is a normal variant and should not be interpreted as abnormal unless it is accompanied by frontal narrowing and retrusion of the superior-lateral orbital rims. These findings are not present in this patient.

The metopic suture closes normally within the first year of life, so the presence of a fused metopic suture on CT scan in a child this age is not necessarily abnormal. The degree of frontal narrowing required to classify a patient as having pathologic cranial shape is a matter of much debate and is not settled. Some authors point to the importance of additional clinical (hypotelorism, biparietal widening) or radiographic (endocortical thickening or omega sign on CT) findings to secure the diagnosis of metopic craniosynostosis.

The other responses are surgical interventions and should be invoked only in the context of pathologic metopic closure and resultant trigonocephaly. Endoscopic suturectomy and postoperative helmet therapy, spring-mediated frontal distraction, and fronto-orbital advancement are all viable options to correct the frontal narrowing associated with trigonocephaly. Total calvarial remodeling is rarely if ever required to correct trigonocephaly.

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114. In adults, which of the following bones is most commonly fractured in isolated orbital floor fractures?

- A) Ethmoid
- B) Frontal
- C) Lacrimal
- D) Maxillary
- E) Zygomatic

The correct response is Option D.

Most isolated orbital fractures involve the orbital floor made up of the maxillary bone. The maxillary bone is quite thin behind the infraorbital rim and is perforated by the infraorbital nerve passing in a canal below it. Most pure blow-out fractures involve the orbital floor with the maxillary bone making the majority of the orbital floor.

A retrospective study by Hwang et al. evaluated 391 patients with orbital bone fractures from a variety of accidents that were treated at the department of Plastic and Reconstructive Surgery, Inha University Hospital, Incheon, South Korea, between February 1996 and April 2008. The medical records of these patients were reviewed and analyzed to determine the clinical characteristics and treatment of the orbital bone fractures. The following results were obtained. The mean age of the patients was 31.1 years, and the age range was 4 to 78 years. The most common age group was the third decade of life (32.5%). There was a significant male predominance in all age groups, with a ratio of 4.43:1. The most common etiology was violent (assault) or nonviolent traumatic injury (57.5%) followed by traffic accidents (15.6%) and sports injuries (10.7%). The most common isolated orbital bone fracture site was the orbital floor (26.9%). The largest group of complex fractures included the inferior region of the orbital floor and zygomaticomaxilla (18.9%). Open reduction was performed in 63.2% of the cases, and the most common fracture reconstruction material was MEDPOR (56.4%) followed by a resorbable sheet (41.1%). The postoperative complication rate was 17.9%, and there were no statistically significant differences among the reconstruction materials with regard to complications. During follow-up, diplopia, hypoesthesia, and enophthalmos occurred as complications; however, there was no significant difference between porous polyethylene sheet (MEDPOR) and resorbable sheet groups.

Long-term epidemiologic data regarding the natural history of orbital bone fractures are important for the evaluation of existing preventative measures and for the development of new methods of injury prevention and treatment.

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115. A 7-year-old boy with a history of bilateral cleft lip and palate has undergone multiple procedures including lip and nose repair, palate repair, and closure of an oronasal fistula. His parents note that during the past 6 months he has had nighttime snoring, frequent pauses in his breathing, and daytime somnolence. Physical examination shows mixed dentition with severe midface hypoplasia and Angle class III malocclusion with 12 mm of negative overjet. A polysomnogram demonstrates an obstructive apnea-hypopnea index (AHI) of 12.5 per hour. The patient is otherwise healthy. Which of the following is the best treatment option for this patient?

- A) Continuous positive airway pressure (CPAP)
- B) Le Fort I advancement and bilateral sagittal split setback
- C) Le Fort I osteotomy and application of bilateral internal maxillary distractors
- D) Le Fort III osteotomy and application of external halo distractor
- E) Tracheostomy

The correct response is Option A.

The patient in this question has had multiple palate surgeries and severe midface hypoplasia. One of the sequelae of severe midface hypoplasia is obstructive sleep apnea, which is confirmed by the patient's abnormal polysomnogram. The best treatment for this patient is a trial of CPAP. Although midface advancement surgery (either conventionally or with distraction) is often used to address obstructive sleep apnea, this patient is a poor candidate for the surgical options provided. The patient is in mixed dentition, and a Le Fort I level surgery would risk permanent injury to his unerupted adult teeth. Although a Le Fort III osteotomy would avoid injury to tooth roots, it would also advance his infraorbital rims, which are not affected in patients with cleft lips. A tracheostomy will bypass his midface level obstruction; however, it is associated with significant cost, burden of care, and a 1% annual mortality risk and should be avoided if less invasive options exist.

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116. A patient with facial hyperkinesia comes to the office for treatment with botulinum toxin type A for temporary improvement in the appearance of moderate to severe glabellar facial lines. How many units of botulinum toxin type A should be administered to this patient, according to the Food and Drug Administration?

- A) 1
- B) 10
- C) 20
- D) 50
- E) 100

The correct response is Option C.

Two phase 3 randomized, multi-center, double-blind, placebo-controlled studies of identical design were conducted to evaluate botulinum toxin type A prior to FDA approval. The injection volume was 0.1 mL/injection site, for a dose/injection site in the active treatment groups of 4 units. Subjects were injected intramuscularly in five sites—1 in the procerus muscle and 2 in each corrugator supercilii muscle—for a total dose in the active treatment groups of 20 units.

Botulinum toxin type A blocks neuromuscular transmission by binding to acceptor sites on motor nerve terminals, entering the nerve terminals, and inhibiting the release of acetylcholine. One unit corresponds to the calculated median intraperitoneal lethal dose (LD<sub>50</sub>) in mice. Each vial of botulinum toxin type A contains either 100 units of *Clostridium botulinum* type A neurotoxin complex, 0.5 mg of albumin (human), and 0.9 mg of sodium chloride, or 50 units of *C. botulinum* type A neurotoxin complex, 0.25 mg of albumin (human), and 0.45 mg of sodium chloride in a sterile, vacuum-dried form without a preservative.

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1. Food & Drug Administration (FDA) website. BOTOX® Cosmetic (onabotulinumtoxinA) for injection. Available at: [http://www.accessdata.fda.gov/drugsatfda\\_docs/label/2009/103000s5109s5210lbl.pdf](http://www.accessdata.fda.gov/drugsatfda_docs/label/2009/103000s5109s5210lbl.pdf). Revised: July 2009. Accessed January 19, 2016.

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117. A 45-year-old man is evaluated because of a 5-cm mass at the angle of the mandible. A CT scan shows an intraparotid mass. Ultrasound-guided fine-needle aspiration shows benign findings. Which of the following is the most appropriate next step in management?

- A) Chemotherapy and superficial parotidectomy
- B) Follow-up evaluation in 3 months
- C) MRI
- D) Superficial parotidectomy only
- E) Total parotidectomy

The correct response is Option D.

Most parotid tumors are benign, but they can grow to a large size and produce significant symptoms of discomfort and distortion of anatomy. The differential diagnosis is aided by the use of imaging, CT, or MRI to confirm the location of the mass. Ultrasound-guided fine-needle aspiration is a useful next step in diagnosis of the majority (92%, Sharma, et al). MRI would be superfluous in the present case since imaging is sufficient. Benign neoplasms include pleomorphic adenoma, mucocele, branchial cleft cysts, and lymph nodes. Malignancies include adenocarcinoma.

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2. Sharma G, Jung AS, Maceri DR, et al. US-guided fine-needle aspiration of major salivary gland masses and adjacent lymph nodes: accuracy and impact on clinical decision making. *Radiology.* 2011 May;259(2):471-8.

118. A 62-year-old man has a lesion of the left pinna. Examination of a specimen obtained on biopsy shows a 2.01-mm-thick melanoma with no ulceration, 11 mitoses, and a positive deep margin. The surgeon's decision to perform sentinel node biopsy is most heavily influenced by which of the following factors?

- A) Breslow thickness
- B) Head and neck location
- C) Lack of ulceration
- D) Number of mitoses
- E) Positive deep margin

The correct response is Option A.

Head and neck melanomas in general were thought to be distinct from other anatomic sites. Clearly there can be reconstructive and functional issues that are unique, such as in an ear melanoma. In general the first Multicenter Selective Lymphadenectomy Trial (MSLT-1) concluded that for intermediate-thickness melanoma (1-4 mm), the status of the sentinel node was the most powerful predictor of outcome. In an interim report in 2006, well before the final report in 2014, the specifics on what percentage of patients had melanoma of the head and neck in the MSLT-1 trial were not described, but what was reported was a lower rate of identification of a sentinel node in the neck versus lesions that mapped to the groin or axilla. This led many to conclude that the utility of the sentinel node biopsy in the head and neck was in question. More recent data from multiple high-volume institutions have concluded that identification of the sentinel node for head and neck melanoma is as accurate as other sites in the body, including similar false-negative rates and impact on prognostication.

Mitotic rate does not affect staging above 1-mm thick lesions, and although ulceration can, it does not influence the rationale to perform a sentinel node biopsy in intermediate thickness tumors. In thinner melanomas, a positive deep margin may be an indication for a sentinel node biopsy, but not for a tumor greater than 1-mm thick. The fact that lymphoscintigraphy may map the sentinel node to the parotid region means that the surgeon should be prepared to do a parotidectomy with facial nerve preservation, although recently less-invasive techniques have been described.

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6. Samra S, Sawh-Martinez R, Tom L, et al. A targeted approach to sentinel lymph node biopsies in the parotid region for head and neck melanomas. *Ann Plast Surg*. 2012 Oct;69(4):415-7.

119. A 14-year-old girl is brought to the office because of a 1-month history of a painful, growing lesion in the hard palate with "electric-shock sensations" on palpation. Results of incisional biopsy show adenoid cystic carcinoma of the minor salivary glands. Which of the following is the most appropriate next step in management of this patient?

- A) Chemotherapy
- B) CT scan and MRI
- C) Excision with 1-cm margins
- D) Excision with 2-cm margins
- E) Radiation therapy

The correct response is Option B.

Although minor salivary gland tumors are much less common than major salivary gland tumors, minor salivary gland tumors are much more likely to be malignant. Additionally, pediatric salivary cancers represent only about 5% of all salivary cancers, but are also more likely to be malignant (almost 50% were malignant in Armed Forces Institute of Pathology series of 168 pediatric salivary gland tumors). Finally, the palate is the most common source of minor salivary gland tumors, which are more likely to be malignant and higher stage when detected.

The clinical presentation of paresthesias of adenoid cystic carcinoma (ACC) suggests perineural invasion. One series (University of Maryland) of 243 minor salivary gland tumors found 78% of them were malignant, and of those malignant tumors, 15% were ACC. Given the perineural invasion symptoms, imaging, in particular MRI, can detect perineural invasion and help plan the degree of surgery.

In this scenario, clinical exam pointed to perineural invasion, which should be imaged to plan for surgery. Chemotherapy is not used in the treatment of this disease. Radiation therapy alone is not usually performed, as this is considered a surgical disease. However, it can be used as adjuvant therapy in addition to surgery. Excisional biopsy usually recommends 1- to 2-cm margins. Patients with high-stage, perineural invasion, lymphadenopathy, or other signs of extensive disease may receive surgery with adjuvant radiation therapy. Regardless, ordering a CT scan and MRI is a reasonable initial approach before surgical treatment.

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120. Which of the following findings is most common in patients with vertical maxillary excess?

- A) Counterclockwise rotation of the mandible
- B) Excessive height in the upper half of the face
- C) Mentalis strain
- D) Posterior open bite
- E) Retrusive midface

The correct response is Option C.

Vertical maxillary excess (VME), or long face syndrome, occurs when there is excessive (imbalanced) anterior facial height in the lower half of the face. The midface is relatively protrusive. Excessive eruption of the posterior dentition in the maxilla can cause clockwise rotation of the mandible. There is lip incompetence, excessive gingival show, and an effort to close the lips can result in mentalis strain. It is associated with an anterior open bite.

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2. Kiran J, Isaac A, Shanthraj R, Madannagowda S. Surgical-orthodontic treatment of Class I malocclusion with maxillary vertical excess--a case report. *Int J Orthod Milwaukee.* 2012 Summer;23(2):57-62.

121. A 35-year-old man returns for postoperative evaluation 12 months after undergoing facial nerve reconstruction with free gracilis transfer. Physical examination shows significant hyperkinesis of the contralateral side. In addition to injections of botulinum toxin type A, which of the following measures has been shown to improve facial symmetry?

- A) Cryotherapy of facial musculature
- B) Mirror biofeedback therapy
- C) Oral beta-adrenergic blocker therapy
- D) Radiofrequency ablation
- E) Selective contralateral facial neurotomy

The correct response is Option B.

Hyperkinesis is generally considered to be the hyperactivity of the contralateral, unaffected side. Mirror biofeedback therapy has been shown to significantly improve facial symmetry when used in conjunction with botulinum toxin injections in the treatment of facial hyperkinesis.

Beta-adrenergic blocker therapy is not indicated for facial hyperkinesis following facial nerve reconstruction.

While selective facial myotomy has been used for improvement in synkinesis, selective contralateral facial neurotomy is not generally indicated for correction of hyperkinesis.

Radiofrequency ablation and cryotherapy have only recently begun to be investigated as an option for improvement of synkinesis, but have not been generally accepted as treatments for hyperkinesis.

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122. Which of the following is the best method to treat maxillary transverse deficiency in a skeletally mature patient?

- A) Mandibular setback (bilateral sagittal split osteotomy)
- B) Maxillary advancement (Le Fort I advancement)
- C) Orthopedic and orthodontic expansion
- D) Reverse-pull headgear
- E) Surgically assisted rapid palatal expansion

The correct response is Option E.

Maxillary transverse deficiency (MTD) in the skeletally mature patient is best addressed with surgically assisted rapid palatal expansion (SARPE). In the young patient (before suture closure), orthopedic and orthodontic forces can be more easily used to correct the MTD.

Reverse-pull headgear does not aid in expansion in the skeletally mature patient.

One-piece Le Fort and bilateral sagittal split osteotomy (BSSO) procedures address anterior-posterior discrepancies rather than transverse deficiencies.

## REFERENCES:

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2. Wells AP, Sarver DM, Proffit WR. Long-term efficacy of reverse pull headgear therapy. *Angle Orthod*. 2006 Nov;76(6):915-22.

123. A 55-year-old woman comes to the office with a 10 x 6-mm full-thickness defect after undergoing Mohs micrographic surgery to remove a basal cell carcinoma on the nasal tip not involving the alar margin. The denuded lower lateral cartilages with no perichondrium are exposed. Which of the following is the most appropriate reconstruction option?

- A) Auricular composite graft
- B) Bilobed flap
- C) Forehead flap
- D) Glabella flap
- E) Nasolabial flap

The correct response is Option B.

There are many methods to reconstruct this nasal tip defect. Denuded cartilage needs a flap for coverage. As this patient's cartilages are intact, they do not need to be replaced. Smaller defects can be covered with a locally available flap. In this case neither a forehead nor a nasolabial flap is necessary, and each would result in more severe donor site morbidity.

Bilobed flaps are ideal for distal nasal reconstruction, while the glabella flap is ideal for proximal reconstruction. A dorsal nasal flap, if large enough, may also be an option for reconstruction of the nasal tip.

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124. A 59-year-old man with tongue cancer undergoes a hemiglossectomy, neck dissection, and reconstruction with a radial forearm fasciocutaneous free flap. On postoperative day 10, he fails a swallowing study for all food consistencies. Postoperative radiation therapy is scheduled to begin in 2 weeks. What is the appropriate next step in management?

- A) Laryngectomy for aspiration
- B) Percutaneous endoscopic gastrostomy tube placement
- C) Revision of the free flap
- D) Tracheoesophageal puncture
- E) Observation with delay of radiation therapy for 10 weeks

The correct response is Option B.

Most patients who undergo hemiglossectomy can expect reasonable speech and swallowing function when reconstructed with a thin, pliable free flap, such as the radial forearm fasciocutaneous free flap, that facilitates unrestricted residual tongue movement. Although his swallowing may likely improve as he recovers from surgery and tissue edema resolves, this patient will need a feeding tube to maintain his nutrition at this time. Additionally, it can be difficult for many patients who have undergone substantial tongue resections to meet their caloric needs even if they pass their initial swallowing study during radiation therapy and short-term feeding tube placement may be indicated.

Tracheoesophageal puncture with placement of a one-way valve speech prosthesis is used to restore speech function in patients who have received a laryngectomy and does not apply to this patient. Revision of the free flap is not indicated in the early postoperative period as it is unlikely to significantly improve swallowing and may delay adjuvant treatment. A laryngectomy for aspiration would only be indicated as a last resort in a patient with chronic, long-term aspiration of oral secretions resulting in recurrent pneumonia, most commonly following more extensive tongue resections, such as a total glossectomy, including removal of the tongue base. Postoperative radiation therapy should be administered within 4 to 6 weeks of surgery for maximal effectiveness and, therefore, delaying for 10 more weeks may adversely affect this patient's survival.

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2. Engel H, Huang JJ, Lin CY, et al. A strategic approach for tongue reconstruction to achieve predictable and improved functional and aesthetic outcomes. *Plast Reconstr Surg*. 2010;126:1967-1977.
3. Lin DT, Yarlagadda BB, Sethi RK, et al. Long-term functional outcomes of total glossectomy with or without total laryngectomy. *JAMA Otolaryngol Head Neck Surg*. 2015;141:797-803.

125. A 30-year-old primigravid woman at 24 weeks' gestation, who has a history of Bell palsy, has synkinesis and squinting of the left eye when smiling. She wants to know her treatment options, but is not interested in options that may put her pregnancy at risk or impact her goal of breast-feeding for 1 year after delivery. Which of the following treatment options is most appropriate for this patient?

- A) Chemodenervation to the left orbicularis oculi
- B) Chemodenervation to the left orbicularis oris
- C) Facial neuromuscular retraining
- D) Gold weight to the left upper eyelid
- E) Selective neurolysis to the temporal branch of the facial nerve

The correct response is Option C.

Chemodenervation is a common treatment for ocular-oral synkinesis and perhaps the most effective. The chemodenervation medications have unknown effects for pregnant or nursing women. Botulinum toxin type A is a class C drug. Permanent surgical selective denervation is not recommended as it could impact eye protection. Surgery may also have risks for the fetus.

This patient would benefit from a physical therapy referral to work on facial neuromuscular re-education, including biofeedback using mirrors and electromyography. Additional strategies such as use of sunglasses and other strategies to avoid squinting can be helpful. These are likely the treatment modalities that this patient is most interested in.

Gold weight insertion would not be appropriate in a patient with symptoms of squinting.

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2. Terzis JK, Karypidis D. Therapeutic strategies in post-facial paralysis synkinesis in pediatric patients. *J Plast Reconstr Aesthet Surg*. 2012 Aug;65(8):1009-18.

126. Which of the following findings is most likely in patients who undergo superficial parotidectomy for treatment of sialadenitis?

- A) Frey syndrome at 3 months postoperatively
- B) Hematoma after the first 24 hours postoperatively
- C) Permanent postoperative facial nerve dysfunction
- D) Salivary fistulae
- E) Tinnitus

The correct response is Option D.

Frey syndrome occurs with injury and abnormal regeneration of the auriculotemporal nerve, but is a late complication (median time at presentation: 11 months). Postoperative facial nerve dysfunction can occur in up to 60% of patients, but the majority (90%) resolve without need for operative intervention. Tinnitus is not a recognized complication of superficial parotidectomy, and hematoma is an early complication (<24 hours). Patients with sialadenitis alone have increased risk for developing salivary fistulae.

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127. A 70-year-old man is referred for evaluation directly after undergoing excision of recurrent squamous cell carcinoma and Mohs micrographic surgery. A photograph is shown. Pathology shows some extension onto the parotid capsule. Clinical examination shows two enlarged postauricular lymph nodes. Which of the following is the most appropriate management of this patient?

- A) Cervical facial flap plus radiation
- B) Direct closure alone
- C) Superficial parotidectomy and direct closure
- D) Superficial parotidectomy, neck dissection, and coverage with a cheek rotation flap
- E) Superficial parotidectomy, neck dissection, and direct closure

The correct response is Option D.

Direct closure is being used more commonly in large Mohs facial defects, especially in the elderly, as it minimizes the disruption of skin tension lines. The contraindication in this case to closure alone is the nodal involvement and the extension into the parotid capsule. Given the parotid capsule extension, adequate margins at a minimum will require a superficial parotidectomy. Radiation alone plus flap closure would have a higher recurrence rate because residual disease is left in the capsule. The nodal enlargement requires further evaluation and given the options the best combination is superficial parotidectomy, neck dissection, and a local rotation flap.

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3. Soliman S, Hatef DA, Hollier LH, et al. The rationale for direct linear closure of facial Mohs' defects. *Plast Reconstr Surg*. 2011 Jan; 127(1):142-9.

128. A 65-year-old man comes to the office because of slow-growing, painless masses within each of the parotid glands. He has smoked 10 cigarettes daily for the past 25 years. Superficial parotidectomies are performed, and pathologic examination shows papillary cysts and mucoid fluid as well as nodules of lymphoid tissue in both tumor specimens. Which of the following is the most likely diagnosis?

A) Adenoid cystic carcinoma

B) Hemangioma

C) Pleomorphic adenoma

D) Squamous cell carcinoma

E) Warthin tumor

The correct response is Option E.

Salivary gland tumors are relatively rare and make up about 3 to 4% of all head and neck neoplasms. The majority of salivary gland tumors (approximately 80%) originate in the parotid gland. Approximately 80% of parotid gland tumors are benign. Facial paralysis may be associated with malignant tumors and are a sign of neural invasion.

Warthin tumor (papillary cystadenoma lymphomatosum) is the second most common tumor of the parotid gland and is benign. Warthin tumors predominantly occur in men of 50 to 70 years of age, most frequently smokers, and are the most common bilateral salivary gland tumors. The histologic appearance of this tumor is very characteristic and is characterized by papillary cysts and mucoid fluid as well as nodules of lymphoid tissue.

Pleomorphic adenoma, also known as benign mixed tumor, is the most common tumor of the parotid gland. This tumor is histologically characterized by epithelial and connective tissue elements, with stellate and spindle cells interspersed within a myxoid background.

Adenoid cystic carcinoma is the second-most common malignancy of the salivary glands after mucoepidermoid carcinoma and exhibits a propensity for perineural invasion. There are three histologic subtypes: cribriform, tubular, and solid. The cribriform pattern has a classic “swiss cheese” appearance with cells arranged in nests separated by round or oval spaces. The tubular pattern has a glandular architecture, while the solid (or basaloid) pattern has sheets of cells with little or no luminal spaces.

Hemangiomas are the most common salivary gland tumors found in children and usually involve the parotid gland. Histologically, the tumors are composed of capillaries lined by proliferative endothelial cells.

Squamous cell carcinoma is a malignant tumor that rarely involves the parotid gland, in comparison to the skin and aerodigestive tract. It is histologically identical to squamous cell cancers arising from other sites with epithelial cells that form sheets or compact masses, which invade adjacent connective tissue. Round nodules of keratinized squamous cells known as “keratinous pearls” are the hallmark of well-differentiated squamous cell carcinoma.

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2. Rodriguez CP, Parvathneni U, Mendez E, et al. Salivary gland malignancies. *Hematol Oncol Clin North Am*. 2015 Dec;29(6):1145-57.

129. A 75-year-old woman is evaluated because of a new skin lesion on the right upper eyelid. Examination of the specimen obtained on biopsy shows a 1-cm Merkel cell carcinoma. In addition to regional node sampling, which of the following is the most appropriate excision and adjuvant management in this patient?

- A) 1-cm margins and chemotherapy
- B) 2-cm margins and chemotherapy
- C) 1-cm margins and postoperative radiation therapy
- D) 2-cm margins and postoperative radiation therapy
- E) 5-mm margins and postoperative radiation therapy

The correct response is Option C.

Merkel cell carcinoma, an aggressive neuroendocrine tumor, is most likely. It presents in older, immunocompromised women in sun-exposed areas. About 80% of Merkel cell carcinomas are secondary to polyomavirus infection. Treatment of the primary tumor should be wide local excision or Mohs micrographic surgery. For wide local excision of tumors smaller than 2 cm, the recommended surgical margin should be 1 cm. As there is a high rate of occult nodal metastasis, and nodal status is associated with mortality rates, biopsy of the sentinel node is recommended for all cases regardless of primary tumor size. Merkel cell carcinoma is a radiosensitive tumor, and postoperative adjuvant radiation therapy has been shown to decrease local recurrence. Chemotherapy is only currently indicated for palliation and distant metastasis.

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130. A 7-year-old girl with a history of cleft palate repair is brought to the office for evaluation of velopharyngeal insufficiency. After speech evaluation, which of the following is the most appropriate initial tool for diagnosis and management of this patient's condition?

- A) Cine MRI
- B) CT scan
- C) Physical examination under anesthesia
- D) Rhinometry
- E) Video nasal endoscopy

The correct response is Option E.

The primary goal of cleft palate repair is normal speech. Velopharyngeal competence, the ability to completely close the velopharyngeal sphincter, is required for the normal production of all but the nasal consonants (in English: /m/, /n/, and /ng/). Velopharyngeal insufficiency is defined as the inability to completely close the velopharyngeal sphincter. The primary effects of velopharyngeal insufficiency are nasal air escape and hypernasality. Video fluoroscopy and nasal endoscopy can detect the sagittal deficiency closure pattern occurring in patients with velopharyngeal insufficiency after cleft palate surgery. Speech articulation errors (i.e., distortions, substitutions, and omissions) are secondary effects of velopharyngeal insufficiency. The result is decreased intelligibility of speech. The velopharyngeal port is bordered anteriorly by the velum, bilaterally by the lateral pharyngeal walls, and posteriorly by the posterior pharyngeal wall. Velopharyngeal insufficiency can be diagnosed by both subjective and objective means. The speech evaluation by a trained pathologist with perceptual evaluation of speech by an experienced speech language pathologist is the standard. Multiview videofluoroscopy and nasendoscopy both provide visual information (i.e., closure pattern and closure rating) that is valuable for surgical planning. However, the need for radiation has caused most cleft centers to migrate to direct nasal endoscopy. The MRI is emerging technology but would not be the first line choice in the diagnostic workup. Rhinometry is an objective measurement of nasal air emission during speech and is not routinely used for surgical decision-making. Overall, the exam under anesthesia would likely not be required but instead a complete exam and nasal endoscopy would likely be able to be performed comfortably in the office. Experience with nasal endoscopy has grown in most comprehensive cleft centers and has become an invaluable tool for surgical planning.

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131. A 9-year-old girl is brought to the office because of a 3-month history of a slowly enlarging right mandible angle mass. Medical history includes multiple basal cell carcinomas. A panoramic x-ray study (Panorex) is shown. A biopsy of the mass is performed. Which of the following histologic characteristics is most likely to be identified from the biopsy specimen?
- A) Dysmorphic squamous epithelial cells with multiple mitoses
  - B) Keratinized epithelium without evidence of rete ridges
  - C) Multinucleated giant cells
  - D) Palisading basaloid cells with large nuclei
  - E) Polymorphonuclear cell infiltrate

The correct response is Option B.

A 9-year-old girl with a history of basal cell carcinoma as well as kyphoscoliosis and a cystic mass in the mandible should raise concerns for Gorlin syndrome (also known as basal cell nevoid syndrome). Gorlin syndrome is an autosomal dominant disorder characterized by multiple basal cell carcinomas, keratocystic odontogenic tumors mostly of the mandible, as well as skeletal abnormalities including kyphoscoliosis and bifid ribs. The histologic features of keratocystic odontogenic tumors include keratinized epithelium without characteristic epidermal architecture, such as rete ridges. The other answer options describe different head and neck tumors not associated with Gorlin syndrome. Palisading basaloid cells with large nuclei are characteristic of ameloblastoma; multinucleated giant cells are found in giant-cell granulomas; polymorphonuclear cell infiltrate would be seen with a

foreign body reaction; and dysmorphic squamous epithelial cells with high mitoses are suggestive of squamous cell carcinoma of the head and neck. None of these answer choices are supported by the clinical description.

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132. A patient underwent open reduction and internal fixation of naso-orbital-ethmoid fractures 12 months ago, and epiphora was noted on follow-up examination. After 6 months of observation and persistent epiphora, which of the following is the most appropriate next step in management of the patient's nasolacrimal system?

- A) Conjunctivorhinostomy tube placement
- B) Continued observation
- C) Dacryocystorhinostomy
- D) Jones tests
- E) Lacrimal system flushing

The correct response is Option D.

Naso-orbital-ethmoid (NOE) fractures can be challenging fractures, and either through direct instrumentation with transcanthal wiring or from the fractures themselves, the lacrimal drainage system can be affected. Postoperative epiphora can be very common and is present in at least 50% of patients who have undergone open reduction and internal fixation (ORIF) of an NOE fracture. After 3 to 6 months approximately half of this epiphora resolves, with the other half of patients (25%) requiring consideration for other investigations to evaluate lacrimal drainage.

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133. A 32-year-old woman with bilateral masseter hypertrophy comes to the physician because she wants to have a more heart-shaped face. She has normal occlusion otherwise. Which of the following is the most appropriate initial treatment option for this patient?

- A) Injection of botulinum toxin type A 30 to 50 U into the area of the masseter bulk
- B) Intraoral debulking of the deep masseteric muscles
- C) Sagittal split of the mandible with retrusion
- D) Selective denervation of the masseter muscles
- E) Use of an orthodontic dental appliance to realign the dentition

The correct response is Option A.

One of the determinants of beauty is facial shape. For a woman, a heart-shaped face is considered youthful and attractive. With a history of bruxism, masseter hypertrophy changes the face into a more square, masculine shape. Botulinum injections can reduce the facial bulk, redefine the lower facial width, and make the face more youthful and heart-shaped.

The other surgical options are associated with significant morbidity and may not give the desired shape. Orthodontic care is used for patients whose malocclusion has altered the facial shape.

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2. Kim NH, Park RH, Park JB. Botulinum toxin type A for the treatment of hypertrophy of the masseter muscle. *Plast Reconstr Surg*. 2010 Jun;125(6):1693-705.
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134. A 50-year-old man is scheduled to undergo mandibulectomy with floor of mouth resection for cancer. An osteocutaneous radial forearm free flap is being considered. Which of the following is the strongest contraindication to performing this flap?

- A) Abnormal Allen test
- B) Anterior mandibular tumor location
- C) Defect length of 8 cm
- D) History of prior radiation
- E) Lack of availability of ipsilateral neck muscles as recipients

The correct response is Option A.

The osteocutaneous radial forearm free flap (OCRFFF) is based on the radial artery, one of the major sources of blood to the hand. An abnormal Allen test is a sign of insufficient ulnar artery blood flow and would be a major contraindication to utilizing this flap.

While the quantity of bone available for transfer from the radius is thought of as a limitation of this flap, many authors have reported safely harvesting up to 10 cm or more of bone length. The thickness of the bone is also a limitation and it is recommended that no more than one-third to one-half of the bone thickness be harvested to avoid an iatrogenic radial fracture, even when the remaining bone is prophylactically plated and/or bone grafted. Because of this, osseointegrated implants for dental restoration can rarely be performed. The bone component of the OCRFFF is well vascularized and associated with high rates of union and can tolerate osteotomies needed for anterior mandible restoration as well as be used for closing irradiated wounds. An advantage of this flap, in addition to providing a thin, pliable skin paddle, is that it has a long pedicle length that can often reach the ipsilateral transverse cervical blood vessels or contralateral neck blood vessels without the need for interposition vein grafting.

## REFERENCES:

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2. Torina PJ, Matros E, Athanasian EA, et al. Immediate bone grafting and plating of the radial osteocutaneous free flap donor site. *Ann Plast Surg.* 2014;73:315-20.

135. A 30-year-old man comes to the physician 2 months after sustaining a deep laceration from forehead to cheek with medial canthal degloving in a motor vehicle collision. His initial workup included a CT scan that showed no facial fractures; the laceration was primarily repaired in the emergency department. Today, his vision is the same as his pre-injury vision. Which of the following is the triad of clinical sequelae that this patient is most likely to report today?

- A) Exophthalmos, ptosis, and ophthalmoplegia
- B) Lagophthalmos, ptosis, and eyes not closing at night
- C) Miosis, ptosis, and anhidrosis
- D) Strabismus and ptosis that worsen at night
- E) Telecanthus, ptosis, and epiphora

The correct response is Option E.

A medial canthal degloving injury may or may not be associated with a naso-orbito-ethmoid fracture. In this scenario, CT scan showed no fractures.

These injuries can present as vertical lacerations from the forehead to the cheek, crossing the medial canthus. They usually present with the triad of telecanthus (from degloving of the medial canthal tendon, usually the posterior limb that is the weakest limb), ptosis (from avulsion or injury to the upper eyelid), and epiphora (from lacrimal or canalicular injuries). One suggested algorithm is to stage the initial repair of the telecanthus and lacrimal/canalicular repair, and then allow 3 to 6 months of healing before a second stage of ptosis repair.

The other choices are not as consistent with medial canthal degloving: miosis, ptosis, and anhidrosis are incorrect, as these are the triad in Horner syndrome. Exophthalmos, ptosis, and ophthalmoplegia may be seen in superior orbital fissure syndrome. Lagophthalmos, ptosis, and eyes not closing at night may be more associated with congenital ptosis. Strabismus and ptosis, which worsen at night, are suggestive of myasthenia gravis.

## REFERENCES:

1. Priel A, Leelapatranurak K, Oh SR, et al. Medial canthal degloving injuries: the triad of telecanthus, ptosis, and lacrimal trauma. *Plast Reconstr Surg*. 2011 Oct;128(4):300e-305e.

2. Spinelli HM, Shapiro MD, Wei LL, et al. The role of lacrimal intubation in the management of facial trauma and tumor resection. *Plast Reconstr Surg*. 2005 Jun;115(7):1871-6.

136. A 22-year-old man comes to the office because of a history of nasal trauma with resultant nasal deformity, C-shaped septal fracture, and nasal obstruction. Two weeks after injury, he undergoes closed reduction of the nasal fractures, but significant nasal obstruction persists. Which of the following is the most likely reason for his residual nasal deformity and nasal obstruction?

- A) Inadequate time of nasal casting
- B) Nonunion of the nasal bones
- C) Presence of a septal fracture
- D) Turbinate hypertrophy
- E) Unidentified septal hematoma

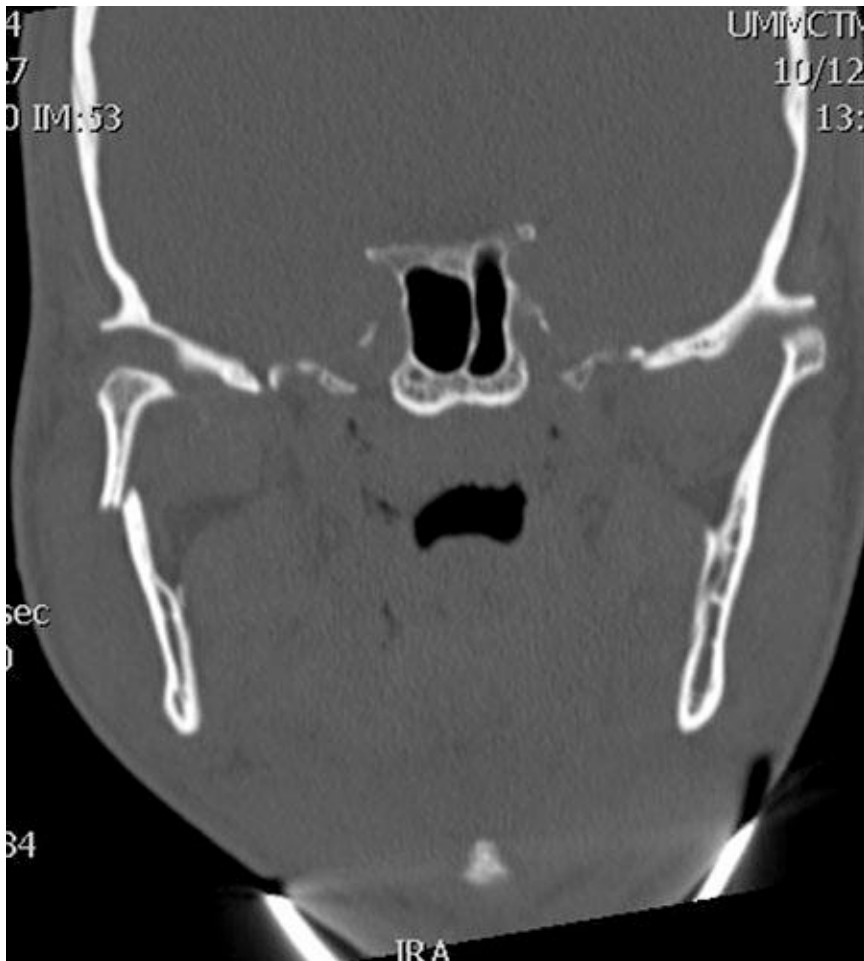
The correct response is Option C.

One of the most important causes of failure of closed reduction to address the nasal fracture is simultaneous nasoseptal fracture. Murray, et al. found 30 to 40% residual nasal deformity after closed reduction. The cadaver study showed failure consistently associated with a C-shaped nasoseptal deviation and fracture when the external nose deviated at least 1/2 of the nasal bridge width. The theory is that the interlocking of the septal fracture creates tension causing the nasal bone to displace.

Untreated septal hematoma results in thickening of the cartilage and nasal obstruction, but not with inadequate reduction. Nasal casting for 7 to 10 days is sufficient to allow the reduction to set. Nonunion is a rare cause of inadequate reduction, usually in comminuted or open nasal fractures. Turbinate hypertrophy can cause nasal obstruction but does not interfere with nasal bone reduction.

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2. Harrison DH. Nasal injuries: their pathogenesis and treatment. *Br J Plast Surg*. 1979 Jan;32(1):57-64.
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137. A 27-year-old man is admitted to the emergency department after being injured in an altercation. Physical examination shows objective malocclusion with a left-sided crossbite and right-sided open bite. A CT scan is shown. Which of the following muscles is most likely responsible for these radiographic and physical examination findings?

- A) Genioglossus
- B) Lateral pterygoid
- C) Masseter
- D) Medial pterygoid
- E) Mylohyoid

The correct response is Option B.

The patient described has typical radiographic and physical exam findings of a right subcondylar mandibular fracture. Anteromedial displacement of the condylar segment out of the glenoid fossa occurs secondary to pull from the lateral pterygoid muscle, which normally functions in anterior translation of the condyle across the articular eminence of the temporal bone during wide mouth opening. This leads to loss of height of the mandibular ramus and a premature occlusion on the fracture side. This causes the typical findings of condylar/subcondylar fractures: ipsilateral crossbite and contralateral open bite. The masseter and medial pterygoid form the pterygomasseteric sling, which attaches from the skull base and zygoma to the inferior mandibular border, and is responsible for fracture displacement after angle and body fractures. The mylohyoid and genioglossus muscles run along the floor of the mouth and can contribute to fracture displacement in the body and parasymphyseal region.

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138. A 64-year-old post-menopausal woman is referred for evaluation and treatment of mandibular osteonecrosis. Discontinuation of which of the following medications should be considered?

- A) Alendronate
- B) Calcitonin
- C) Estrogen
- D) Raloxifene
- E) Teriparatide

The correct response is Option A.

Bisphosphonate-related osteonecrosis of the jaw is a condition found in patients who have received intravenous and oral forms of bisphosphonate therapy for various bone-related conditions such as osteoporosis. The patient may develop exposed, nonvital bone involving the maxillofacial structures. Osteonecrosis may occur following minor trauma with decreased capacity for bone healing due to the effects of bisphosphonate therapy. Treatment may involve antimicrobial rinses, systemic antibiotics, systemic or topical antifungals, and discontinuation of bisphosphonate therapy.

Raloxifene is in a class of drugs called estrogen agonists/antagonists that have been developed to provide the beneficial effects of estrogens without their potential disadvantages. It is neither an estrogen nor a hormone. Raloxifene used to be called a selective estrogen receptor modulator (SERM).

Calcitonin is a synthetic hormone for the treatment of osteoporosis. The naturally occurring hormone is involved in calcium regulation and bone metabolism.

Teriparatide, a type of parathyroid hormone, is approved for the treatment of osteoporosis in postmenopausal women and in men who are at high risk for fracture.

Estrogen therapy with or without progesterone is approved for the prevention of osteoporosis in postmenopausal women. Estrogen reduces bone loss, increases bone density in both the spine and hip, and reduces the risk for hip, spine, and other fractures in postmenopausal women.

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139. A newborn male with a Tessier No. 3 orofacial cleft is evaluated in the NICU. Which of the following locations is the most common pathway of this cleft through the alveolar ridge?

- A) Between the canine and premolar
- B) Between the central and lateral incisors
- C) Between the central incisors
- D) Between the lateral incisor and canine
- E) Between the premolar and first molar

The correct response is Option D.

Tessier No. 3 orofacial clefts are the most common type. When they affect the alveolus, they typically traverse between the lateral incisor and the canine and extend into the floor of the nose and through the nasolacrimal system and orbital floor, involving the medial canthal region.

The other options are all incorrect, because they are not typically the route seen in the Tessier No. 3 orofacial cleft.

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3. da Silva Freitas R, Alonso N, Busato L, et al. "Oral-nasal-ocular cleft: the greatest challenge among the rare clefts." *J Craniofac Surg*. 2010 Mar;21(2):390-5.



140. An otherwise healthy 20-year-old woman is evaluated 5 weeks after sustaining facial shear injury in a motor vehicle collision. She has a facial nerve palsy on the right and exposed mastoid, zygoma, and zygomatic arch. A photograph is shown. She has had previous debridement and titanium mesh cranioplasty for the traumatic cranial defect of the temporal bone. Multifocal extratemporal facial nerve injuries are suspected. Which of the following is the most appropriate management for the wound coverage and facial nerve palsy?
- A) Free tissue transfer for wound coverage with delayed facial reanimation
  - B) Immediate cross-face nerve grafting with cervicofacial flap for soft tissue coverage
  - C) Immediate exploration and primary repair of the facial nerve followed by skin grafting for coverage
  - D) Split-thickness skin grafting for coverage with delayed facial reanimation
  - E) Temporalis muscle sling with skin grafting for wound coverage

The correct response is Option A.

The patient shown has a large soft tissue defect with exposed bone and hardware. There is friable granulation tissue, and the patient presents several weeks after injury. She has a complete facial palsy and her eye is closed at rest (good eye protection) without taping. The ultimate goals are to address both her wound and her facial palsy, with an aesthetic facial reconstruction.

In this setting, a simple nerve transection that would benefit from a simple neuroorrhaphy is unlikely. The tissues are very friable, and tissue planes are not easily identified due to inflammation, extensive damage, and subacute time period. Dissection and exploration would be difficult and could lead to further damage.

Soft tissue coverage is a priority at this point in the patient's reconstruction. She has a large defect with exposed bone and hardware. Free tissue transfer could provide stable coverage. A skin graft will not provide durable coverage over hardware and exposed bone.

Delayed facial reanimation after stable soft tissue coverage will allow for improved healing. Delaying addressing the facial nerve palsy a few weeks to months can still have good outcomes and there will be an improved healing environment.

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141. A 5-year-old girl is brought to the physician because her parents are interested in correction of the unilateral ear anomaly shown in the photographs. Which of the following materials is most likely to be used in the procedure to correct this anomaly?

- A) Acellular dermal matrix
- B) Autogenous rib cartilage
- C) Porous polyethylene
- D) Silicone
- E) Skin

The correct response is Option E.



This patient has cryptotia. The superior helical rim and scapha are not absent but lie buried under the supra-auricular skin. Although some authors have advocated expanding the superior helical framework, this is rarely indicated. In this patient with very mild auricular shortening, supplementing or reconstructing the cartilage framework with rib cartilage, polyethylene, or silicone is unnecessary. Instead, the ear framework simply released its posterior aspect and the resultant defect lined with full-thickness skin graft or any number of skin flaps raised from the postauricular region. The use of acellular dermal matrix is not an accepted method of correcting cryptotia.

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142. The congenital anomaly shown in the photograph is thought to be caused by which of the following?

- A) Failure of fusion of the lateral and maxillary nasal processes
- B) Failure of fusion of the maxillary prominence with the medial nasal prominence
- C) Failure of fusion of the medial nasal prominence and the lateral nasal prominence
- D) Failure of fusion of the medial nasal prominences
- E) Failure of the oronasal membrane to rupture

The correct response is Option A.

Proboscis lateralis, which is illustrated in the photograph, is thought to be a failure of fusion between the lateral and maxillary nasal processes. A cleft lip is the result of a failure of fusion of the maxillary prominence with the medial nasal prominence. A midline cleft or Tessier Zero cleft is a result of the failure of fusion of the medial nasal prominences. Choanal atresia is a result of a failure of the oronasal membrane

to rupture. Finally, a mandibular cleft or Tessier # 30 cleft is a result of the failure of fusion of the mandibular prominences.

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2. Eroğlu L, Uysal OA. Proboscis lateralis: report of two cases. *Br J Plast Surg*. 2003 Oct;56(7):704-8.
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143. The muscles of facial expression, the posterior belly of the digastric muscle, and the stapedius muscle are derived from which of the following pharyngeal arches?

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

The correct response is Option B.

The pharyngeal, or branchial, arches are developmental structures derived from all three germ layers and also contain neural crest cells. These arches give rise to bony, cartilaginous, vascular, muscular, and neural structures of the head and neck.

The second pharyngeal arch gives rise to the muscles of facial expression, posterior belly of the digastric muscle, and the stapedius muscle. These muscles are innervated by the facial nerve (VII), which also arises from this arch.

The first pharyngeal arch gives rise to the muscles of mastication, anterior belly of the digastric, mylohyoid, tensor tympani, and tensor veli palatini muscles as well as the trigeminal nerve (V). The third pharyngeal arch gives rise to the stylopharyngeus muscle as well as the glossopharyngeal nerve (IX). The fourth pharyngeal arch gives rise to the cricothyroid muscle and all intrinsic muscles of the soft palate except the tensor veli palatini, as well as the superior laryngeal nerve (X). The sixth pharyngeal arch gives rise to the intrinsic muscles of the larynx except the cricothyroid muscle as well as the recurrent laryngeal nerve (X). The fifth pharyngeal arch does not give rise to structures in humans.

| Arch/Nerve   | Skeletal                                                      | Ligaments                                                       | Muscles                                                                                                         | Pouch                                        |
|--------------|---------------------------------------------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| First (V)    | 1.Malleus<br>2 Incus                                          | 1. Anterior ligament of malleus<br>2. Sphenomandibular ligament | 1. Muscles of mastication<br>2. Tensor palatini<br>3. Tensor tympani<br>4. Mylohyoid<br>5. Ant. Belly digastric | 1. Ext. auditory can.<br>2. Middle ear space |
| Second (VII) | 1. Stapes<br>2. Styloid<br>3. Hyoid (lesser horn, upper body) | Stylohyoid ligament                                             | 1. Facial expression<br>2. Stapedius<br>3. Stylohyoid<br>4. Post belly digastric                                | Tonsillar fossae                             |
| Third (IX)   | Hyoid greater horn, lower body                                | None                                                            | Stylopharyngeus                                                                                                 | 1. Inf parathyroid<br>2. Thymus              |
| Fourth (X)   | Larynx                                                        | None                                                            | 1. Laryngeal mm<br>2. Pharyngeal mm<br>3. Soft palate                                                           | 1. Sup parathyroid<br>2. Thyroid cells       |
| Sixth (XI)   | None                                                          | None                                                            | 1. Sternocleidomastoid<br>2. Trapezius                                                                          | None                                         |

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144. A 12-year-old boy is evaluated for a vertical furrow near the midline of his face from the hairline to the eyebrows. Each of the listed clinical findings can be seen in hemifacial atrophy EXCEPT

- A) Atrophy of the tongue
- B) Change in facial sensation
- C) Malar hypoplasia
- D) Malocclusion
- E) Mandible hypoplasia

The correct response is Option B.

The relationship between *morphea en coup de sabre* and Parry-Romberg syndrome is unclear but there is some overlap. Morphea is characterized by the vertical furrow, atrophy of the tongue and upper lip, absent or flattened zygoma, orbital rim, and a hypoplastic maxilla and mandible on the affected side. A lateral open bite may be

seen due to the maxillary and mandibular hypoplasia. Sensation, function of muscles of facial expression, and mastication are normal.

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145. A 5-year-old child is brought to the office for evaluation of several supernumerary teeth. Which of the following is most characteristic regarding this anomaly?
- A) More common in the primary dentition than in the secondary dentition
  - B) More frequent in the maxilla than in the mandible
  - C) More prevalent in females than in males
  - D) Occurs most often from disruption during the morphodifferentiation stage of tooth development
  - E) Typically associated with ectodermal dysplasia

The correct response is Option B.

Hyperdontia is an anomaly of number of teeth and occurs most frequently in the maxilla (90%). It occurs during the initiation or proliferation stage.

Morphodifferentiation issues lead to an anomaly of enamel/dentin/cementin composition. It is more common in males (2:1). It is 5 times more common in permanent dentition than in primary dentition. Finally, ectodermal dysplasia is associated with hypodontia.

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3. Rajab LD, Hamdan MA. Supernumerary teeth: review of the literature and a survey of 152 cases. *Int J Paediatr Dent*. 2002 Jul;12(4):244-54.

146. A 63-year-old woman is admitted to the hospital with a fracture to the left mandibular angle that she sustained in a motor vehicle collision. Open reduction and internal fixation is planned via a submandibular (Risdon) incision. The region between which of the following planes of dissection is most appropriate for approaching the fracture and avoiding injury to the marginal mandibular branch of the facial nerve?

- A) Carotid sheath and the posterior belly of the digastric muscle
- B) Platysma and the superficial (investing) layer of the deep cervical fascia
- C) Skin and the platysma
- D) Submandibular gland and the carotid sheath
- E) Superficial (investing) layer of the deep cervical fascia and the submandibular gland

The correct response is Option E.

The submandibular approach to the mandibular body/ramus is an important surgical approach to address a number of facial fractures. An understanding of the anatomy of the submandibular region is crucial to performing this approach with minimal complications. The marginal mandibular nerve leaves branches off the facial nerve trunk during its intraparotid course. One to three branches usually exit the inferior border of the parotid gland before changing course to travel along the mandibular border toward the symphysis. In almost all cases, the marginal mandibular nerve travels superficial to or within the investing layer of the deep cervical fascia as it courses anteriorly. In several cadaveric studies, the nerve consistently coursed within 1 cm below the mandibular border posterior to the facial vessels, and above the mandibular border anterior to the facial vessels. The submandibular approach to facial fractures involves incising the skin 2 cm below the mandibular border, dividing the platysma and dissecting deep to the investing fascia, just above the submandibular gland. Once in this plane, the course of dissection is carried superiorly toward the mandibular border.

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147. A 55-year-old man undergoes resection of locally destructive floor-of-mouth cancer including a tooth-bearing segment of the mandible. Immediate reconstruction is performed using a fibula flap. Dental restoration with implants is planned. Which of the following properties of the fibula flap is most likely to ensure the greatest initial stability of the dental implants?

- A) Cancellous bone thickness
- B) Cortical bone thickness
- C) Periosteal thickness
- D) Total bone thickness
- E) Total bone width

The correct response is Option B.

When dental implants are placed in thicker cortical bone, better initial stability is achieved at the bone implant interface, reducing micromotion during the process of osseointegration. Cortical bone thickness has also been shown to correlate with the amount of torque required to remove a dental implant. No significant correlation has been shown between removal torque and total bone thickness. The presence of osteogenic cells in cancellous bone is responsible for a biologic response, although it is not as important in improving initial stability as thick cortical bone. Periosteal thickness is not relevant to dental restoration.

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148. Which of the following best describes the principal goal of using the nasopalveolar molding (NAM) appliance?

- A) Decrease of the financial and care burden on the family
- B) Improvement in feeding
- C) Improvement in midface growth in the sagittal and vertical planes
- D) Palatal expansion
- E) Repositioning and approximation of the alveolar segments and nasal cartilage

The correct response is Option E.

The primary goal of nasopalveolar molding (NAM) is to reposition and approximate the alveolar segments and reshape the nasal cartilage. Financial analysis shows that NAM costs significantly less than lip adhesion, but this a labor-intensive process for the family. It is not designed to address palatal collapse. There is anecdotal information on impact of feeding, but this is not the principal goal as customized bottles work well in these children. There is no impact on midface growth in either place based on studies with more than 18 years, follow-up. Finally, the biggest benefit of NAM in the bilateral cases is the correction in columella height—even more than in unilateral cases.

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149. A 34-year-old woman is scheduled to undergo resection of a left-sided cerebellopontine angle tumor with sacrifice of the facial nerve trunk. Staged cross-facial nerve grafting is planned. Which of the following treatment options is most likely to minimize the risk for permanent facial asymmetry at the time of tumor resection?

- A) Free gracilis muscle transfer to the left facial nerve stump
- B) Hypoglossal to facial nerve transfer and cross-facial nerve grafting
- C) Insertion of a 1.2-g gold weight in the left upper eyelid
- D) Percutaneous distal facial nerve branch stimulation
- E) Placement of an extended temporalis fascia static sling

The correct response is Option B.

Cerebellopontine angle (CPA) tumor resection often requires intracranial facial nerve sacrifice. For best recovery of spontaneous ipsilateral facial nerve function, cross-facial nerve grafting (CFNG) should be performed from the contralateral facial nerve branches to the ipsilateral facial nerve branches. CFNG often results in delayed and weakened reinnervation of the ipsilateral facial musculature. For this reason, hypoglossal to facial nerve transfer and cross-facial nerve grafting (babysitter nerve transfers) are often employed to minimize muscle atrophy and enhance the strength of the ipsilateral facial musculature. Both hypoglossal nerve and nerve to masseter have been used. The other choices would not augment the ipsilateral facial musculature and would likely result in more pronounced facial asymmetry.

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150. An 18-year-old man is evaluated for a mandibular fracture sustained in a motor vehicle collision. CT scan shows displaced left parasymphysal and right mandibular body fractures. Resorbable plate fixation is planned. Compared with titanium implants, the use of resorbable fixation to treat this fracture is associated with which of the following?

- A) Decreased postoperative pain
- B) Decreased risk for malunion
- C) Increased overall cost
- D) Increased risk for infection
- E) Lower hardware profile

The correct response is Option C.

Bioresorbable fixation is now widely employed in craniomaxillofacial surgery. While this technology has theoretical advantages in the treatment of craniosynostosis (e.g., obviates concerns of intracranial implant migration), the benefits of orthognathic surgery and the management of facial trauma are dubious. For mandibular fractures, several studies have found no statistical differences in overall or specific complication rates, including the need for plate removal, postoperative infection, malreduction/malocclusion, postoperative pain, or loss of fixation. Rigorous comparisons are lacking, but a recent comprehensive review of the reported studies demonstrated a trend toward increased complications using resorbable fixation to treat facial fractures. The only consistent difference is the cost of the implants, which is considerably higher for the resorbable systems.

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# Section 4: Breast and Cosmetic

151. A 45-year-old man comes to the office for consultation regarding hair loss concerns. He reports that he has a friend who underwent a hair transplantation procedure that looks unnatural, especially at the front hairline. Using the minigraft and micrograft strategy, how many follicles should be in a minigraft?

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

The correct response is Option B.

Minigrafts consist of 3 to 4 follicular units and are commonly used in concert with micrografts which contain 1 to 2 follicular units. Larger numbers of follicular units have been associated with artificial appearing outcomes (plug look).

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2. Barrera A. The use of micrografts and minigrafts in the aesthetic reconstruction of the face and scalp. *Plast Reconstr Surg*. 2003 Sep;112(3):883-90.
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152. Breast implant–associated anaplastic large cell lymphoma is most closely associated with which of the following implant characteristics?

- A) High-profile dimensions
- B) Saline filling
- C) Silicone gel filling
- D) Smooth shell
- E) Textured shell

The correct response is Option E.

The overwhelming majority of reported cases of breast implant–associated anaplastic large cell lymphoma (BIA-ALCL) have been associated with textured surface implants.

Anaplastic large cell lymphoma in association with breast implants is a rare occurrence; however, when it does appear, the course is usually less aggressive with a better prognosis than when it is unrelated to breast implants. Recent studies suggest that the breast implant shell causes a chronic T-cell stimulation. This reaction is thought to be caused by an interaction of textured surface characteristics and associated biofilm.

BIA-ALCL associated with smooth shell implants has occurred; however, it is disproportionately rare.

ALCL is seen with both silicone- and saline-filled implants. These numbers are highly influenced by the specific popularity of each implant. Specific implant dimensions, be it projection or width, are not uniquely associated with ALCL.

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2. Brody GS, Deapen D, Taylor CR, et al. Anaplastic large cell lymphoma occurring in women with breast implants: analysis of 173 cases. *Plast Reconstr Surg*. 2015 Mar;135(3):695-705.
3. Clemens M, Butler C. PROFILE registry: PSF, ASPS and FDA efforts lead to BIA-ALCL registry, need your data. *Plastic Surgery News* October/November 2015: 8-9.

153. Which of the following is a risk factor for hormone-sensitive breast cancer?

- A) Breast-feeding
- B) Early age at first pregnancy
- C) Early menopause
- D) Late menarche
- E) Post-menopausal obesity

The correct response is Option E.

Post-menopausal obesity is associated with increased adipose production of estrogen, which can increase the risk for hormone-sensitive breast cancer. Other options (late menarche, early menopause, and breast feeding) decrease the number of menstrual cycles, and therefore may decrease the risk of breast cancer. Early age at first pregnancy is also associated with decreased risk for hormone-sensitive breast cancers.

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2. What are the Risk Factors for Breast Cancer? American Cancer Society. Available at: <http://www.cancer.org/cancer/breastcancer/detailedguide/breast-cancer-risk-factors>. Published December, 2015.

154. Which of the following is the most common cause of litigation in cosmetic breast surgery?

- A) Assault
- B) Failure to diagnose or treat an injury related to the procedure
- C) Lack of informed consent
- D) Negligence
- E) Retained surgical instrument

The correct response is Option D.

Plastic surgery faces one of the highest proportions of malpractice claims compared with other medical specialties. A number of studies have revealed that breast-related surgeries account for 37% of overall claims against plastic surgeons. The most common cause of action is negligence, related either to lack of appropriate knowledge or skill or to failing to meet the standard of care. The second most common cause of action is lack of informed consent. Lack of informed consent results from the failure of the physician to thoroughly discuss the risks associated with surgery and the options of alternative therapies. Other causes of action include failure to diagnose or treat injury related to the procedure, retained surgical materials, assault, and distortion of physician's credentials.

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3. Paik AM, Mady LJ, Sood A, et al. A look inside the courtroom: An analysis of 292 cosmetic breast surgery medical malpractice cases. *Aesthet Surg J*. 2014 Jan 1;34(1):79-86.

155. At the keystone area of the nose, which of the following most accurately describes the anatomic position of the upper lateral cartilage in relation to the nasal bones?

- A) Anterior to the nasal bones
- B) Caudal to the nasal bones with a 1 to 2 mm fibrous gap
- C) Edge to edge with the nasal bones with no overlap
- D) Posterior to the nasal bones

The correct response is Option D.

The keystone area of the nose is where the nasal bones overlap the upper lateral cartilages. This is usually the widest part of the nasal dorsum.

At the dorsal keystone area, the nasal bones overlap the upper lateral cartilages for a distance of 4 to 14 mm.

When reducing a dorsal hump, rasping of the bone at the keystone area uncovers the underlying cartilages, which often dictate the width of this area. Once uncovered, these structures may need to be reduced for a more aesthetic dorsal line.

In large cadaver studies, all noses demonstrate that the upper lateral cartilages are posterior to the nasal bones at the keystone area, and as such all other answer choices are incorrect.

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156. An otherwise healthy 28-year-old woman comes to the physician requesting removal of bilateral axillary masses. She states that the masses fluctuate in size and tenderness with her menstrual cycle. She reports that the masses have not had discharge or drainage. Physical examination shows smooth, spongy masses in both axillae. A photograph is shown. Which of the following is the most appropriate next step in management of this patient?

- A) Excise the bilateral axillary masses and skin
- B) Obtain bilateral mammograms of the axillary masses
- C) Order an MRI of the chest
- D) Perform a core biopsy of both axillary masses
- E) Perform liposuction

The correct response is Option A.

This patient presents with ectopic breast tissue. In utero, the milk line (galactic band) forms at 5 weeks of gestation. This bilateral structure courses from the axillae to the groin, and normal breasts form in the prepectoral region after there has been regression of the rest of the galactic band. When there is failure of this regression,

breast tissue remains in locations outside of the normal breast. The most common location for ectopic breast tissue is in the axillae, although it can be found anywhere along the milk line from the axillae to the groin. Ectopic breast tissue outside of the milk line has been described and is termed aberrant breast tissue.

The tissue found in these ectopic locations is breast tissue with the same characteristics and propensity for disease as normally located breast tissue, and breast cancer has been described in these tissues. In the absence of pathologic findings such as a mass, pain, and skin changes that are associated with breast cancer, there is no strong oncologic indication for excision. If there are findings concerning for a neoplasm, then work-up should be initiated and might include further imaging, core biopsy, and surgery. However, most cases present without pathologic findings and are excised to achieve a more reasonable appearance for the patient, the ability to don clothing more comfortably, and for the obvious social advantages.

In this case, the patient is young, has no complaints, and has no physical findings to suggest a neoplasm. Excision should be offered.

Obtaining bilateral mammograms is incorrect because there is no indication for imaging in this patient based on her age, history, and physical examination. In addition, mammograms of axillary breast tissue are technically unfeasible.

Performing a core biopsy is incorrect as there is no concern for malignancy in this case. In the case of a mass noted within the ectopic axillary breast tissue, then an oncologic workup should be initiated which might include a core biopsy.

An MRI of the chest is incorrect because there is no indication for imaging in this patient based on her age, history, and physical examination.

Reassuring the patient with no further action is not the most appropriate management, as it will not address the patient's concerns and desires. In the patient who does not request excision or is not an appropriate surgical candidate, then reassurance and surveillance are appropriate.

As this is a young female with axillary breast tissue, liposuction will not improve the excess breast tissue or skin.

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157. In embryologic breast development, which of the following best describes the formation of the mammary ridge?

- A) Starts at the fifth or sixth week of fetal development, when buds of mesoderm grow into the overlying ectodermal skin layer
- B) Starts at the fifth or sixth week of fetal development, when outgrowths from the ectodermal skin layer penetrate into the mesoderm
- C) Starts at the seventh or eighth week of fetal development, when buds of mesoderm grow into the overlying ectodermal skin layer
- D) Starts at the seventh or eighth week of fetal development, when outgrowths from the ectodermal skin layer penetrate into the mesoderm
- E) Starts at the third or fourth week of fetal development, when buds of mesoderm grow into the overlying ectodermal skin layer

The correct response is Option B.

Muntan, et al. described breast development as starting at the fifth or sixth week of development, when outgrowths from the ectodermal skin layer penetrate into the underlying mesoderm, forming the mammary ridge or milk line. The ectodermal thickenings along the mammary line regress between gestational months 2 and 4, except for two of them in the region of the third and fourth ribs. The ectoderm keeps on extending into the underlying mesoderm at the fifth month, and a branching network forms what will eventually become the lactiferous system. The supportive connective and adipose tissue of the breast develops from the surrounding mesenchyme.

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158. After laser removal of an elaborate multi-color tattoo, a patient has residual green ink remaining. Which of the following is the most appropriate treatment for this residual pigment?

- A) Carbon dioxide laser
- B) Intense pulsed light
- C) Long pulse Nd:YAG (1064-nm) laser
- D) Q-switched alexandrite (755-nm) laser
- E) 70% Trichloroacetic acid peel

The correct response is Option D.

Green tattoo ink responds effectively to treatment with a 755-nm Q-switched alexandrite laser. As of 2013, a picosecond-domain alexandrite laser became commercially available, giving 75% clearance of green pigment in just one to two treatments in fair-skinned patients. Alternatively, ruby lasers, with a 694-nm wavelength, can be used.

The 1064-nm wavelength is very effective for black and other dark colors when a Q-switched or picosecond machine is used. Typically, this wavelength is less effective for green, with this color commonly being left behind after completion of a 1064-nm treatment series.

The long-pulse Nd:YAG is used for hair removal and varicose veins. It does not have the short pulse width required for effective tattoo removal. Similarly, intense pulsed light (IPL), even when filtered to the correct wavelength, doesn't give the short pulse width required for tattoo removal. Long-pulse laser or IPL pulses in the millisecond domain usually result in incomplete tattoo clearance, thermal damage to surrounding tissues, and scarring.

Trichloroacetic acid (TCA) peels are not pigment-specific. They have become popular with the do-it-yourself patient population, with unregulated sales over the Internet, leading to reports of hypertrophic scarring and chemical burns requiring formal excision and skin grafting. A TCA peel is not recommended as a tattoo treatment, even in the more commonly used concentrations of 30 to 40%, which are used for facial resurfacing.

Carbon dioxide laser is not effective at targeting tattoo pigment.

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159. A 48-year-old woman with a history of a 160-lb (73-kg) weight loss after gastric bypass surgery comes to the office because she seeks a trimmer torso. Current BMI is 29 kg/m<sup>2</sup>. Physical examination shows excessive skin on the horizontal and vertical dimensions of the abdomen. Which of the following procedures is most likely to result in aesthetic correction of the deformity?

- A) Circumferential dermolipectomy
- B) Corset abdominoplasty
- C) Externally applied laser lipolysis
- D) Liposuction of the anterior abdomen
- E) Revision of the gastric bypass

The correct response is Option B.

The increasing popularity of bariatric surgical procedures for the management of obesity has generated a plethora of plastic surgical techniques to deal with the sequelae of massive weight loss. A thorough analysis of the anatomical result of weight loss is key in determining the ideal procedure for each individual's situation and goals. While liposuction might be helpful as an adjunct to surgical excision, it does not usually produce measurable skin tightening in this group of patients. Skin resection options have been devised based on the skin laxity pattern. When significant horizontal and vertical skin excess is present, a corset trunkplasty, devised by A.P. Moya, is the most likely of the choices to result in a trimmer abdomen shape. This option addresses the upper abdominal skin laxity that is not routinely addressed with traditional abdominoplasty. Circumferential dermolipectomy, also known as belt lipectomy, creates a vertical tightening but not a horizontal tightening of loose skin. Laser lipolysis applied externally is not indicated for the management of excessive skin laxity. This patient has achieved an acceptable result (BMI of 29) of bariatric surgery and therefore no revision of the bypass operation is indicated.

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2. Moya AP, Sharma D. A modified technique combining vertical and high lateral incisions for abdominal-to-hip contouring following massive weight loss in persistently obese patients. *J Plast Reconstr Aesthet Surg*. 2009 Jan;62(1):56-64.

160. A 36-year-old woman, gravida 3, para 3, comes to the physician because she desires larger breasts. She has breast-fed three children. Physical examination shows grade 3 ptosis and loss of superior pole volume. The distance from nipple to sternal notch is 26 cm. Result of upper pole pinch test is 1.5 cm. A dual-plane augmentation/mastopexy is planned. Which of the following is the strongest indicator for subpectoral placement of the implant in this patient?

- A) Concurrent mastopexy
- B) Grade 3 ptosis
- C) Loss of superior pole volume
- D) Nipple to sternal notch distance of 26 cm
- E) Pinch test result of 1.5 cm

The correction response is Option E.

A dual-plane approach is subpectoral in the superior pole and subglandular in the inferior pole. This is to afford more subcutaneous coverage in the superior pole. Tebbetts recommends pinching the skin and subcutaneous tissues of the superior pole for a “pinch test.” For thickness less than 2 cm, he recommends a dual-plane placement for adequate soft tissue coverage. This is not affected by the grade of ptosis, need for mastopexy, history of loss of superior pole volume, or nipple to notch distance.

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1. Lee MR, Unger JG, Adams WP. The tissue-based triad: a process approach to augmentation mastopexy. *Plast Reconstr Surg*. 2014 Aug;134(2):215-25.
2. Tebbetts JB. Dual plane breast augmentation: optimizing implant-soft-tissue relationships in a wide range of breast types. *Plast Reconstr Surg*. 2006 Dec;118(7 Suppl):81S-98S; discussion 99S-102S.

161. A 30-year-old man comes to the office because of a frontal headache and persistent watery drainage from the right nostril 2 weeks after undergoing septorhinoplasty. Which of the following is the most appropriate next step in management?

- A) Place nasal packing for 48 hours
- B) Start oral antihistamines
- C) Start vasoconstrictor nasal spray
- D) Test nasal discharge for beta-2 transferrin
- E) Reassure the patient that these symptoms are normal

The correct response is Option D.

Postoperative cerebrospinal fluid (CSF) leak is a rare but known complication following septoplasty. It is related to an error in surgical technique, with overly forceful manipulation of the perpendicular plate region resulting in a cribriform plate defect. The cardinal symptoms are frontal headache and a clear, watery persistent rhinorrhea. If nasal packing is present, the patient may report a metallic or salty-tasting post-nasal drip. Prompt diagnosis is required to avoid complications, particularly meningitis and pneumocephalus. CSF rhinorrhea is more common on the right side, reflecting a predominance of left-sided surgical approaches. It may present in an early manner, as in this case, or have a delayed presentation; some documented reports have a 20-year delay between septoplasty and diagnosis of CSF leak.

While imaging is beneficial, initial diagnosis of CSF leak can be made with the beta-2 transferrin or Beta-trace protein testing, which are both specific and sensitive for CSF. Both are more accurate than the traditional "halo" sign or measuring the glucose level of the fluid.

The other options listed are incorrect, as they do not diagnose or effectively treat the underlying problem.

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162. A 20-year-old woman comes to the office with her parents because of her significant concern with the appearance of a scar on her forehead of 1 year's duration. Physical examination shows a well-healed scar that blends in nicely with the surrounding skin and is difficult to see at conversation distance. The patient's parents do not see the need for any intervention since they also find the scar difficult to see. Which of the following must be present to confirm a diagnosis of body dysmorphic disorder in this patient?

- A) History of treatment for an eating disorder
- B) Occasional social anxiety
- C) Preoccupation with obvious flaws in her appearance
- D) Prior rhinoplasty
- E) Repetitive behavior related to her appearance concerns

The correct response is Option E.

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th edition, (DSM-V) the following criteria define the diagnosis of body dysmorphic disorder (BDD):

- Preoccupation with one or more perceived defects or flaws in physical appearance that are not observable or appear slight to others.
- At some point during the course of the disorder, the individual has performed repetitive behaviors (e.g., mirror checking, excessive grooming, skin picking, reassurance seeking) or mental acts (e.g., comparing his or her appearance with that of others) in response to the appearance concerns.
- The preoccupation causes clinically significant distress and impairment in daily function.
- An eating disorder may be seen with body dysmorphia, but is not pivotal to its diagnosis.

A diagnostic criterion describing repetitive behaviors or mental acts in response to preoccupations with perceived defects or flaws in physical appearance has been added since the DSM-IV-TR, consistent with data indicating the prevalence and importance of this symptom.

Prior history of cosmetic surgery (rhinoplasty in this case) is not part of the diagnostic criteria for body dysmorphic disorder.

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2. Varma A, Rastogi R. Recognizing Body Dysmorphic Disorder (Dysmorphobia). *J Cutan Aesthet Surg*. 2015 Jul-Sep;8(3):165-8.

163. Which of the following is most commonly associated with decreased incidence of capsular contracture?

- A) Formation of biofilm
- B) Placement of textured silicone device
- C) Subglandular placement of the implant
- D) Use of a periareolar incision
- E) Use of a postoperative surgical brassiere

The correct response is Option B.

The rest of the options have been shown to increase the incidence of capsular contracture. Textured silicone implants, inframammary incisions, and submuscular implant placement have been shown to decrease the incidence of capsular contracture. The use of a surgical brassiere postoperatively has not been shown to decrease incidence of capsular contracture as well.

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164. A 48-year-old man is evaluated for a panniculectomy for symptomatic panniculitis 18 months status post Roux-en-Y gastric bypass. The patient has lost 150 lb (68 kg), and BMI is 28 kg/m<sup>2</sup>. He reports taking a multivitamin every day and exercising for 30 minutes three times a week. Physical examination shows no abnormalities. Preoperative nutritional evaluation will most likely show a deficiency in which of the following micronutrients?

- A) Iron
- B) Vitamin A
- C) Vitamin B<sub>1</sub> (thiamine)
- D) Vitamin B<sub>12</sub> (cobalamin)
- E) Vitamin D

The correct response is Option A.

Because of the restrictive and malabsorptive components of the procedure, iron deficiency anemia is very common in post-bariatric patients. Iron deficiency occurs in 30 to 50% of post-bariatric patients despite a recommended daily multivitamin.

Roux-en-Y gastric bypass promotes weight loss through both a restrictive component and a malabsorptive component. This has implications for micronutrient absorption, because pancreatic release of enzymes is no longer synced with gastric emptying, and factors involved in the processing and absorption of micronutrients are decreased. Micronutrient deficiencies are common after bariatric surgery, and while many are asymptomatic, they can have effects on wound healing after surgery.

Vitamin B<sub>12</sub> deficiencies are most common at least 12 months after surgery and range from 3.6 to 37%, but they depend on chronicity, degree of supplementation, and type of bypass. Brolin, et al, in 2002, compared patients with a distal Roux-en-Y gastric bypass to those with short Roux limbs (150 cm and 50 to 75 cm). Vitamin B<sub>12</sub> deficiency was most common in patients who underwent Roux-en-Y gastric bypass, and B<sub>12</sub> deficiency was most common after surgery with short limbs (50 to 75 cm). Vitamin B<sub>6</sub> (pyridoxine) deficiency is approximately 17.6%. Vitamin B<sub>1</sub>, (thiamine), deficiency is estimated at 18.3% of post-bariatric patients. Most B complex deficiencies are asymptomatic. Vitamin B<sub>12</sub> (riboflavin) deficiency is estimated to be 13.6% one year after bariatric surgery.

Because of the malabsorptive component of Roux-en-Y gastric bypass, fat-soluble vitamin deficiencies can also occur in the post-bariatric patient. Vitamin A deficiency can be progressive, and deficiency is estimated to be 11% one year after surgery and 69% four years after surgery. Vitamin E deficiency is relatively uncommon in post-bariatric patients who are taking supplementation.

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165. A 52-year-old woman comes to the office to receive botulinum toxin type A injections to the corrugator and procerus. She returns to the office 1 week later because she is upset that her eyelids on both sides are droopy. Physical examination shows bilateral ptosis. Which of the following is the most appropriate treatment to improve this patient's condition until the effects of the botulinum toxin type A subside?

- A) Apraclonidine
- B) Artificial tears
- C) Botulinum toxin type A to the lateral orbicularis oculi
- D) Ophthalmic tobramycin and dexamethasone
- E) Tetracaine

The correct response is Option A.

This patient has developed true eyelid ptosis from her botulinum toxin type A treatments coming into contact and affecting the levator palpebrae superioris muscle within the eyelid. Although the effects of botulinum toxin type A on any muscle are irreversible with medications, attempts to lessen the severity of the ptosis have been made with the use of eyedrops to stimulate the Müller muscle, which is located deep to the levator. Apraclonidine is an alpha-adrenergic agonist and as such stimulates the Müller muscle to contract. This contraction may elevate the eyelid 1 to 3 mm and lessen the amount of ptosis to varying degrees in order to make the overall appearance of the eyelids more tolerable to the patient until the effects of botulinum toxin type A wear off on their own and levator function naturally returns. The most common dose of apraclonidine is 1 to 2 drops three times daily until ptosis resolves.

Tetracaine is a commonly used numbing agent for the corneal surface that enhances the comfort of using corneal protectors for periorbital surgery. Tobradex eyedrops are a combination of tobramycin and dexamethasone used for treatment of infection and/or its anti-inflammatory effect in the periorbital region. It has no effect on eyelid ptosis. Artificial tears are lubricating drops and have no effect on muscular action.

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166. Accidental injection of hyaluronic acid filler into which of the following areas is most likely to cause blindness by retrograde occlusion of the central retinal artery?

- A) Cheek
- B) Geniomandibular groove
- C) Lateral lip commissure
- D) Nasal dorsum
- E) Nasolabial fold

The correct response is Option D.

The dorsal nasal artery is a distal continuation of the ophthalmic artery from the internal carotid artery. During nasal dorsum augmentation, accidental injection of filler into this artery under pressure can push the filler retrograde into the ophthalmic artery. When the pressure is returned to normal, the filler then can flow distally occluding the retinal artery and causing blindness. Intravascular injection of fillers into the angular artery of the nasolabial line can also cause blindness, although this would more commonly result in skin mottling and necrosis of the nasal tip skin.

The cheek area overlying the malar bone, with few deep vessels, is a relatively safe place for injectables.

Intravascular injection of the geniomandibular groove and lateral lip commissure is more commonly associated with vascular compromise of the lips and chin.

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167. A 55-year-old woman presents with androgenic alopecia. Her husband had a hair transplant 5 years ago. Which of the following characteristics of androgenic alopecia is more common in women than men?

- A) More rapidly progressive
- B) Not induced by dihydrotestosterone
- C) Thinning tends to be frontoparietal
- D) Topical minoxidil is ineffective

The correct response is Option C.

Unlike in men, androgenic alopecia in women tends to spare the frontal hairline and tends to affect the frontoparietal scalp. Like in men, it is a chronically progressive disease and causes miniaturization of scalp follicles through exposure of endogenous dihydrotestosterone in patients with increased scalp androgen receptors and 5-reductase concentrations. Topical minoxidil has been shown to increase scalp blood supply and slow hair loss in both males and females.

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168. A 51-year-old woman with Fitzpatrick type I skin comes to the office seeking improvement for fine rhytides on the lower eyelid. She was started on isotretinoin and hydroquinone 6 weeks ago by the aesthetician and has been compliant with the regimen. Which of the following treatments is most appropriate for optimal improvement of the lower eyelid in this patient?

- A) Dermabrasion
- B) Microdermabrasion
- C) Phenol-croton oil peel 0.4% solution
- D) Trichloroacetic acid peel 30% solution
- E) Ultrasound-based skin tightening

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option D.

There are several treatment modalities that may be properly used to resurface lower eyelid skin. The skin in this special area is quite thin and caution must be exercised to not cause scarring or retraction issues. Trichloroacetic acid (TCA) is a chemical peel agent that is commonly used to resurface wrinkles on the face. The solution comes in several strengths, and concentrations of 20 to 40% are commonly utilized in the thinner lower eyelid skin.

Phenol-croton oil chemical peels have seen a dramatic increase in their use for facial surfacing once details were worked out to vary the strength of the solution. Previously, old-fashioned phenol peels contained a standard amount of croton oil as an irritant, and these peels produced a vigorous and drastic “all or none” effect. Once Hetter described techniques that involve varying the concentration of croton oil within the peel, it became possible to utilize this peel to resurface all areas of the face effectively, using varying concentrations on different parts of the face depending on the thickness of the skin within each region. For the lower eyelids, 0.1% or less is considered standard, and the use of 0.4% should be reserved for thicker skin such as that around the cheeks or the brow or perioral region. Use of this higher concentration would have a high likelihood of producing scarring within the ultrathin lower eyelid skin.

Dermabrasion is a highly effective skin resurfacing modality that produces damages

via an abrasive process to nearly any depth of the skin depending on the force applied to the head. This modality is most commonly used in the perioral area. Lower eyelid skin rhytides cannot be properly treated with standard dermabrasion techniques given the high risk for inducing damage to the sensitive and fragile structure of the lower eyelid and an inability to hold this skin taut enough to perform dermabrasion effectively and safely.

While microdermabrasion can safely be used to resurface the lower eyelid skin, this modality penetrates the most superficial layer of skin only, affecting only the epidermis and not traversing the reticular dermis, which would be required to effect change in the wrinkles on the skin.

Ultrasonic based skin tightening (e.g. Ultherapy) involves the use of ultrasonic energy to bypass the skin and affect deeper soft tissues and cause them to contract, giving the appearance of a “lift.” It has no effect on the outer appearance of the skin.

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169. An otherwise healthy 14-year-old boy is evaluated because of bilateral breast enlargement over the past 3 months. He is worried that his friends will notice. He reports no illicit drug use and takes no medications. Physical examination shows normal hair distribution for the patient's age, no testicular masses, and firm discs of tissue under the areola of each breast. Which of the following is the most appropriate next step in treatment?

- A) Direct excision in the subareolar area, leaving a small button of tissue, and marginal breast liposuction
- B) Liposuction of entire breast with use of cutting cannula under the areola
- C) Reassessment in 9 months
- D) Testosterone replacement
- E) Wise pattern skin excision with nipple grafting

The correct response is Option C.

The patient appears to have benign pubertal gynecomastia, and many of these cases resolve spontaneously. The recommended treatment is observation and reassessment. Early surgery in these circumstances is usually reserved for patients experiencing more extreme psychological impact. Testosterone replacement would not be useful since by examination the patient appears to have an otherwise normal physiology. The three surgical interventions are all potential treatments for gynecomastia, but surgery is usually not recommended within the first six months of onset of gynecomastia in a pubertal male. The skin excision and nipple grafting option would be most useful if the patient had large quantities of fat and skin. The two techniques employing liposuction both might be adequate surgical techniques to address the type of gynecomastia this patient demonstrates, should surgery eventually become recommended.

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170. In augmentation mammoplasty, which of the following is the ideal upper pole to lower pole anatomic ratio?

- A) 25:75
- B) 35:65
- C) 45:55
- D) 50:50
- E) 55:45

The correct response is Option C.

Studies have demonstrated the ideal anatomical characteristics of the breast to include: an upward pointing nipple, a straight or mildly concave upper pole slope, smooth lower pole convexity and fuller lower pole compared to upper pole. Breasts with an upper pole-to-lower pole ratio of 45:55 were identified as defining the ideal breast. The ratio was defined ideal by respondents including women, men, plastic surgeons, and individuals of ethnic diversity.

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171. A 50-year-old woman comes to the office seeking cosmetic improvement of the lower eyelids. Transposition of a pedicled postseptal fat graft from the central compartment is planned through a transcutaneous approach. A preoperative photograph is shown. Which of the following is the most appropriate structure to release for transposition?

- A) Capsulopalpebral fascia
- B) Inferior oblique tendon
- C) Lockwood ligament
- D) Lower slip of the lateral canthal tendon
- E) Orbicularis retaining ligament

The correct response is Option E.

The orbicularis retaining ligament or the orbital malar ligament is a bilaminar membrane that spans from the periosteum of the inferior orbital rim to the fascia on the underside of the orbicularis. During aging, this ligament accentuates the orbital malar depression and restricts the orbital fat from blending with the sub oribularis oculi fat (SOOF). This patient presents with a prominent orbitomalar sulcus and tear trough deformity. Release of the medial portion of the orbicularis oculi muscle and the orbicularis retaining ligament allows fat transposition over the orbital rim, thus softening and improving this deformity. This procedure can be performed through either a transcutaneous or transconjunctival approach.

The capsulopalprebral fascia is a retractor of the lower eyelid. It is incised during a

transconjunctival fat excision. It is not incised in a transcutaneous approach.

The inferior oblique tendon of the inferior oblique muscle should be protected during lower eyelid surgery. Lockwood's ligament is a supportive structure of the globe. The inferior limb of the lateral canthal tendon is not released for fat transposition. It may be released for canthal support and repositioning.

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172. A 36-year-old woman with a BMI of 35 kg/m<sup>2</sup> undergoes liposuction of the anterior trunk, posterior trunk, and circumferential thighs. Which of the following is the minimum volume of lipoaspirate that can be classified as "large volume" liposuction?

- A) 1000 mL
- B) 2500 mL
- C) 5000 mL
- D) 7500 mL

The correct response is Option C.

Lipoaspirate volumes over 5000 mL are what are widely considered to define "large volume" liposuction. This distinction has relevance as it relates to postoperative care. Patients undergoing "large volume" liposuction are often considered for overnight observation as an inpatient admission. The other volumes (1000 mL, 2500 mL, and 7500 mL) are not the cutoffs for consideration as "large volume" liposuction.

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173. A 50-year-old man with a BMI of 36 kg/m<sup>2</sup> comes to the office for consultation regarding gynecomastia. He takes no medications. Physical examination shows no other abnormalities. Which of the following is the most likely cause of this patient's gynecomastia?

- A) Decreased circulating estrogen
- B) Decreased estrogen receptors
- C) Excessive androgen receptors
- D) Excessive aromatization of androgen to estrogen
- E) Increased circulating androgen

The correct response is Option D.

Gynecomastia is benign proliferation of breast tissue in men. It is present in 40 to 50% of men over 40 years of age. It can manifest in pubertal boys and in men of advanced years. The etiology can be variable and may be due to excess circulating estrogen, decreased circulating androgens, or a deficiency of androgen receptors. However, in middle-aged and older men, it is most commonly due to the excessive aromatization of androgens to estrogens. Initial evaluation requires a detailed history and physical examination to differentiate between fatty tissue, parenchymal enlargement, and a tumor. Mammography may be useful and biopsy may be indicated in some cases.

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174. A 50-year-old woman receives an injection of 0.5 mL of hyaluronic acid filler into each nasolabial fold. She returns to the office 30 minutes later because of pain and mottled skin discoloration of the nasal tip and right ala nasi. Which of the following is the most appropriate next step in management?

- A) Doppler ultrasonography
- B) Hyaluronidase injection
- C) Lidocaine injection
- D) Massage
- E) Prostaglandin E1 injection

The correct response is Option B.

This patient presents with signs and symptoms consistent with an intra-arterial injection of hyaluronic acid (HA), which requires emergency treatment to restore circulation.

Accidental intra-arterial injection of fillers leading to arterial compromise is a rare occurrence. When it occurs, devastating outcomes include blindness, stroke, skin necrosis, and permanent scarring. The presenting signs and symptoms may include pain, skin blanching, mottled skin discoloration, and slow capillary refill. The mainstay of treatment for intra-arterial injection of HA products is local injection of hyaluronidase into the site of injection and the local area of skin mottling. Hyaluronidase is an enzyme that catalyzes HA hydrolysis.

Other treatments include massaging the area in order to promote distribution of hyaluronidase, topical nitropaste, aspirin, and warm compresses. Secondary treatments that can be considered after hyaluronidase injection include hyperbaric oxygen, papavarin, prostaglandin E1, heparin, and lidocaine. Radiologic evaluation with Magnetic resonance angiogram (MRA) or Doppler ultrasound would only delay treatment. Massage alone will not benefit this patient.

Recommendations for risk reduction include the following: using large-bore blunt cannulas (27 gauge and larger), injecting less than 0.1-mL bolus in any single injection site, avoiding high-pressure injections, awareness of likely position of named vessels in the treatment area, using local anesthesia with epinephrine, and caution with deep injections around the radix, lateral nasal wall, and periorbital area.

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175. A 28-year-old woman suffered a wound dehiscence after an abdominoplasty. History includes a 70-lb (32-kg) weight loss over the past 5 years through diet and exercise. She is angry and wants to know why the separation happened. Which of the following is the most likely contributor to the development of this complication?

- A) Central rectus plication
- B) Discontinuous release of tissue over the costal margins
- C) Extensive undermining over the hips
- D) Liposuction of the bilateral mid flanks
- E) Liposuction of the central supraumbilical flap

The correct response is Option E.

Liposuction of the central supraumbilical flap may further impair blood supply to the area farthest from the remaining blood supply after undermining and is the most likely of the choices to cause wound healing complications. Extensive undermining over the hips is usually well tolerated and a component of most abdominoplasties. Central rectus plication, if too tight, may contribute to respiratory difficulty or umbilical loss due to constricted blood supply, but it is unlikely to directly relate to poor healing of the midline incisional skin and fat. Liposuction of the bilateral mid flanks (in contrast to the central supraumbilical flap) is usually well tolerated as it allows preservation of the blood supply traveling from the costal region into the flap. While wide undermining over the costal margins may promote poor wound healing of the advanced tissue at the superior aspect of the incision, tunneling or discontinuous release aimed at perforator preservation is a described technique to increase the ability to contour the upper abdomen without concomitant significant increase in wound healing complications.

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176. A 58-year-old woman with moderate ptosis is evaluated for mastopexy. According to Regnault classification, which of the following best describes the location of the nipple-areola complex in type II breast ptosis?
- A) 1 to 3 cm inferior to the inframammary fold
  - B) 4 cm inferior to the inframammary fold
  - C) 6 cm inferior to the inframammary fold
  - D) At or 1 cm inferior to the inframammary fold
  - E) Superior to the inframammary fold

The correct response is Option A.

Regnault classification of breast ptosis, based on the position of the nipple-areola complex (NAC) relative to the inframammary fold (IMF):

| Scale              | Criteria                                   |
|--------------------|--------------------------------------------|
| Pseudoptosis       | NAC is above the IMF                       |
| Type I (mild)      | NAC is at or 1 cm below the IMF            |
| Type II (moderate) | NAC is 1 to 3 cm below the IMF             |
| Type III (severe)  | NAC is at the lowest portion of the breast |

The type of mastopexy performed will depend on the degree of breast ptosis. Breast ptosis is graded using Regnault classification. Type I can be treated with a crescent mastopexy, when the degree of nipple-areola complex elevation does not exceed 1 cm. Type I or II ptosis can be treated with a periareolar mastopexy, when the distance of nipple-areola complex elevation ranges from 1 to 2 cm. Type II and III ptosis is amenable to the inverted-T technique, where the horizontal incision will reduce the distance from the nipple-areola complex to the inframammary fold, while the vertical incision will reduce the base diameter.

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2. Nahabedian MY. Breast deformities and mastopexy. *Plast Reconstr Surg*. 2011 Apr;127(4):91e-102e.

177. A 48-year-old woman, gravida 3, para 3, who wears a size 36B bra comes to the physician for evaluation of breast ptosis. BMI is 24 kg/m<sup>2</sup>. Physical examination shows the distance from sternal notch to nipple is 28 cm, and there is grade 2 breast ptosis with skin laxity. A combined augmentation/mastopexy is planned. Which of the following is the biggest risk of combining the procedures rather than staging them?

- A) Hematoma
- B) Need for revision procedure
- C) Nipple-areola complex necrosis
- D) Seroma
- E) Transection of lateral intercostal nerves

The correct response is Option B.

Combining an augmentation with a mastopexy has long been considered risky because the surgeon is addressing two opposing forces during the same operation: the ptosis and volume, for which the placement of additional weight may exacerbate ptosis. Studies have shown, however, that the two operations can safely be combined. During the planning, particularly for severe ptosis, the surgeon must be careful not to overresect skin that will be critical for closure over an implant.

Compared with staged procedures, mastopexy-augmentation has a higher rate of need for revision procedures. Patients should be counseled about the potential need for revisions.

Seroma and hematoma are not increased when combining the procedures, and nipple-areola complex necrosis is a function of pedicle size and patient-specific factors such as obesity and tobacco use, rather than the combination of procedures. Similarly, transection of intercostal nerves is associated more closely with pedicle type than with combining procedures.

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178. Which of the following structures is an anatomical component of the internal nasal valve?

- A) Anterior portion of the middle turbinate
- B) Caudal edge of the upper lateral cartilage
- C) Cribriform plate of the ethmoid
- D) Ostium of the maxillary sinus
- E) Superior border of the nasal bone

The correct response is Option B.

The internal nasal valve is an anatomical structure composed of several parts. Its cross-sectional dimension determines the quantity of airflow that passes through the nose while breathing both at rest and during exercise. Because it is the narrowest part of the entire airway, compromise of any of its elements correlates with symptoms of nasal obstruction. The internal nasal valve is bounded by the caudal border of the upper lateral cartilage superiorly, the nasal septum medially, the floor of the nasal vestibule inferiorly, the anterior part of the inferior turbinate posteriorly, and the bony edge of the pyriform aperture laterally. Internal nasal valve narrowing may be due to one or more of several factors, including septal deviation, turbinate hypertrophy, collapse of the upper lateral cartilage due to surgical disruption of the ligaments which support it to adjacent structures, and loss of cartilage strength due to aging. A variety of techniques have been described for restoration of the internal valve function. Most of these involve stiffening the upper lateral cartilage with cartilage graft struts, submucous resection of the nasal septum, reduction of hypertrophic turbinates, or combinations of these procedures.

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179. A 54-year-old woman with *BRCA* mutation is scheduled for a bilateral nipple-sparing mastectomy. Which of the following would lead to the highest risk for postoperative nipple necrosis?

- A) Grade 2 breast ptosis
- B) Periareolar mastectomy incision
- C) Previous excisional breast scar
- D) Tumor greater than 1.5 cm
- E) Use of smooth round gel implants

The correct response is Option B.

Nipple-sparing mastectomy and direct to implant reconstruction is becoming increasingly popular in the setting of prophylactic mastectomies. The criteria for nipple-sparing mastectomies have been increased to tumors not involving the nipple-areola complex, with some surgeons requiring a distance of 2 cm from the nipple and others espousing just a clean surgical margin at the nipple. Nipple-sparing mastectomies do not require recreating the breast envelope and therefore direct to implant reconstruction is possible. Increased risk for incidence of nipple necrosis in the setting of direct to implant reconstruction is associated with mastectomy incision involving the areola. The use of smooth round gel implants, grade 2 ptosis, tumor size, or previous breast biopsy scars are not associated with nipple necrosis.

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180. A 65-year-old man is prescribed leuprolide acetate for prostate cancer. Which of the following is the most likely effect the drug will have on this patient's breasts?

- A) Darkening of the nipple-areola complex
- B) Decrease in size
- C) Galactorrhea
- D) Mastodynia
- E) Petechiae

The correct response is Option D.

Leuprolide acetate (Lupron) is used in the treatment of certain cancers, including prostate, endometriosis, and precocious puberty. Because it is a synthetic gonadotropin-releasing hormone (GnRH), it acts as an agonist of pituitary GnRH receptors. Its ultimate effect is a lowering of estradiol and testosterone levels through downregulation of luteinizing hormone and follicle-stimulating hormone secretion.

Gynecomastia and breast tenderness are known side effects of leuprolide treatment for prostate cancer. Selective estrogen receptor modulators (SERMs), such as tamoxifen, are recommended for the prevention of gynecomastia as a result of antiandrogen monotherapy. Radiation as well has been shown to decrease the breast side effects of leuprolide acetate. Thus, an increase in size, rather than a decrease in size is expected. Darkening of the nipple areolar complex is often associated with pregnancy, but not leuprolide acetate. Galactorrhea is associated with drugs—commonly drugs that contain dopamine depleting agents, such as methyl dopa, that cause receptor block (such as Reglan), and that inhibit release, such as codeine and morphine. Histamine receptor blockade, from drugs such as cimetidine, can also cause galactorrhea. Pituitary tumors are also a cause of galactorrhea.

A thorough assessment of all medications and medical history is necessary for evaluation of a patient with gynecomastia and mastodynia.

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181. Compared with reduction mammoplasty excisional techniques, which of the following is characteristic of liposuction-only reduction mammoplasty?

- A) Does not typically impair breast-feeding potential
- B) More effectively treats ptosis
- C) Poses a higher risk to the blood supply of the nipple-areola complex
- D) Results in a higher incidence of impaired sensation to the nipple-areola complex
- E) Results in minimal swelling postoperatively

The correct response is Option A.

Liposuction-only reduction mammoplasty does not involve the use of a pedicle to ensure blood supply to the nipple. The nature of liposuction involves leaving major vessels and nerves intact and therefore does not pose an increased risk for blood supply loss to the nipple-areola complex. In addition, sensation to the breast as well as to the nipple-areola complex is not typically impaired following liposuction-only reduction mammoplasty. For similar reasons, breast-feeding potential is not typically compromised. The recovery from liposuction-only reduction mammoplasty can be quite significant, and it can take about 6 weeks for bruising and swelling to decrease and about 6 months for the breast to soften and for lumpiness to settle. Liposuction-only reduction mammoplasty does not work well when breast tissue is mostly glandular and thus has limited usefulness in those patients in whom it may seem most desirable, such as teenagers. Liposuction-only reduction mammoplasty does not more effectively treat ptosis.

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182. A healthy 42-year-old woman undergoes bilateral reduction mammoplasty for symptomatic breast hypertrophy. Pathologic analysis of one of the tissue specimens shows ductal carcinoma in situ. Which of the following percentages best represents the incidence of this finding in a reduction mammoplasty specimen?

- A) 1%
- B) 7%
- C) 10%
- D) 12%
- E) 25%

The correct response is Option A.

The histologic finding is consistent with a diagnosis of ductal carcinoma in situ (DCIS). The incidence of occult breast cancer in reduction mammoplasty specimens most closely approximates 1%. Invasive ductal carcinoma is the most common malignant lesion identified, but DCIS, lobular carcinoma in situ, Paget disease, and fibrosarcoma have also been reported less frequently. All breast tissue removed from women older than 40 years should be sent to pathology for microscopic analysis.

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3. Pitanguy I, Torres E, Salgado F, et al. Breast pathology and reduction mammoplasty. *Plast Reconstr Surg*. 2005 Mar;115(3):729-34; discussion 735.
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183. Which of the following cell types is most associated with the chronic inflammation that leads to breast implant–associated anaplastic large cell lymphoma?

- A) B-cells
- B) Monocytes
- C) Neutrophils
- D) Red blood cells
- E) T-cells

The correct response is Option E.

Evidence suggests that chronic inflammation is the stimulus responsible for the development of breast implant–associated anaplastic large cell lymphoma (ALCL) and T-cells are the predominant cell type responding to this antigenic stimulus. B-cells have been implicated in orthopedic implant lymphomas. The other cell types are involved in inflammation, but they are not associated with breast implant-associated ALCL.

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184. For aesthetic analysis, the face can be divided into which of the following segments?

- A) Equal horizontal fifths and vertical fifths
- B) Equal horizontal fifths and vertical thirds
- C) Equal horizontal thirds and vertical fifths
- D) Equal horizontal thirds and vertical thirds
- E) There is no regular division of the face into horizontal or vertical proportions

The correct response is Option C.

Aesthetic analysis of the face may be simplified by dividing the face into equal horizontal thirds and vertical fifths. The length of the face is divided into equal thirds as follows:

- The upper third includes the forehead and brows, extending from the anterior hairline to the glabella and brows.
- The middle third includes the midface, eyes, and nose and extends from the glabella to the subnasale.
- The lower third includes the lower cheeks, jawline, and neck and extends from the subnasale to the menton.

The width of the face may be divided into equal fifths by lines dropped from the lateral canthi and lines dropped from the medial canthi, with each partition approximating the width of the horizontal palpebral fissure. Of note, the lines dropped from the lateral canthi should approximate the width of the neck and the lines dropped from the medial canthi should approximate the distance between the left and right alar-facial grooves.

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185. A 38-year-old woman reports decreased areola sensitivity after undergoing mastopexy. Intraoperative injury to which of the following nerves is the most likely cause of this patient's reduced sensitivity?

- A) Intercostobrachial nerve
- B) Lateral cutaneous branch of the fourth intercostal nerve
- C) Lateral cutaneous branch of the sixth intercostal nerve
- D) Medial cutaneous branch of the fifth intercostal nerve
- E) Medial cutaneous branch of the third intercostal nerve

The correct response is Option B.

The lateral cutaneous branch of the fourth intercostal nerve is most commonly responsible for nipple and areola sensitivity. The other intercostal nerve branches listed do contribute to breast sensitivity but are less often thought to be the primary innervation to the nipple and areola. The intercostobrachial nerve supplies innervation to the upper medial arm.

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186. A 42-year-old woman comes to the clinic because of numbness of the right arm that extends from the mid arm to the medial aspect of the forearm to the wrist 5 weeks after undergoing bilateral brachioplasty. Which of the following operative techniques is most likely to decrease the risk for this numbness while adequately correcting the deformity?

- A) Dissecting adjacent to the muscle fascia throughout the length of the arm
- B) Dissecting deep to the muscle fascia throughout the length of the arm
- C) Leaving a 1-cm cuff of fat overlying the deep fascia throughout the length of the arm
- D) Performing a skin-only resection

The correct response is Option C.

The medial antebrachial cutaneous (MABC) nerve arises from the medial cord of the brachial plexus and innervates the medial arm and forearm. Distal to the axilla, the MABC nerve travels with the basilic vein. Anatomic studies have shown that the nerve penetrates the deep fascia approximately 14 cm proximal to the medial epicondyle relatively consistently. It is vulnerable during brachioplasty because of this position. The recommended technique to protect the medial antebrachial cutaneous (MABC) nerve is to leave a 1-cm cuff of fat overlying the deep fascia. A smaller cuff is inadequate to protect the nerve.

In cases where the brachioplasty dissection must extend distal to the elbow, one can minimize injury to the nerve by maintaining a dissection plane superficial to the deep brachial fascia and transitioning to the subcutaneous plane below the elbow.

A skin-only resection is unlikely to adequately correct the defect. Dissecting adjacent to, or deep to, the subcutaneous fascia places the nerve at risk because of the depth of the dissection.

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2. Shermak, MA. Aesthetic refinements in body contouring in the massive weight loss patient: Part 2. Arms. *Plast Reconstr Surg.* 2014 Nov;134(5):726e-735e.

187. A 34-year-old man comes to the office for a routine follow-up examination 1 month after undergoing extensive micrograft hair transplantation. He is extremely upset, complaining that "all the grafts have fallen out and are gone." Which of the following is the most appropriate response to this patient's concerns?

- A) Loss of hair shaft is expected and part of the normal healing process
- B) Loss of the grafts is a potential complication that was explained preoperatively
- C) More grafts will be performed without additional surgical fees
- D) The patient should wait and see what happens and return to the office in several months
- E) The patient will be started on finasteride immediately

The correct response is Option A.

Hair shaft loss is to be expected after the first month following implantation as the hair follicles enter into the telogen phase. Initially, hair grafts enter the catagen phase of hair growth, which is a transitional phase. Implanted hair can grow 3 to 4 mm at this time. Following this stage, implanted hair grafts enter the telogen phase or the “resting” phase, which lasts for 3 to 4 months. During this phase, the attachment of the hair at the base of the follicle becomes weaker until the hair finally sheds, and the hair follicle is inactive and hair growth ceases. Almost every implanted hair falls out during this time, and patients must be prepared for this preoperatively. This phase can last up to 6 to 9 weeks, and this is when patients worry most about whether the surgery was indeed a success. Following this time, the anagen phase begins, generating new hair growth, which is initially quite thin. This hair then grows thicker with time. Final results of hair transplantation are not evident until 6 to 8 months in men and 10 to 12 months in women.

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188. A healthy 40-year-old woman is scheduled for bilateral brachioplasty along with liposuction of the upper arms. Which of the following is the most common unfavorable outcome of this combined procedure?

- A) Hematoma
- B) Hypertrophic scar
- C) Infection
- D) Sensory nerve injury
- E) Wound dehiscence

The correct response is Option B.

Adverse scarring is a common complication after brachioplasty and can warrant surgical revision in some cases. Liposuction of the arm with concomitant brachioplasty is a well-described and safe procedure. Along with seromas, recent studies show that hypertrophic scarring is the most common adverse outcome after this combined procedure. Other adverse outcomes such as hematoma, infection, and wound dehiscence are less frequently encountered. Sensory nerve injury, especially the medial antebrachial nerve, is possible, although it is much less likely than the incidence of hypertrophic scarring.

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2. de Runz A, Colson T, Minetti C, et al. Liposuction-assisted medial brachioplasty after massive weight loss: an efficient procedure with a high functional benefit. *Plast Reconstr Surg*. 2015 Jan;135(1):74e-84e.
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189. A 55-year-old woman comes to the office for facial rejuvenation surgery. Rhytidectomy with a high superficial musculoaponeurotic system flap and plication of the platysma are planned. In comparison with general anesthesia, the primary advantage of intravenous sedation in this patient is decreased risk for which of the following?

- A) Deep venous thrombosis
- B) Hematoma
- C) Infection
- D) Prolonged operative time
- E) Skin necrosis

The correct response is Option A.

The risk for deep venous thrombosis (DVT) is decreased in many plastic surgical procedures when intravenous sedation is used instead of general anesthesia. Intravenous sedation avoids the need for muscle relaxant and the associated loss of peripheral vascular resistance.

Many rhytidectomy patients are at elevated risk for DVT; however, utilizing chemoprophylaxis will increase the hematoma risk and potentially jeopardize the final surgical result. Switching to an intravenous sedation technique is a safe and easy alternative for lowering DVT risk.

The incidence of hematoma, infection, and skin necrosis have not been linked with this type of anesthesia. Intravenous sedation can be associated with increased operative time for the rare patient who is resistant to sedation.

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190. Which of the following is the most common histologic effect of skin treatment with tretinoin?

- A) Decrease in angiogenesis
- B) Decrease in mucin
- C) Increase in collagen
- D) Increase in melanin
- E) Thinning of the epidermis

The correct response is Option C.

Retinoids pass through the cell wall via nonreceptor-mediated endocytosis, are carried to the nucleus on cellular retinoic acid-binding proteins (CRABP, CRABP-II), and exert their effect through binding to retinoic acid receptors and retinoid X receptors. The retinoid-receptor complex binds to the promoter gene in the region of the retinoid response elements, resulting in production of proteins responsible for effects we see histologically and grossly.

In sun-damaged skin, the major findings histologically are reduced collagen quantity and dermal collagen disorder. Retinoids have come to be a mainstay in the treatment of photodamaged skin due to their ability to repair this damage. The effects noted histologically of retinoids on photodamaged skin include increased quantity of collagen (types I, III, and VII), greater organization of the collagen within the dermis, improved organization of elastic tissue, epidermal hyperplasia, increased mucin deposition (epidermal and dermal), and decreased melanin, among others. These histologic changes translate into improvement in rhytides, smoother skin, and correction of dyschromia.

Thinning of the epidermis is incorrect because retinoids result in epidermal hyperplasia.

Decrease in mucin deposition is incorrect because retinoids result in increased mucin deposition.

Decrease in angiogenesis is incorrect because retinoids result in increased angiogenesis in the skin.

Increase in melanin is incorrect because retinoids result in a decrease in melanin content of the skin.

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191. A 35-year-old woman undergoes suction-assisted lipectomy of the bilateral arms using a tumescent technique. A total of 500 mL of aspirate is recovered. She is discharged home the same day, and returns to the emergency department 8 hours after discharge. Lidocaine toxicity is suspected. Which of the following symptoms is most likely in this patient?

- A) Anisocoria
- B) Petechial rash of the neck and axillae
- C) Supraventricular tachycardia
- D) Tachypnea
- E) Tinnitus

The correct response is Option E.

Although safe doses of lidocaine in tumescent solution can reach 35 mg/kg, lidocaine toxicity is still a risk. Peak plasma levels of lidocaine, when injected into fatty tissue, occur 10 to 14 hours after infiltration.

Lidocaine toxicity symptoms include neurologic or cardiac toxicity. In the early stages, the complications are primarily neurologic, and can include slurred speech, restlessness, tinnitus, and a metallic taste, as well as numbness of the mouth. As the concentrations increase, the neurologic concentrations become more severe, and can progress to muscle twitching, seizures, and cardiac arrest. Treatment of lidocaine toxicity is supportive.

A petechial rash of the neck and axillae is a typical sign of fat embolism, and tachypnea is a typical sign of a pulmonary embolism. Anisocoria can be a benign finding, although if it is a new finding, it is suggestive of Horner syndrome or a brain aneurysm.

Supraventricular tachycardia (SVT) refers to tachycardia that occurs above or at the atrioventricular node. Paroxysmal SVT, atrial fibrillation, and Wolff-Parkinson-White syndrome are the most common forms of SVT. SVT can cause syncope and long-term cardiac damage.

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192. A 30-year-old woman with symptomatic macromastia is scheduled for a Wise pattern breast reduction. Which of the following postoperative complications is most likely in this patient?

- A) Delayed wound healing
- B) Fat necrosis
- C) Hematoma
- D) Hypertrophic scarring
- E) Tear-drop deformity of the nipple-areola complex

The correct response is Option A.

In the 2005 prospective, multicenter trial of 179 patients by Cunningham, Gear, Kerrigan and Collins, reduction mammoplasty had an overall complication rate of 43%. The most common complication was delayed wound healing (21.6%), followed by spitting sutures (9.2%), hematoma (3.7%), nipple necrosis (3.6%), hypertrophic scars (2.5%), fat necrosis (1.8%), seroma (1.2%), and infection (1.2%).

Delayed wound healing correlated directly with average preoperative breast volume, average resection weight per breast, and smoking; and inversely with patient age. In this study, vertical techniques had a higher overall rate of complications.

In the Stevens, et al. report of their 11-year experience with outpatient breast reduction, delayed wound healing was also the most common complication.

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193. Parents of a healthy 3-day-old male newborn request consultation for management of their child's bilateral lop ear deformities. Which of the following is the most appropriate next step in management?
- A) Await spontaneous correction
  - B) Fit the infant's head and ears for a helmet
  - C) Initiate ear molding devices immediately
  - D) Prescribe oral estrogen blocker therapy
  - E) Schedule bilateral otoplasty surgery at age 3 months

The correct response is Option C.

Newborn infant ear deformities, in order of frequency, are prominent/cup ear, lop ear, mixed deformities, Stahl ear, helical rim anomalies, conchal crus deformity, and cryptotia. Bilateral congenital ear deformities occurred in 70% of 340 patients in one study, with unilateral involvement in 30%. While surgical correction of deformed ears constituted the mainstay of therapy for decades, more recent developments in ear molding techniques have demonstrated 90% success in some studies. The presence of circulating maternal estrogen is blamed for lack of helical cartilage rigidity. This fact allows clinicians to shape the ear and, if pursued for a sufficient period of time, therapy will eliminate the deformity without need for surgical intervention. For the technique to be maximally effective, molding should be initiated by the end of the first week after birth. When begun even a few weeks later, the success rate falls to 50%. Surgical intervention is more likely to be performed just before the child reaches preschool age, allowing the ear to reach most of its adult size first. Helmets may have applicability in cranial reshaping but are not suited for management of deformed ears. Oral medication of any kind is unlikely to affect ear shape. Awaiting spontaneous correction as the child ages is the least likely means of achieving corrected ear shaping.

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194. In bilateral component separation for abdominal wall reconstruction, which of the following points is most likely to be the area of greatest advancement?

- A) Arcuate line
- B) Ligament of Treitz
- C) Suprapubic
- D) Umbilicus
- E) Xyphoid

The correct response is Option D.

Component separation for abdominal wall reconstruction involves release of the fascia lateral to the rectus abdominus muscles, just lateral to the semilunar line, dissecting the external oblique off the internal oblique muscles. This creates innervated musculofascial flaps that can be advanced medially for closure of ventral hernias. If the posterior rectus sheath is also dissected free, further advancements can be gained. Per rectus muscle, approximately 4 cm can be gained at the epigastric and suprapubic areas; 10 cm can be advanced at the waist. Therefore, the most advancement can be gained at the umbilicus, which is in the area of the waist. The xyphoid and ligament of Treitz are in the epigastric area, while the arcuate line is in the suprapubic area.

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195. An otherwise healthy 16-year-old girl comes to the office because of a painless mass in the left breast. Physical examination of the left breast discloses a circumscribed firm, rubbery, 3-cm mass without overlying skin changes, and no axillary lymphadenopathy. Results of a pregnancy test are negative. Which of the following is the most likely diagnosis?

- A) Common fibroadenoma
- B) Giant fibroadenoma
- C) Lactating adenoma
- D) Phyllodes tumor
- E) Tubular adenoma

The correct response is Option A.

A common fibroadenoma is the most likely diagnosis of this patient. Common fibroadenoma is the most common breast tumor in adolescent females and present between the ages of 14 and 16.

Juvenile fibroadenoma is a variant of fibroadenoma and is usually seen in adolescents and young adults. It is associated with a normal stromal/epithelial balance, which distinguishes it from phyllodes tumor, and has both stromal and epithelial hyperplasia. In addition, juvenile fibroadenomas are characterized by rapid growth.

A giant fibroadenoma is a clinical diagnosis, rather than a pathologic diagnosis. It is characterized by its size, usually greater than 5 cm.

Complex fibroadenoma is characterized by fibrocystic changes on glandular tissue with underlying features of common fibroadenoma on pathologic analysis.

A tubular adenoma has glandular proliferation on pathologic analysis, and while it is a subtype of fibroadenoma, it is not as common as common fibroadenoma. A lactating adenoma, similarly, is defined by the presence of secretory hyperplasia of lobules on pathologic analysis. Lactating adenomas are so defined because of the histologic presence of secretory hyperplasia, and they commonly occur in pregnant or lactating women. Many lactating adenomas will spontaneously regress.

A phyllodes tumor is typically a large, rapidly growing lesion and can be either benign or malignant. It is rare in adolescents, but when found, is usually aggressive. Phyllodes tumor is related to fibroadenoma and is distinct from other forms of breast cancer. Treatment is wide local excision.

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196. A 45-year-old woman comes to the office because of deep rhytides caused by photoaging. Topical application of 35% trichloroacetic acid in combination with Jessner solution is planned. Which of the following best describes the clinical endpoint during application of this chemical peel?

- A) Dark firm eschar
- B) Grey hue
- C) Hypopigmentation
- D) Transparent frost with a pink background
- E) Uniform deep white frost

The correct response is Option E.

The deep white frost indicates the endpoint for the depth of skin penetration with a deep rhytid chemical peel such as the combination Jessner/35% trichloroacetic acid solution. This indicates that the peel has penetrated into the upper reticular dermis. There is no pink hue because at this level there is vasospasm of the capillaries in the papillary dermis. This depth of penetration is for moderate and deep rhytides. This is a transient phenomenon. Capillary refill should return within 20 to 40 minutes.

A transparent frost with a pink background is the endpoint for a superficial peel, such as that done with a trichloroacetic solution (<30%) alone. This frost is due to the coagulation of proteins in the dermis and epidermis. The pink hue emanates from blood vessels that remain intact in the papillary dermis.

A grey hue indicates a deeper penetration with destruction to the dermis. This level of penetration could lead to abnormal healing, scarring, pigmentation, and texturing changes. Hypopigmentation and superficial epidermolysis are potential complications of a chemical peel and not clinical endpoints to determine depth of penetration.

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197. An overweight 36-year-old woman who underwent full abdominoplasty by another surgeon 6 months ago is referred to the office from the emergency department because of persistent pain around the right lower quadrant of the abdomen with concomitant paresthesia to the lateral thigh. The patient reports her postoperative course was unremarkable. Abdominal CT scan from the emergency department shows postsurgical changes and an 8 x 1-cm linear fluid collection subjacent to the incision. Which of the following is the most appropriate next step in management?

- A) Administer oral gabapentin
- B) Apply compression garment
- C) Inject a local anesthetic
- D) Massage the scar
- E) Surgically explore the wound

The correct response is Option C.

In the absence of other postoperative findings, damage to or entrapment of the lateral femoral cutaneous nerve (LFCN) is the most likely cause of this patient's symptoms. The LFCN exits the abdomen near the anterior superior iliac spine and is the most commonly injured nerve during abdominoplasty (incidence of 1.36%).

If a nerve injury is suspected, the diagnosis can be confirmed by injection of local anesthetic just proximal to the location of the pain or Tinel sign. Conservative treatment includes scar massage and physical therapy aimed at desensitization techniques. These nonoperative treatments can be combined with an oral anticonvulsant such as gabapentin for pain management in the short term. More severe or debilitating symptoms may warrant earlier surgical intervention. However, a local anesthetic nerve block is diagnostic and is indicated prior to either conservative or surgical treatment.

A compression garment would be neither therapeutic nor diagnostic for this patient.

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198. A 47-year-old woman, gravida 2, para 2, who has grade III breast ptosis is evaluated for mastopexy. Attenuation of which of the following structures is the most likely cause of the ptosis?

- A) Breast acini
- B) Cooper ligaments
- C) Lactiferous ducts
- D) Scarpa's fascia
- E) Subdermal plexus

The correct response is Option B.

Breast ptosis is a complex interaction of events, informed by breast size, gravity, aging, lactation, and parity. It occurs through a combination of atrophy of the breast tissue, loss of elasticity of the skin envelope, and attenuation of Cooper ligaments.

While the breast is surrounded by fascia, the continuation of Scarpa's fascia forms the posterior capsule of the breast.

The lactiferous ducts and breast acini do not contribute significantly to ptosis.

Subdermal plexus provides vascularity rather than support to the breast.

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2. Netter FH, ed. *Atlas of Human Anatomy*. 6th ed. Saunders, 2014.

199. A 28-year-old man is evaluated after sustaining a laceration across the ear from the tragus to the antitragus. A ring block of the ear using 1% lidocaine is performed prior to repair. The patient reports pain when the conchal skin near the external auditory canal is sutured. Which of the following nerves is most likely NOT anesthetized in this patient?

- A) Auricular branch of the vagus (X) nerve
- B) Branch of the glossopharyngeal (IX) nerve
- C) Great auricular (C2, C3) nerve
- D) Lesser occipital (C2, C3) nerve
- E) Trigeminal (V2) nerve

The correct response is Option A.

The auricular branch of the vagus (X) nerve (Arnold's nerve) innervates the external auditory canal and conchal area of the ear. This would not be blocked with a ring block. Direct infiltration of this area is needed.

The lesser occipital nerve innervates the superior pinna. A branch of the glossopharyngeal nerve innervates the middle ear. The trigeminal nerve does not innervate the ear. The great auricular nerve innervates the lobule and the majority of the pinna.

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200. Which of the following best describes the mechanism of inhibition of muscle contraction by botulinum toxin type A?

- A) Binds to acetylcholine in presynaptic nerves, degrading acetylcholine
- B) Binds to acetylcholine in postsynaptic nerves, degrading acetylcholine
- C) Binds to acetylcholine in postsynaptic nerves, preventing acetylcholine interaction with nicotinic receptors
- D) Binds to nicotinic receptor sites on the neuromuscular junction, blocking acetylcholine stimulation
- E) Binds to receptor sites in presynaptic nerve terminals, blocking acetylcholine release

The correct response is Option E.

Botulinum toxin type A works by binding to receptor sites in presynaptic nerves to prevent the release of acetylcholine into the synapse of neuromuscular junctions.

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# Section 5: Core Surgical Principles

201. A 154-lb (70-kg), 42-year-old woman undergoes wide-awake flexor tendon repair during local anesthesia. The surgical area is infiltrated with a total of 20 mL of 1% lidocaine with epinephrine. To minimize bleeding, which of the following is the optimal timing between injection of the anesthetic and initiation of the incision?
- A) 5 minutes
  - B) 10 minutes
  - C) 15 minutes
  - D) 25 minutes
  - E) 45 minutes

The correct response is Option D.

Wide-awake hand surgery has been successfully performed for a number of procedures including nerve decompression, excision of soft-tissue tumors, fracture repair, arthrodesis, tendon repair, and fasciectomy for Dupuytren disease. The wide-awake technique allows the surgeon to perform the procedure without general anesthetic or sedation and often without the use of a tourniquet to minimize tourniquet pain. In order to successfully use this technique, a bloodless field is paramount, and allowing the epinephrine to achieve maximal vasoconstrictive effect is essential.

A prospective, randomized, triple-blind study was performed comparing the subcutaneous hemoglobin level at various times in patients after undergoing local anesthetic infiltration of lidocaine with epinephrine in one arm and plain lidocaine in the contralateral arm as the control. This study demonstrated that the lowest cutaneous hemoglobin level in the epinephrine group was obtained 25.9 minutes after injection. This is considerably longer than the 7 to 10 minutes often cited in the literature. The authors recommend waiting 25 minutes after injection if optimal visualization is desired.

## REFERENCES:

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2. McKee DE, Lalonde DH, Thoma A, et al. Optimal time delay between epinephrine injection and incision to minimize bleeding. *Plast Reconstr Surg*. 2013 Apr;131(4):811-4.
3. Lalonde D, Bell M, Benoit P, et al. A multicenter prospective study of 3,110 consecutive cases of elective epinephrine use in the fingers and hand: the Dalhousie Project clinical phase. *J Hand Surg Am*. 2005 Sep;30(5):1061-7.

202. A 30-year-old man with AIDS is evaluated for a 6-week history of painless but increasing swelling of the flexor surfaces of the right wrist. Physical examination shows limited motion of the wrist and positive Phalen and Tinel signs. At the time of surgical exploration, rice bodies are present in the flexor tenosynovium. Which of the following is the most likely diagnosis in this patient?

- A) *Aspergillus fumigatus*
- B) *Mycobacterium tuberculosis*
- C) *Nocardia asteroides*
- D) *Sporothrix schenckii*
- E) *Vibrio vulnificus*

The correct response is Option B.

Rice bodies are pathognomonic for tuberculosis.

Ziehl-Neelsen staining confirms the presence of acid-fast bacilli. All *Mycobacterium* and *Nocardia* species are potentially acid-fast. Many of these organisms are fastidious, so false-negative results are common. Surgeons should obtain multiple tissue samples and alert the laboratory that a diagnosis of tuberculosis is suspected. *M. tuberculosis* is traditionally cultured in Löwenstein-Jensen culture medium under specific temperature conditions 37.0°C (98.6°F). Histologic examination of specimens shows a granulomatous inflammatory process with the central portion of the granulomas appearing caseated.

If a mycobacterial infection is suspected, a Mantoux test should be performed. The test involves purified protein derivative injection into the dermis and evaluation of the cutaneous site after 48 to 72 hours.

*M. tuberculosis* should be considered in all immunocompromised patients. The other organisms can all be seen in hand infections in immunocompromised patients but do not produce rice bodies.

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1. Dennis L. Stevens et al. Practice Guidelines for the diagnosis and management of skin and soft tissue infections. *Clin Infect Dis*. 2005;41:1373-407 (1394-406).
2. Huyen HA, Lacey SH, Graham TJ. Atypical hand infections. *Hand Clin*. 1998 Nov;14(4):613-634.

203. A 24-year-old, right-hand–dominant man is brought to the emergency department after sharp amputation of the index, long, and ring fingers of the left hand at the middle phalanx level sustained in a rollover motor vehicle collision. The digits are appropriately preserved. Before replantation surgery is performed, which of the following is the most appropriate next step in management?
- A) Administer aspirin orally
  - B) Administer subcutaneous heparin
  - C) Obtain cervical spine x-ray
  - D) Obtain x-rays of the hand and digits
  - E) Predissection of the amputated digits

The correct response is Option C.

The NEXUS Criteria were developed to help physicians determine whether cervical spine imaging could be safely avoided in appropriate patients. The NEXUS literature defines a distracting injury as “a condition thought by the clinician to be producing pain sufficient to distract the patient from a second (neck) injury.” Similarly, the Canadian C-spine rule describes distracting injuries as “injuries [...] that are so severely painful that the neck examination is unreliable.” It also must be recognized that the surgeon and ER staff can be “distracted” by what appears to be the overwhelming injury. Trauma evaluation algorithms strictly apply.

A patient involved in a rollover motor vehicle accident has significant mechanism of injury to warrant a complete trauma evaluation.

All other answers here are appropriate to prepare for the operating room AFTER the initial trauma clearance is obtained.

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2. Stiell IG, Wells GA, Vandemheen KL, Clement CM, et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA*. 2001;286:1941-1848.

3. Hoffman KR, Mower WR, Wolfson AB, Todd KH, Zucker MI. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. *NEJM*. 2000;343:94-99.

204. A 26-year-old woman who is at 32 weeks' gestation sustains a traumatic head injury during a boating collision. CT scan shows subarachnoid hemorrhage and pan-facial fractures. The patient is cleared by the neurosurgeon for facial fracture repair. In the ICU, blood pressure is 112/70 mmHg and heart rate is 95 bpm. Fetal monitoring shows no distress. The patient is taken to the operating room and placed in supine position. On the operating table, blood pressure is 80/50 mmHg and heart rate is 130 bpm. Which of the following is the most appropriate next step in management?

- A) Administer fluid bolus intravenously
- B) Logroll the patient to the left
- C) Obtain immediate chest x-ray study
- D) Prepare and drape the patient for the planned procedure
- E) Start vasopressors

The correct response is Option B.

The most appropriate next step in this scenario is to logroll the patient 4 to 6 inches (or 15 degrees) to the left, decompressing the inferior vena cava (IVC). Women in the second half of pregnancy may become hypotensive when placed in the supine position, caused by compression of the inferior vena cava by the enlarged uterus, reducing venous return to the heart by up to 30%. Spinal precautions should be maintained for any patient whose spine has not been appropriately cleared.

Vasopressors should be used as a last resort in restoring the blood pressure of pregnant trauma patients, as these drugs further reduce uterine blood flow, resulting in fetal hypoxia. The placental vasculature is exquisitely sensitive to catecholamine stimulation.

Crystalloid fluid resuscitation would be indicated if the patient's vital signs did not return to baseline after repositioning and IVC decompression. Similarly, a chest X-ray could be obtained as part of the workup for unresponsive hypotension.

Ignoring this patient's hemodynamic changes and proceeding with surgery would be a mistake, as the placenta would most likely be deprived of vital perfusion, resulting in fetal distress.

## REFERENCES:

1. Lucia A, Dantoni, SE. Trauma Management of the Pregnant Patient. *Crit Care Clin*. 2016 Jan;32(1):109-17.
2. Trauma in Pregnancy and Intimate Partner Violence. American College of Surgeons, ed. In: American College of Surgeons, prof ed. *Advanced Trauma Life Support - Student Course Manual*. 9th ed. Chicago, IL: American College of Surgeons; 2012:286-97.

205. A 50-year-old man recently enrolled in a new health insurance plan under the Affordable Care Act. Which of the following benefits is NOT offered as a basic service to this patient?

- A) Dental care
- B) Mental health and substance use treatments
- C) Prescription drugs
- D) Preventative services
- E) Rehabilitation services

The correct response is Option A.

The Affordable Care Act (ACA) signed into law in 2010 began enrollment in 2013. One of the most fundamental components of the ACA was that any new health insurance plan must offer ten “Essential Health Benefits.” These include: 1) outpatient care; 2) emergency room visits; 3) hospitalization; 4) maternity and newborn care; 5) mental health and substance use treatments; 6) prescription drugs; 7) rehabilitation and rehabilitative services and devices; 8) laboratory tests; 9) preventative services and chronic disease care; and 10) pediatric services including dental and vision. Because the individual in the vignette is 50 years old, his new plan will not cover basic dental services.

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1. Chen J, Israel J, Poore SO, et al. The Affordable Care Act: a primer for plastic surgeons. *Plast Reconstr Surg*. 2014 Nov;134(5):830e-8377e.
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206. In a patient with burns covering more than 30% of the total body surface area, which of the following parameters is most likely to increase in the first few hours of the pre-resuscitation phase?

- A) Cardiac output
- B) Peripheral blood flow
- C) Plasma volume
- D) Systemic vascular resistance
- E) Urine output

The correct response is Option D.

Extensive burn injuries are characterized by the hemodynamic changes seen in hypovolemia, including decreased cardiac output, decreased peripheral blood flow, and decreased urine output. Decreased plasma volume is seen secondary to extravasation of plasma into the burn wound and surrounding tissues. Increased systemic vascular resistance is found in hypovolemia.

## REFERENCES:

1. Pham TN, Cancio LC, Gibran NS. American Burn Association practice guidelines burn shock resuscitation. *J Burn Care Res.* 2008 Jan-Feb;29(1):257-266.
2. Steinstraesser L, Al-Benna S. Acute management of burn injuries. In: Neligan PC, Song DH, eds. *Plastic Surgery*. Vol 4. Philadelphia: Elsevier-Saunders; 2013:393-436.

207. A 30-year-old woman comes to the office because of pain in the left breast. Two weeks ago, she underwent core needle biopsy of a breast mass that was diagnosed as benign. Family history does not include breast cancer. She does not smoke cigarettes. On examination, the left breast is erythematous and tender to palpation, and the skin of the breast is retracted laterally. There is a palpable, rope-like mass that courses longitudinally along the breast. Which of the following is the most appropriate diagnosis and treatment of this lesion?
- A) Breast abscess, perform incision and drainage of the mass
  - B) Fibrocystic changes, perform biopsy
  - C) Mastodynia, treat with 10-day course of broad-spectrum antibiotics
  - D) Nipple papilloma, perform diagnostic mammography
  - E) Superficial thrombophlebitis, manage with analgesics

The correct response is Option E.

Mondor disease, or superficial thrombophlebitis of the breast, involves the superficial veins of the breast and anterior chest wall. It may occur following surgery, core biopsy, irradiation, or trauma. Clinical manifestations include pain, redness and swelling, and the presence of a thickened tender cord. This condition usually resolves in 4 to 6 weeks with symptomatic treatment using pain relief.

Nipple papillomas may be identified as a mass on breast imaging or may be found incidentally. They frequently present with bloody nipple discharge. While not concerning in and of themselves, these lesions may harbor areas of atypia or ductal carcinoma in situ, and are treated with core needle biopsy.

While a breast abscess is possible after a diagnostic procedure such as a biopsy, it would present as localized swelling, tenderness, and induration. The skin retraction and rope-like mass would not be present.

Fibrocystic changes in the breast present as a solitary mass and may cause patients to seek medical attention because of associated pain. They may fluctuate in size and tenderness during a patient's menstrual cycle. Because no breast mass can be definitively declared benign on physical examination alone, imaging and/or biopsy may be considered.

Breast pain in the absence of a finding on physical examination may have a number of causes including menstrual changes, breast hypertrophy, diet, hormone replacement therapy, ductal ectasia, mastitis, malignancy, and hidradenitis. While the patient does have breast pain, the other physical findings rule out mastodynia alone.

## REFERENCES:

1. Courtillot C, Plu-Bureau G, Binart N, et al. Benign breast diseases. *J Mammary Gland Biol Neoplasia*. 2005 Oct;10(4):325-35.
2. Laroche JP, Galanaud J, Labau D, Van Kien AK, Brisot D, Boge G, Quéré I. Mondor's disease: what's new since 1939? *Thromb Res*. 2012 Oct;130 Suppl 1:S56-8.
3. Salemis NS, Vasilara G, Lagoudianakis E. Mondor's disease of the breast as a complication of ultrasound-guided core needle biopsy: management and review of the literature. *Breast Dis*. 2015;35(1):73-6.

208. The plastic surgeon is evaluating the strength of a recently published clinical study. The surgeon notes that the study does not include a power calculation to assess the adequacy of the sample size. Which of the following study errors is minimized by the inclusion of a statistical power calculation?
- A) Type I
  - B) Type II
  - C) Type III
  - D) Type IV

The correct response is Option B.

The statistical power is the probability that a sample can detect a treatment effect if a true effect exists. It is the value defined by the equation  $1-\beta$ , where  $\beta$  represents the probability of making a type II error. The alpha level represents the probability of making a type I error. Statistical power increases with increasing sample size. The power of a study is meaningful only when it is associated with detecting a specific clinically meaningful treatment effect or difference that is likely to occur, and thus a power calculation requires the researcher to specify the desired alpha level, sample size, and magnitude of the clinical meaningful treatment effect.

Type I error involves rejecting the null hypothesis and falsely concluding that there is a treatment effect. Researchers often guard against this type of error by setting a low significance ( $\alpha$ ) level.

Type II error involves failing to reject the null hypothesis and falsely concluding that there is a treatment effect. Setting an adequate sample size to increase the statistical power of the study minimizes this.

Type III and type IV errors are more recently described errors that may be committed by the investigator and focus on the two main parts of the reasoning chain: the model used to evaluate the question and the evaluation and conclusion of the study. Type III error involves correctly rejecting the null hypothesis for the wrong reason. Type IV error involves the incorrect interpretation of a correctly rejected hypothesis.

## REFERENCES:

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2. Type III and Type IV Errors: Statistical Decision-Making Considerations in addition to Rejecting and Retaining the Null Hypothesis. *Tate CU*. Available at: <http://web.stanford.edu/group/bps/cgi-bin/wordpress/wp-content/uploads/2015/06/Tate.pdf>. Accessed December, 2015.
3. Zhu VZ, Tuggle CT, and Au AF. Promise and limitations of big data research in plastic surgery. *Ann Plast Surg*. 2016 Feb 5. [ePub ahead of print]

209. Oral contraceptive use increases the incidence of which of the following histologic risk factors for breast cancer?

- A) Apocrine metaplasia
- B) Atypical hyperplasia
- C) Intraductal hyperplasia
- D) Intraductal papilloma
- E) Sclerosing adenosis

The correct response is Option B.

Patients in whom an otherwise benign breast biopsy shows atypical hyperplasia have a 4.5- to 5-fold increased risk for developing breast cancer. Proliferative breast disease without atypia increases the risk 1.5- to 2-fold. Oral contraceptives have shown to decrease the occurrence of all proliferative forms of benign breast disease without atypia, such as intraductal hyperplasia, intraductal papilloma, and sclerosing adenosis. Apocrine metaplasia is a non-proliferative histologic change and carries no increased risk for breast cancer. Of the choices, only atypical hyperplasia is increased with oral contraceptive use.

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1. Rohan TE, Miller AB. A cohort study of oral contraceptive use and risk of benign breast disease. *Int J Cancer*. 1999 Jul 19;82(2):191-196.
2. Schnitt SJ. Benign breast disease and breast cancer risk: potential role for antiestrogens. *Clin Cancer Res*. 2001 Dec;7(12 Suppl):4419s-4422s.
3. Vamre TB, Stalsberg H, Thomas DB, et al. Extra-tumoral breast tissue in breast cancer patients: variations with steroid contraceptive use. *Int J Cancer*. 2006 Jun 1;118(11):2827-2831.

210. A 65-year-old woman is brought to the recovery room after undergoing brow lift surgery. Postoperatively, acute ST-elevation myocardial infarction is noted. Aspirin is administered. Frequent ventricular premature beats and occasional short runs of nonsustained ventricular tachycardia are noted on cardiac monitoring. Current blood pressure is 115/75 mmHg, heart rate is 65 bpm, and respiratory rate is 12/min. Oxygen saturation is 100%. Which of the following is the most appropriate next step in management?

- A) Intravenous administration of amiodarone 150 mg over 10 minutes
- B) Intravenous administration of flecainide 2 mg/kg body weight
- C) Intravenous administration of lidocaine bolus 1 mg/kg body weight followed by continuous infusion at 1 mg/min
- D) Replenishment of serum potassium to  $> 4.0$  mEq/L and magnesium to  $> 2.0$  mg/dL
- E) Withhold administration of metoprolol

The correct response is Option D.

Asymptomatic ventricular premature beats (VPBs) and nonsustained ventricular tachycardia (NSVT) are not uncommon following myocardial infarction (MI), with reported incidences as high as 93% and 7%, respectively. These arrhythmias are thought to arise from transient abnormalities of cardiac automaticity or triggered activity in the region of ischemia or infarction. Routine suppression in the absence of hemodynamic compromise does not improve overall mortality, and because treatment may be associated with numerous potential adverse effects, antiarrhythmic medications are not recommended in this setting. Maintaining serum potassium concentration above 4.0 mEq/L and serum magnesium concentration above 2 mg/dL to normal ranges per general ACC/AHA guidelines followed by expectant management is the most reasonable option in this scenario.

In stark contrast, ventricular fibrillation (VF) and other symptomatic sustained ventricular tachyarrhythmias are thought to be indicators, if not potentiators, of ongoing myocardial ischemia and sudden cardiac death following acute MI. Consequently, rapid identification and treatment of these arrhythmias using defibrillation with or without antiarrhythmic medications, according to ACLS protocols, can be lifesaving. When indicated, amiodarone would be the recommended antiarrhythmic in this setting because it has not been associated with increased mortality.

Both flecainide and lidocaine have been associated with increased mortality in the post-MI period and are therefore not recommended in the scenario described.

Intravenous administration of beta-adrenergic blockers has demonstrated numerous positive effects post MI including a reduced risk of VF. In the absence of other contraindications such as reactive airway disease and hypoperfusion, its ongoing administration in order to maintain a resting heart rate below 70 bpm is generally supported by the ACC/AHA guidelines for management of patients with STEMI.

Hypokalemia during an acute MI is a risk factor for VF, while hypomagnesemia can interfere with correction of hypokalemia, which is why ACC/AHA guidelines generally recommend maintaining normal concentrations in patients with an acute MI.

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1. O'Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction. *J Am Coll Cardiol*. 2013 Jan 29;61(4):78-140.



211. A 24-year-old man is brought to the emergency department 5 hours after being involved in a motorcycle collision. The patient reports worsening pain of the left forearm despite previous opioid administration. On physical examination, the left radial pulse is easily palpable. Hypoesthesia in a median nerve distribution is noted in the left hand. Active motion of wrist and fingers is present but is minimal and limited by pain. Passive wrist motion produces intense pain in the left forearm. X-ray study of the left upper extremity shows no fracture, and remaining trauma workup is negative. A photograph is shown. Which of the following is the most appropriate next step in management?

- A) Carpal tunnel release
- B) Forearm fasciotomy
- C) Local wound care until demarcation of tissue loss
- D) Splinting and observation
- E) Wound debridement and skin grafting

The correct response is Option B.

This patient presents with acute compartment syndrome (ACS) in the left forearm after blunt soft tissue trauma. The most appropriate next step in management is emergent forearm fasciotomy for decompression.

The diagnosis of ACS in the extremities should be based on clinical presentation and progress. Signs and symptoms commonly evolve over a few hours after the initial traumatic event, especially after fluid resuscitation. Occasionally, the patient's initial

presentation may raise strong suspicion and warrant immediate decompression. ACS in the extremities may develop from soft tissue injury without a fracture in up to 30% of cases.

The commonly accepted clinical findings suggestive of ACS (rest pain, pain on passive motion, paresthesia, and paresis) have been shown to have high specificity but low sensitivity, rendering them a poor predictive value. Paresis/paralysis and other signs of arterial obstruction (pulselessness, pallor, pain out of proportion) are thought to be particularly late findings. Therefore, physicians should have a high level of suspicion for ACS in any case of limb trauma associated with excessive pain and paresthesia. Measurement of compartment pressures may be of diagnostic assistance in equivocal cases, especially when the patient is unable to communicate.

Carpal tunnel release is an important component of a forearm fasciotomy; however, it is not sufficient decompression alone. Emergent decompressive fasciotomy should precede wound debridement, demarcation of tissue loss, and splinting of the extremity. Skin grafting of the wounds (including the skin incisions for fasciotomy) may or may not be needed after resolution of limb edema.

## **REFERENCES:**

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2. von Keudell AG, Weaver MJ, Appelon PT, et al. Diagnosis and treatment of acute extremity compartment syndrome. *Lancet.* 2015 Sep 26;386(10000):1299-310.

212. A 55-year-old woman undergoes ventral hernia repair. BMI is 45 kg/m<sup>2</sup>. According to surgical care improvement project (SCIP) guidelines, which of the following is the most appropriate management of antibiotics and Foley catheter placement in this patient?

- A) Thirty minutes before incision, removal 24 hours postoperatively
- B) Thirty minutes before incision, removal 48 hours postoperatively
- C) Thirty minutes before incision, removal 72 hours postoperatively
- D) Sixty minutes before incision, removal 48 hours postoperatively
- E) Sixty minutes before incision, removal 72 hours postoperatively

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option D.

The Surgical Care Improvement Project (SCIP) is a national quality partnership of organizations interested in improving surgical care by significantly reducing surgical complications.

The surgical infection prevention (SIP) measures were added as a core measure set in the fall of 2003. Hospitals began collecting core measure data for SIP with patient discharges beginning July 1, 2004. The SIP set subsequently transitioned to the SCIP measures effective July 1, 2006.

SCIP-1 states that prophylactic antibiotics should be received within one hour prior to surgical incision.

SCIP-9 states that the Foley catheter be removed on postoperative day 1 or postoperative day 2 with the day of surgery being postoperative day 0.

## REFERENCES:

1. The Joint Commission. Surgical Care Improvement Project Core Measure Set. Available at: <http://www.jointcommission.org/assets/1/6/Surgical%20Care%20Improvement%20Project.pdf>. Accessed January 14, 2016.

213. A 62-year-old man is evaluated because of a new skin lesion in his back. Excision of the lesion with administration of a local anesthetic agent is planned. Medical history shows hypertension and coronary artery disease treated with coronary balloon angioplasty 10 years ago. He takes 81 mg of aspirin daily. Preoperatively, which of the following is the most appropriate aspirin regimen for this patient?

- A) Maintaining current dosage
- B) Withholding for 1 day
- C) Withholding for 2 days
- D) Withholding for 7 days
- E) Withholding for 14 days

The correct response is Option A.

For this patient with increased risk of cardiovascular events, the safest approach is not to withhold aspirin prior to dermatologic surgery.

Aspirin inhibits platelet aggregation by irreversibly binding to the cell's cyclooxygenase enzyme stores, blocking the production of thromboxane. Its use at lower doses in long-term primary and secondary prevention of cerebrovascular and cardiovascular thrombotic events is well established.

Withholding of daily aspirin in patients with known cardiovascular disease can lead to a platelet rebound phenomenon featuring increased thromboxane production, decreased fibrinolysis, and a prothrombotic state. Discontinuation of oral antiaggregants has been found to be an independent predictor of both death and major ischemic events.

Several studies revealed no significant increase in the risk of bleeding complications after cutaneous surgery in patients who continued taking aspirin perioperatively.

## REFERENCES:

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214. During surgical procedures that do not involve the airway, which of the following oxygen delivery methods is most likely to increase the risk of fire in the operating room?
- A) Endobronchial tube
  - B) Endotracheal tube
  - C) Laryngeal mask
  - D) Nasal cannula
  - E) Tracheostomy tube with cuff

The correct response is Option D.

For surgical procedures not involving the airway, open oxygen sources such as masks or nasal cannulae are most likely to increase the risk of fire in the operating room, as they may allow for trapping or pooling of an oxidizer-enriched atmosphere (oxygen with or without nitrous oxide).

The incidence of operating room fires in the United States is estimated to be around 600 cases per year. Fire requires the presence of three components: fuel, an oxidizer, and an ignition source. Common fuels in the operating room include alcohol-containing prepping agents, drapes and bandages, gowns and other personal protection equipment, petroleum jelly, etc. Ignition sources include electrocautery, lasers, fiberoptic light sources, and defibrillators. The two most common oxidizing agents in the operating room are oxygen and nitrous oxide.

Most protocols for assessment of risk of fire in the operating room take into account the presence of an open oxygen source, surgical site or incision above the xiphoid, and an available ignition source (such as electrocautery, laser, fiberoptic light source, etc).

For surgical procedures not involving the airway, closed-system oxygen sources using endotracheal/endobronchial tubes, tracheostomy cuffed tubes, or laryngeal masks convey less risk of fire, when compared with open oxygen sources.

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215. According to HIPAA regulations, which of the following is considered individually identifiable personal health information?

- A) Age
- B) Date of birth
- C) Gender
- D) Race
- E) State of residence

The correct response is Option B.

According to HIPAA Privacy Rules, “Individually identifiable health information” is information, including demographic data, that relates to:

- the individual’s past, present, or future physical or mental health or condition,
- the provision of health care to the individual, or
- the past, present, or future payment for the provision of health care to the individual

and that identifies the individual or for which there is a reasonable basis to believe can be used to identify the individual. Individually identifiable health information includes many common identifiers (e.g., name, address, birth date, social security number).

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216. A 25-year-old man returns to the operating room for closure of the abdomen 2 weeks after undergoing small-bowel resection. The abdomen was left open after the resection and treated with abdominal negative pressure wound therapy. The bowel wall edema has improved, and the fascia and rectus muscles are 30 cm apart at the level of the umbilicus. There is no evidence of contamination. Abdominal wound closure is planned. There is adequate skin for primary closure. Which of the following methods is most appropriate for fascial closure?

- A) Acellular dermal matrix and negative pressure wound therapy
- B) Component separation and acellular dermal matrix interposition
- C) Skin grafting and negative pressure wound therapy
- D) Subcutaneous tissue expansion, staged closure of skin flaps
- E) Submuscular tissue expansion, staged closure of fascial flaps

The correct response is Option B.

Abdominal wall reconstruction after severe trauma involves evaluation of the skin and fascia. First, the surgeon needs to determine if there is sufficient skin and subcutaneous tissue for primary closure. If there is insufficient skin, then tissue expanders, local tissue rearrangement, or distant flaps need to be considered. Second, if there is insufficient fascia, then component separation with primary fascial closure and mesh onlay or a mesh interposition are options for fascial closure. Since the fascial defect is 30 cm, it is unlikely that primary fascial closure can be achieved with component separation alone. An interposition of acellular dermal matrix is appropriate to bridge the fascial gap if primary fascial closure cannot be achieved.

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217. A 30-year-old man who sustained burns on 35% of the total body surface area 24 hours ago is being treated in the burn unit. The patient was resuscitated according to the Parkland formula and is maintaining adequate urine output. Gastric feeding access was established on initial presentation, and the patient is being fed according to his initial body weight. Which of the following clinical indices is most suggestive of the need to decrease his feeding to trophic feeds?
- A) Early operative excision with planned start time in 8 hours
  - B) Hypotension requiring vasopressin support
  - C) Mild abdominal distension that is soft to palpation
  - D) Nasogastric output of 100 mL for the past 24 hours
  - E) Need for escharotomy

The correct response is Option B.

There is no doubt that nutritional support for burn patients is integral. A multidisciplinary approach to nutritional assessment and support is ideal, and general knowledge of the indications of when to delay or decrease enteral feeding is essential.

Since the patient has gastric and not post pyloric feeding access, nil per os (NPO) for eight hours allowing adequate gastric emptying to decrease risk of aspiration is necessary.

Gut mucosal integrity is important during the stress of large trauma including burn, and enteral feeding is the preferred modality of access. However, during times of extreme stress, decreased splanchnic flow can cause poor intestinal perfusion, and there is the possibility of gut ischemia due to increased metabolic demand of the gut. Decreasing the gastric feeds to trophic feeds is recommended to decrease the risk of inducing gut ischemia. Clinical indications for threatened intestinal perfusion include firm, obvious abdominal distension and gastric output greater than 200 mL per day; the patient doesn't exhibit any of these clinical signs.

Hypotension requiring vasopressor support indicated decreased perfusion, which can lead to possible mismatch of gut perfusion with required metabolic demand. Trophic feeds are recommended for patients who exhibit signs of significant decreased perfusion requiring vasopressor support.

Escharotomy will increase fluid losses, but will not change caloric needs.

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218. A 28-year-old, right-hand–dominant woman is brought to the emergency department 18 hours after sustaining a cat bite to the dorsum of the hand proximal to the fifth metacarpophalangeal (MCP) joint. Which of the following organisms is most likely to be cultured from this abscess?

- A) *Eikenella corrodens*
- B) Group A *Streptococcus*
- C) Methicillin-resistant *Staphylococcus aureus*
- D) *Pasteurella multocida*
- E) *Pseudomonas aeruginosa*

The correct answer is option D.

*Pasteurella multocida* is a small, gram-negative coccobacillus that is frequently associated with infections caused by dog and/or cat bites. Local findings are consistent with infection including erythema, warmth, pain and tenderness, and fluctuance or purulent discharge. Delayed treatment may result in chronic deep-space infection and/or osteomyelitis. Treatment involves starting penicillin combined with local wound care as well as surgical incision and debridement if needed.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is becoming more common in community-acquired hand infections, but is not typically associated with dog or cat bites. *Eikenella corrodens* is more commonly associated with infections occurring after human bites. *Pseudomonas* infection is often seen as a nosocomial infection that is very resistant to antibiotics. Group A *Streptococcus* is a common bacterial infection associated with strep throat.

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219. A 51-year-old woman undergoes bilateral breast reconstruction with free deep inferior epigastric artery perforator (DIEP) flaps. She is concerned about postoperative pain control. To achieve anesthetic effect, an infusion of 10 mL of 0.25% bupivacaine is administered bilaterally into the transversus abdominis plane (TAP) block space. Which of the following are the most appropriate anatomical landmarks to use when performing this technique?

- A) Latissimus dorsi, external oblique, and iliac crest
- B) Linea semilunaris, inferior epigastric vessels, and inguinal ligament
- C) Quadratus lumborum, internal oblique, and 12th rib
- D) Teres major, teres minor, and long head of the triceps

The correct response is Option A.

The transverse abdominis plane (TAP) block is a peripheral nerve block designed to anesthetize the nerves supplying the anterior abdominal wall (T6 to L1). Local anesthetic is injected between the internal oblique and the transverse abdominis muscles in the plane through which the sensory nerves pass. Use of this technique provides a suitable block to the multiple nerves supplying the abdominal wall with a single needle stick. The technique was first described in 2001 by Rafi using the anatomical landmarks of the inferior lumbar triangle (triangle of Petit): the anterior border of the latissimus dorsi muscle posteriorly, the posterior edge of the external oblique muscle anteriorly, and the superior edge of the iliac crest inferiorly.

The effectiveness of this technique has been demonstrated in the general surgery and OB-GYN literature with recent studies also being performed specifically in the harvest of abdominal free flaps for breast reconstruction. In a recent meta-analysis of this technique, the TAP block decreased narcotic use, provided more effective pain relief, and decreased opioid-related side effects including sedation and postoperative nausea and vomiting.

The teres major, teres minor, and long head of the triceps muscles form the borders of the triangular space through which the circumflex scapular artery can be found when harvesting the scapular flap.

Hesselbach triangle is bounded by the lateral border of the rectus muscle (linea semilunaris), the inferior epigastric vessels, and the inguinal ligament and is the space through which direct inguinal hernias pass.

The quadratus lumborum, internal oblique, and 12th rib are the anatomical landmarks of the superior lumbar triangle (Grynfeltt triangle) and a site of lumbar herniation.

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220. A 65-year-old man is evaluated for an increased serum potassium concentration of 6 mEq/L. ECG shows peaked T waves, decreased P wave amplitude, and prolonged QRS wave duration. Which of the following is the most appropriate initial step in management?
- A) Administration of acetazolamide 250 mg intravenously
  - B) Administration of metoprolol succinate 20 mg in 4 mL nebulization, inhaled over 10 minutes
  - C) Administration of spironolactone 100 mg intravenously over 2 to 3 minutes, repeated after 5 minutes if ECG changes persist or recur
  - D) Administration of succinylcholine 30 g orally, and repeated every 2 hours as indicated
  - E) Administration of 10 units of regular insulin followed by 50 mL of 50% dextrose intravenously

The correct response is Option E.

Acute hyperkalemia is an electrolyte derangement that can result from a variety of scenarios including supratherapeutic potassium replacement, rhabdomyolysis, hemolysis, tumor lysis syndrome, severe sepsis, acute renal failure, and Addison disease. Among the most serious manifestations are progressive neuromuscular paralysis and progressive volatility in cardiac conduction terminating in cardiac arrest. The spectrum of cardiac collapse is evident on ECG starting with peaked T waves, decreased P wave amplitude, and prolonged QRS wave duration, followed by progressive blending of QRS and T waves into a sinusoidal ventricular fibrillation, followed by asystole.

Because cardiac arrest can occur at any point during ECG progression, hyperkalemia with ECG changes constitutes a medical emergency. Rapidly acting treatments aimed at sequestering or reducing serum potassium include administration of calcium, insulin with glucose, beta-2-adrenergic agonists (e.g., albuterol, sodium bicarbonate), potassium wasting diuretics (e.g. furosemide), cation exchange resins (e.g., Kayexalate), and dialysis.

Of the options listed, only insulin with glucose is an accepted rapidly acting treatment for hyperkalemia. It works primarily by driving via the activity of the Na-K-ATPase pump in skeletal muscle. The effect begins in 10 to 20 minutes, peaks at 30 to 60 minutes, and lasts for four to six hours. Insulin can be given

alone if serum glucose is  $> 250$  mg/dL, and treatment can be repeated as needed. In all cases, serum glucose should be monitored to avoid acute hypoglycemia.

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221. A 42-year-old nurse is scheduled to undergo elective non-implant-based surgery of the left breast. Medical history includes no abnormalities, and she has no allergies. She smokes 1 pack of cigarettes daily. To decrease the incidence of surgical site infection, which of the following is the most effective perioperative strategy?
- A) Administer cefazolin intravenously within 5 minutes of skin incision
  - B) Administer an insulin drip to keep blood glucose concentration less than 100 mg/dL
  - C) Have the patient practice complete smoking cessation for 7 days prior to surgery
  - D) Prescribe nasal mupirocin and chlorhexidine baths for 5 days prior to surgery
  - E) Use povidone-iodine skin preparation rather than chlorhexidine/isopropyl alcohol

The correct response is Option D.

A 2010 randomized controlled trial of over 6700 patients published in the *New England Journal of Medicine* documented a nearly 60% decrease in *Staphylococcus aureus* infections in patients if mupirocin was applied twice a day to the nares as well as a full-body wash with chlorhexidine for 5 days prior to surgery. The mean hospital stay was already reduced almost 2 days. A meta-analysis also demonstrated the same findings, with a nearly 45% decrease in surgical site infections (SSIs).

Data would suggest that isopropyl alcohol-containing skin preparations for surgery decrease SSI rates more effectively than povidone-iodine alone.

Perioperative antibiotics should be administered with enough advance time to achieve proper and adequate rates of skin penetration. With cefazolin, this is 30 to 59 minutes before skin incision, with an odds ratio of 1.0 (vs. 2.0 if given within 30 minutes, and 1.7 if given after 60 minutes). Five minutes prior to skin incision is not sufficient for the SSI-reducing effect to be achieved.

Blood glucose control is critical to decreasing SSI rates, with optimal rates usually being quoted as less than 180 mg/dL. However, this patient is not diabetic; she is otherwise healthy, so an insulin drip would not be appropriate. In addition, hypoglycemia can also have detrimental physiologic effects and also should be avoided.

Smoking cessation decreases SSI rates if the patient does not smoke for 4 weeks before or after surgery. A 2012 systematic review and meta-analysis of nearly 500,000 patients demonstrated this. However, 7 days of smoking cessation is insufficient time in advance of surgery to obtain these statistically significant benefits.

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222. A university-based plastic surgery division begins planning to open an offsite ambulatory surgery center (ASC). The university is located in a state that requires a certificate of need before building an ASC. Which of the following best describes the reason for requiring a certificate of need for this project?

- A) To control health care ASC costs and allow coordinated planning of new services and construction
- B) To demonstrate that the ASC qualifies for Medicare funding
- C) To ensure that nurses working at the ASC abide by the ethical principle of “do no harm”
- D) To ensure that physicians working at the ASC abide by the ethical principle of “do no harm”
- E) To require that at least one registered nurse is on-site at the ASC during surgeries

The correct response is Option A.

According to the National Conference of State Legislatures:

Certificate of need (CON) programs are aimed at restraining health care facility costs and allowing coordinated planning of new services and construction. Laws authorizing such programs are one mechanism by which state governments seek to reduce overall health and medical costs. Many CON laws initially were put into effect across the nation as part of the federal Health Planning and Resources Development Act of 1974. Despite numerous changes in the past 30 years, about 36 states retain some type of CON program, law, or agency as of 2014.

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223. An otherwise healthy 48-year-old woman with no history of smoking comes to an accredited facility to undergo rhytidectomy and neck lift, as well as facial laser resurfacing during general anesthesia. The length of the procedure is 4 hours and 15 minutes, and state regulation allows office-based procedures of this length to be performed in an office-based facility. Which of the following complications is most likely to occur?

- A) Cardiac arrest
- B) Hospitalization
- C) Postoperative nausea and vomiting
- D) Reintubation
- E) Reoperation

The correct response is Option C.

More procedures are performed in a freestanding ambulatory surgery center or office-based procedure room than in a hospital setting, according to ASPS statistics. Although each state can set policies on the upper limit of the duration of these procedures, these policies are not entirely evidence-based. Based on available literature and data, an ASPS Task Force has established guidelines to provide the best level of evidence for ambulatory surgery safety. In terms of duration, the current recommendations suggest that procedures be limited to less than 6 hours and begin early in the morning to decrease the risk of complications.

A review of 2595 consecutive patients in a single practice who had office-based cosmetic surgery performed during general anesthesia using a propofol/remifentanyl intravenous infusion in conjunction with airway protection via use of either a laryngeal mask or endotracheal intubation monitored by certified registered nurse anesthetists demonstrated no increase in major complications such as deep venous thrombosis (DVT), pulmonary embolism, reintubation, reoperation, hospitalization, major cardiac complications, and death. However, the only complications to reach statistically significant differences in procedures over 4 hours were urinary retention and postoperative nausea and vomiting. Additional studies have also demonstrated no increased risks of major complications in this setting.

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224. A 62-year-old woman comes to the office because of squamous cell carcinoma of the tongue and floor of the mouth. Examination shows a 3 x 3-cm partial defect of the tongue and the floor of the mouth. The lesion will be resected and the defect reconstructed at the same time using a submental musculocutaneous flap. Exposure of the pedicle of this flap allows which of the following levels of nodes to be exposed and sampled?

- A) Level I
- B) Levels I and II
- C) Levels I, II, and III
- D) Levels I, II, III, and IV
- E) Levels II and III

The correct response is Option A.

The submental flap is a potentially thin flap. Its pedicle is the submental artery, which arises off the facial artery. The pedicle is described as traveling between the submandibular gland and digastric muscle belly. It also dives deep and lies in between the mylohyoid and geniohyoid. Exposing the pedicle requires incision along the mental region, then in a transverse incision 1 to 2 cm below the mandibular body.

Level I nodes lie within the submental region with the mandibular body being the superior border and the hyoid bone being the inferior margin. They are further divided into 1a-submental, which lies anterior to the anterior belly of the digastric, and the 1b-submandibular, which lies posterior to the anterior belly of the digastric. Thus, exposure to the pedicle alone also exposes all the level I nodes.

Level II nodes are the upper jugular group, which are clustered around the upper third of the internal jugular vein. The superior border is the skull base, the hyoid is the inferior border, the anterior border is the anterior edge of the sternocleidomastoid, and the posterior edge is the posterior edge of the sternocleidomastoid.

Level III nodes are the middle third of the internal jugular, with the hyoid being the superior border, cricoid cartilage the inferior border, and the anterior posterior borders the anterior and posterior edges of the sternocleidomastoid, respectively.

Level IV nodes are the lower third of the internal jugular with the cricoid cartilage as the superior border and the clavicle as the inferior border. Again, the anterior border is the anterior edge of the sternocleidomastoid, and the posterior edge is the posterior edge of the sternocleidomastoid.

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225. An 89-year-old man presents with a 5 x 5-cm ulcerated, biopsy-proven squamous cell carcinoma of the skin involving the pinna of the right ear. On examination, no palpable adenopathy is noted. Radiation Therapy (RT) is planned. Which of the following is the primary predictor of local control rates of RT in this patient?

- A) Age of patient
- B) Histology of tumor
- C) Location of tumor
- D) Presence of ulceration
- E) Size of tumor

The correct response is Option E.

The National Comprehensive Cancer Network (NCCN) has published guidelines for radiation therapy for primary squamous cell carcinoma (SCC). Local control rates for SCCs less than 1 cm were 91%; those 1 to 5 cm were 76%, those larger than 5 cm were 56%.

Mohs micrographic surgery has the highest reported cure rates for SCC compared with all other modalities. However, these rates begin to drop with increased tumor size, differentiation, discontinuity, perineural invasion, and history of recurrence.

Of the head and neck sites, involvement of the ears and lips confers the highest risk for metastatic disease at 8.8% and 13.7%, respectively. In tumors greater than 2 cm in size, the risk may increase.

In the past, it was felt that lesions overlying cartilage should not be treated with radiation therapy due to the risk of chondronecrosis. It is now known that such sites can be safely treated with fractionated radiation therapy.

Radiation therapy for regional node involvement should be considered. NCCN guidelines suggest 25 (2Gy) fractions to clinically negative but "at risk" nodal basins over a 5-week period.

Age, tumor location, ulceration, and histology are secondary predictors to tumor size.

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226. In the evaluation of evidence-based medicine, which of the following is considered Level V evidence?

- A) Case series
- B) Individual case report
- C) Prospective cohort study
- D) Randomized clinical trial
- E) Retrospective comparative study

The correct response is Option B.

Evidence-based medicine, particularly randomized controlled trials, influences many daily decisions within the medical specialties. The evidence-rating scale for therapeutic studies is as follows:

| Level | Description                                                                                                                            |
|-------|----------------------------------------------------------------------------------------------------------------------------------------|
| I     | High-quality, multicentered or single-centered, randomized controlled trial with adequate power; or systematic review of these studies |
| II    | Lesser-quality, randomized controlled trial; prospective cohort study; or systematic review of these studies                           |
| III   | Retrospective comparative study; case-control study; or systematic review of these studies                                             |
| IV    | Case series                                                                                                                            |
| V     | Expert opinion; case report or clinical example; or evidence based on physiology, bench research, or “first principles”                |

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227. A 20-year-old man comes to the office for definitive treatment of a punch biopsy–proven dermatofibrosarcoma protuberans (DFSP) of the scalp. Which of the following is the most appropriate treatment plan?

- A) Cryoablation
- B) Radiation
- C) Referral for Mohs micrographic surgery
- D) Resection with 0.5-cm margin
- E) Resection with 1-cm margin

The correct response is Option C.

Dermatofibrosarcoma protuberans (DFSP) is relatively uncommon, soft-tissue-only tumor that is locally aggressive. Since it can extend along connective tissues along the deep layers, margins required for DFSP need to be no less than 2 cm for an acceptable non-recurrence rate, and even then it is quite high. Predicted rate of recurrence is anywhere from 11 to 20% with a 3-cm margin.

Mohs micrographic surgery has demonstrated to have a much lower recurrence rate, with multiple studies demonstrating less than 10%. Subsequently, Mohs micrographic surgery is the best initial treatment plan for complete resection of DFSP.

Radiation therapy is contraindicated for DFSP. Cryoablation is employed for precancerous skin lesions.

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228. A 40-year-old man with T3 paraplegia undergoes operative debridement of a stage III ischial decubitus ulcer. In the recovery room, the nurse reports that the patient is saying he has severe headache and nausea. Temperature is 37.0°C (99.0°F), blood pressure is 180/90 mmHg, and heart rate is 50 bpm. He is flushed and diaphoretic. Which of the following is the most appropriate initial management of this patient's condition?

- A) Administer dantrolene 2.5 mg/kg intravenously
- B) Administer nitroglycerin lingual spray
- C) Insert a Foley catheter
- D) Perform carotid massage
- E) Place patient in Trendelenburg position

The correct response is Option C.

This patient has autonomic dysreflexia (AD). During an episode of AD, the patient sustains an uncontrolled sympathetic response to a stimulus (precipitant). It usually occurs in patients whose level of paralysis is above T6. AD occurs in 50 to 70% of patients with lesions above T6. Fatal complications may ensue in affected patients.

Common symptoms of AD include headache, hypertension, bradycardia, and flushing, blotching, or sweating above the level of the lesion.

The most common precipitants of AD are urologic (principally bladder distention), gastrointestinal (rectal distention), and musculoskeletal (fractures, dislocations, and heterotopic calcification). Other less common precipitants include skin ulcerations and infections as well as pregnancy and labor.

Primary treatments of AD include removing any stimulus. Remove tight clothing and be sure that a full bladder or rectum is not serving as a precipitant. Sublingual nifedipine may be used secondarily as an oral hypotensive agent. Nitrates are not part of the initial management of AD. A fluid bolus would have no role in the treatment of AD or hypertensive crisis. Dantrolene is used in the management of malignant hyperthermia, not AD. Administration of dextrose in 50% water intravenously is used to manage symptomatic hypoglycemia.

Carotid massage causes vago stimulation and is contraindicated in this patient.

Trendelenburg is usually used for hypotension, not hypertension.

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229. A 46-year-old man is evaluated for a large grade IV left ischial pressure ulcer. Medical history includes a 6-month history of traumatic T12 paraplegia. Excision of the pressure ulcer and reconstruction with a left inferior gluteal thigh flap are planned. During induction of anesthesia, the patient has the onset of cardiac arrhythmia with peaked T waves and tachycardia. Pulse oximetry is 100% with normal end-tidal CO<sub>2</sub>. Temperature is 37.0°C (98.6°F). It is discovered that the patient was given succinylcholine for rapid-sequence intubation by the anesthesia resident. Which of the following is the most appropriate initial management of the patient's condition?

- A) Intravenous adenosine
- B) Intravenous amiodarone
- C) Intravenous calcium chloride
- D) Intravenous dantrolene
- E) Synchronized cardioversion

The correct response is Option C.

Perioperative complications arising from intravenous paralytics and inhalational anesthetics may have devastating outcomes, including death. Rapid and accurate diagnosis is essential for efficient treatment and maximizing successful outcomes. The paraplegic patient presented in this clinical scenario has developed acute hyperkalemia from the use of succinylcholine. Hyperkalemia after succinylcholine administration may result in paraplegics or any patients with upper or lower motor neuron injury, severe burns, crush injuries, or conditions causing rhabdomyolysis. This phenomenon results from the upregulation of nicotinic acetylcholine receptors in denervated or traumatized muscle.

Initial treatment of acute hyperkalemia causing cardiac compromise involves antagonizing the effects of potassium on cardiac conduction and shifting potassium from the extracellular space back into intracellular fluid. Calcium directly antagonizes the hyperkalemia-induced depolarization of resting membrane potential by increasing the threshold potential to stabilize the membrane. Sodium bicarbonate and glucose combined with insulin will promote cellular uptake of potassium. Acidosis enhances the release of potassium from the cell and can be reversed with sodium bicarbonate. In addition, alkalization of plasma decreases levels of ionized calcium permitting the more liberal use of calcium in the treatment of acute hyperkalemia.

Intravenous dantrolene is appropriate for the initial management of malignant hyperthermia (MH). MH may also arise from the use of succinylcholine or inhalational anesthetics. It is caused by a hereditary abnormality that interferes with calcium regulation within skeletal muscle. Once triggered, an uncontrolled hypermetabolism in the muscle occurs secondary to the buildup of calcium in the skeletal muscle. The earliest sign of malignant hyperthermia is a rapid and unexplained increase in end-tidal CO<sub>2</sub> that progresses to the presence of fever. This patient is afebrile and has a normal end-tidal CO<sub>2</sub>. However, if the patient presentation did indeed suggest MH, intravenous calcium chloride would be contraindicated secondary to the already increased levels of calcium present.

Synchronous cardioversion and intravenous adenosine and amiodarone are modalities to consider in the ACLS algorithm for treatment of unstable and stable tachycardia of unknown etiology. They are not first-line medications in the treatment of the hyperkalemia that is causing this patient's symptoms.

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McCullough PA, Beaver TM, Bennett-Guerrero E, et al. Acute and chronic cardiovascular effects of hyperkalemia: new insights into prevention and clinical management. *Rev Cardiovasc Med*. 2014;15(1):11-23.

230. An otherwise healthy 28-year-old woman undergoes emergency splenectomy because of isolated splenic rupture after sustaining blunt trauma. Examination shows hemodynamic instability. Postoperatively, the patient continues to experience hypotensive episodes that are difficult to manage. Total urine output is 200 mL over 12 hours. Tertiary survey identifies no ongoing hemorrhage or other injuries. Laboratory studies show:

|                  |             |
|------------------|-------------|
| Blood            |             |
| Na               | 145 mEq/L   |
| Cl               | 96 mEq/L    |
| K                | 4.1 mEq/L   |
| HCO <sub>3</sub> | 21 mEq/L    |
| BUN              | 60 mg/dL    |
| Cr               | 4.5 mg/dL   |
| Osmol            | 350 mOsm/kg |
| Urine            |             |
| Na               | 35 mEq/L    |
| Cl               | 59 mEq/L    |
| BUN              | 450 mg/dL   |
| Cr               | 35 mg/dL    |
| Osmol            | 270 mOsm/kg |

Which of the following most closely represents the fractional excretion of sodium (FENa) in this patient?

- A) 0.3%
- B) 1.2%
- C) 2.3%
- D) 3.1%
- E) 4.1%

The correct response is Option D.

Acute kidney injury (AKI, formerly called acute renal failure) is characterized by an abrupt decrease in renal function. The differential diagnosis can be categorized into prerenal, intrinsic renal, and postrenal causes. Of these, decreased renal perfusion (prerenal disease) and acute tubular necrosis (ATN) represent the two most common causes, accounting for 65 to 75% of all cases. The fractional excretion of sodium

(FENa) has been shown in a variety of studies to more clearly differentiate between prerenal disease and ATN than other laboratory tests and guide patient management when taken in the context of history and physical examination. FENa measures the percent of filtered sodium and is calculated as:

$$\text{FENa} = [ (\text{UNa} * \text{PCr}) / (\text{PNa} * \text{UCr}) ] * 100\%$$

where UNa and PNa represent urine and plasma concentrations of sodium, and UCr and PCr represent and urine and plasma concentrations of creatinine, respectively.

In general, a FENa below 1% suggests prerenal disease, where there is appropriate reabsorption of the majority of all filtered sodium in response to decreased renal perfusion. FENa above 2% reflects inappropriate salt wasting indicative of ATN. Of note, important limitations of the predictive value of a high FENa include diuretic therapy and chronic renal failure, by altering normal salt handling.

In the example given above,  $\text{FENa} = [ (35 * 4.5) / (145 * 35) ] * 100\% = 3.1\%$

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231. A 40-year-old woman comes to the office for body contouring following a 150-lb (68-kg) weight loss after undergoing laparoscopic gastric banding surgery. Medical history includes deep venous thrombosis 7 years ago while taking progestin for oral contraception. Family history includes two first-degree relatives who sustained a pulmonary embolism. Laboratory studies show the patient has a factor V Leiden coagulation disorder. Which of the following is the most likely cause of this disorder in this patient?

- A) Increased levels of coagulation factor V
- B) Increased resistance to activated protein C
- C) Persistent antibodies to coagulation factor V
- D) Protein C deficiency
- E) Protein S deficiency

The correct response is Option B.

Factor V Leiden is the most prevalent hypercoagulation disorder. It is the most common genetic risk factor for venous thromboembolism.

Activated protein C, together with its co-factor protein S, inhibits the coagulation cascade by inactivating factor V and factor VIIIa. Activated protein C cleaves factor V in three sites; a mutation in the first site is known as factor V Leiden. In carriers of factor V Leiden, factor Va is inactivated approximately 10 times slower than normal.

Protein C and S deficiencies are described coagulation disorders. Lower levels of these proteins also inhibit the coagulation cascade and may be associated with warfarin-related skin necrosis and purpura fulminans in the neonatal period.

The most common cause of acquired coagulation disorders is antiphospholipid syndrome, an autoimmune disorder caused by antibodies to phospholipids. These antibodies include anticardiolipin, lupus anticoagulant and anti-beta-2-glycoprotein I.

Increased levels of coagulation factors VIII, IX and XI are associated with increased risk of thromboembolism.

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232. Which of the following is required in order for an ambulatory surgical center to be compliant with American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) guidelines?

- A) Any death in the facility must be reported to the AAAASF within 15 business days after the facility is notified
- B) Changes in facility ownership must be reported to the AAAASF within 90 days of the change
- C) A final preoperative verification must be performed by one person on the surgical team
- D) The surgeon must be board eligible or board certified through one of the member boards of the American Board of Medical Specialties
- E) The surgeon must hold unrestricted hospital privileges in his or her specialty at two of the nearest accredited and/or licensed acute care hospitals

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option D.

The surgeon must hold, or must demonstrate that he or she has held, unrestricted hospital privileges in his or her specialty at one of the nearest accredited and/or licensed acute care hospitals in the area of the accredited facility for all operations that he or she performs in the facility. Any death in the facility, or any death occurring within 30 days of a surgical procedure performed at the facility, must be reported to the American Association for Accreditation of Ambulatory Surgery Facilities (AAAASF) within 5 business days after the facility is notified. Changes in facility ownership must be reported to the AAAASF within 30 days of the change. A final pre-operative verification must be performed by at least two people on the surgical team.

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[http://www.aaaasf.org/Surveyor/cms\\_web/PDF%20FILES/ASC%20PDFS/ASC%20Standards.pdf](http://www.aaaasf.org/Surveyor/cms_web/PDF%20FILES/ASC%20PDFS/ASC%20Standards.pdf). Accessed January 14, 2016.

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233. Which of the following patients' skin lesions is most suggestive of malignancy on the basis of its clinical features?

- A) A 14-year-old boy with a 5-mm, round, brown macule present since birth on the distal aspect of the thigh
- B) A 22-year-old woman with a 6-mm friable, pedunculated papule present for 6 weeks on the cheek
- C) A 55-year-old man with a 5-mm pink, pearly papule present for 6 months on the lateral nasal sidewall
- D) A 70-year-old man with a 1.5-cm waxy, yellow and brown, scaly plaque present for several years on the left temple

The correct response is Option C.

Once an individual's personal and family histories are considered, the history and appearance of a suspicious skin lesion will provide important information and provide clues about a diagnosis.

The "ABCD" (Asymmetry, Border irregularity, Color variegation, Diameter >6 mm) criteria are important for assessing potential malignancy of pigmented lesions. A flat, unchanging pigmented lesion in a young patient is unlikely to be malignant.

A pyogenic granuloma classically presents after local trauma and is characterized by a friable papule that bleeds easily.

Basal cell carcinoma and squamous cell carcinoma are the most common cutaneous skin malignancies. They may present as discrete, slowly growing lesions that have a history of bleeding and ulceration. Basal cell malignancies have a characteristic appearance of round, oval nodules with a shiny, pearly appearance and overlying telangiectasias.

Seborrheic keratoses are common benign skin lesions found in old age. They are a proliferation of immature keratinocytes and have a characteristic appearance of being well circumscribed, scaly, and have a "stuck on" appearance. While unsightly, these lesions have no malignant potential.

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234. A 19-year-old man is brought to the emergency department after being thrown from his motorcycle. The trauma team has ruled out intracranial, thoracic, abdominal, and spinal injury. A comminuted tibia fracture is visible through a 7-cm full-thickness soft-tissue avulsion of the lower one third of the leg. Which of the following is the most appropriate next step in management?
- A) Intraoperative debridement and washout of the wound, external fixation, and immediate cross-leg flap
  - B) Intraoperative debridement and washout of the wound, external fixation, burring of the tibia, and formation of granulation tissue over the next several weeks
  - C) Intraoperative debridement and washout of the wound, placement of external fixator, serial debridement, and free tissue transfer within 1 week of injury
  - D) Irrigation of the wound, stabilization of reduction with a cast, and application of suction wound dressing
  - E) Serial debridement of the wound and coverage with a gastrocnemius muscle flap

The correct response is Option C.

Lower extremity open fractures are described using the Gustilo classification. The patient in this scenario has a Gustilo IIIB: extensive soft tissue avulsion or degloving, from high velocity injury and gross contamination. The best treatment for such injuries is intraoperative debridement and washout with early or immediate fracture stabilization, often with an external fixator. Immediate soft-tissue reconstruction is not done due to the high-energy mechanism and gross contamination. This mandates repeat evaluation to assure all nonviable tissue and foreign material are removed prior to reconstruction. Definitive and stable soft-tissue reconstruction should be done as soon as possible and is classically thought to be best when provided within 72 hours of injury. Soft-tissue reconstruction done as quickly as possible reduces the risk of nonunion and osteomyelitis. In the proximal third of the leg, the gastrocnemius flap is indicated, while the soleus flap is for the middle third. Most often, free tissue transfer is the best option for the distal third wounds. Cross-leg flap is seldom used because of the prolonged immobilization that is required. Delayed reconstruction beyond the one week window is sometimes necessary because of other confounding factors in a multiple-trauma patient. In such situations, preventing desiccation of the bone is necessary, for which negative

pressure wound therapy is useful. Soft tissue reconstruction is then accomplished when feasible with preference for flap reconstruction.

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235. For the purpose of billing evaluation and management (E/M) services, a “new patient” is considered one who has not received any professional services from another plastic surgeon in a group practice within a minimum of which of the following months?

- A) 6
- B) 12
- C) 18
- D) 24
- E) 36

The correct response is Option E.

According to the 2015 American Medical Association’s (AMA) CPT book, “... a new patient is one who has not received any professional services from the physician/qualified health care professional or another physician/qualified health professional of the exact same specialty and subspecialty who belongs to the same group practice, within the past three years.” If a patient has received professional services evaluation and management (E/M) or other face-to-face service – (such as surgical procedures), within the past three years, from the physician/qualified health care professional, or another physician/qualified health care professional of the exact same specialty and subspecialty who belongs to the same group practice, he or she would be defined as an “established patient.”

The definition of a “new patient” by the Centers for Medicare and Medicaid Services differs slightly from the AMA’s. Instead of including physicians in the same specialty and subspecialty, for Medicare E/M services, the same specialty is determined by the physician's or practitioner's primary specialty enrollment in Medicare. The three-year time period still applies.

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236. A 25-year-old man is brought to the emergency department after sustaining injury during a roll-over motor vehicle collision. CT scan shows multiple facial fractures and systemic injuries. Which of the following is a CONTRAINDICATION to nasotracheal intubation in a trauma patient?

- A) Base of skull fracture
- B) Bilateral mandibular condyle fractures
- C) Cervical spine fracture
- D) Depressed mental status
- E) Fracture of the maxilla

The correct response is Option A.

Of the options listed, base of skull fracture is the only contraindication to nasal intubation. In these patients, there is a risk of the nasotracheal tube passing through the cribriform plate into the frontal lobes of the brain. Other absolute contraindications include mid face instability, suspected epiglottitis, coagulopathy, or apnea/impending respiratory arrest. Relative contraindications to nasotracheal intubation include nasal polyps, suspected nasal foreign bodies, recent nasal surgery, upper-neck hematoma or infection, and a history of frequent epistaxis. Depressed mental status, suspected cervical spine fracture, hypotension, and bilateral mandibular condyle fractures are not contraindications to nasotracheal intubation.

The options for intubating a trauma patient include nasal, oral, and surgical airways. The indications for nasotracheal intubation include intraoral and oropharyngeal surgery, complex intraoral procedures involving the mandible (e.g., segmental mandibulectomy, osteotomy, mandibular reconstructive procedures), and dental surgery.

The advantages of nasotracheal intubation include uninhibited access to the mouth as well as an enlarged surgical field. Despite these advantages, one must be cognizant of the contraindications and when in doubt (e.g., during initial advanced trauma life support management), the airway should be secured using either oral intubation or tracheostomy. Other drawbacks to nasotracheal intubation are that it often requires multiple attempts, there can be an abrupt rise in intracranial pressure, and it is difficult to attempt in an uncooperative patient.

In the presence of an isolated maxillary fracture nasal intubation may be preferred so that premorbid occlusion can be established.

The method of insertion of a nasotracheal tube includes using a well-lubricated tube with the cuff fully deflated. The tube should be inserted into either naris at a right angle to the face. Once the tube is beyond the nasopharynx, a laryngoscope is placed in the oral cavity and the tube is advanced under direct vision.

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237. The morphologic appearance of accelerated facial aging seen within 3 years following vascularized composite facial allotransplantation has been shown to be most markedly associated with which of the following processes?

- A) Atrophy of fat from the superficial subcutaneous tissue
- B) Attenuation of integumentary supporting ligaments
- C) Depletion of fat from the deep facial soft-tissue compartments
- D) Disproportionate thinning of the epidermis and dermis with pronunciation of facial lines
- E) Reduction of bone and non-fat subcutaneous soft tissues

The correct response is Option E.

Promising initial experience with vascularized composite facial allotransplantation has driven the procedure forward, with more than 30 face transplants successfully completed to date. Understanding how these facial allografts change relative to their recipient over time is crucial to the risk/benefit assessment, donor selection, and long-term treatment planning.

Long-term outcome data have shown facial allotransplants to undergo severe changes in volume and composition over the first 3 years post-transplantation that morphologically resemble accelerated aging. Computed tomography (CT) volumetric and histological analysis has shown this effect to result from significant volume loss in the allotransplanted bone and non-fat subcutaneous soft tissues. Allograft bone volume decreased by approximately 21% and allograft non-fat subcutaneous soft tissue decreased by about 26% between 18 and 36 months post-transplantation, respectively. These volume losses are hypothesized to involve transient denervation changes of allograft muscle and possibly differential response to acute and chronic rejection within the allograft. In contrast to typical chronological facial aging, allograft fat (both deep and subcutaneous) underwent no significant change, and skin biopsies obtained throughout the 3-year time period showed no significant thinning of the epidermal or dermal thickness and no change in collagen or fat content.

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238. A 64-year-old man is brought to the emergency department after collapsing at home. Examination shows a ruptured abdominal aortic aneurysm and hemodynamic instability. The patient is taken to the operating room to undergo open repair of the aneurysm. Postoperatively, urine output decreases despite aggressive fluid resuscitation, and urinary bladder pressure is greater than 30 mmHg. Increased peak airway pressures are noted. Which of the following is the physiologic effect of increased intra-abdominal pressure in this patient?

- A) Direct organ compression leads to decreased systemic afterload
- B) Elevation of the diaphragm leads to decreased preload
- C) Elevation of the diaphragm leads to increased flow in the inferior vena cava
- D) Vascular compression leads to increased flow in the inferior vena cava
- E) Vascular compression leads to decreased renal vascular resistance

The correct response is Option B.

Abdominal compartment syndrome (ACS) may develop rapidly after an increase in intra-abdominal pressure. Chronic causes of elevated intra-abdominal pressure (such as central obesity or large abdominal tumors) may be compensated for, but acute elevations as a result of trauma, bleeding, burn, or abdominal surgery may lead to life-threatening failure of multiple organ systems.

Three mechanisms present in ACS lead to multiple organ failure: vascular compression, elevation of the diaphragm, and direct organ compression. These three forces and their interactions create a constellation of physiologic effects that lead to the circulatory collapse at the center of ACS. Vascular compression results in decreased flow to the inferior vena cava and an increase in renal vascular resistance. Diaphragmatic elevation results in decreased flow to the inferior vena cava and an increase in intrathoracic pressure and decreased cardiac pre-load. Direct organ compression leads to an increase in systemic afterload. Left untreated, these forces eventually lead to renal failure, respiratory failure, intracranial hypertension, and intestinal and hepatic ischemia.

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239. An 83-year-old woman comes to the office for repair of a deep sternal wound infection after undergoing open single-vessel coronary artery bypass grafting using the left inferior mammary artery. Medical history includes cancer of the left breast for which she underwent wide excision with oncoplastic reconstruction followed by adjuvant radiation therapy to the breast and axilla. She does not smoke cigarettes. The patient's infection resolves with aggressive debridement and culture-guided antibiotics. A photograph is shown. Which of the following is the most appropriate reconstructive option?
- A) Left pectoralis turnover flap coverage with skin graft resurfacing
  - B) Left vertical rectus abdominis musculocutaneous flap coverage
  - C) Right latissimus dorsi musculocutaneous flap coverage
  - D) Right pectoralis advancement flap with skin readvancement closure
  - E) Right vertical rectus abdominis musculocutaneous flap coverage

The correct response is Option E.



Deep sternal wound infections represent life-threatening infections whose most frequent etiology in contemporary cases is surgical site infection following open heart surgery, with a reported incidence of 0.2 to 3% of patients undergoing median sternotomy. Risk factors in adults include diabetes mellitus, obesity, peripheral arterial disease, tobacco use, reoperation, and other surgical complications such as prolonged operative time and postoperative bleeding. Published mortality rates range from 8.1 to 14.8%. Once a diagnosis is made, initial treatment in cases of deep infection typically involve a combination of antimicrobial therapy and staged surgical debridement followed by delayed closure.

Sternotomy wounds can be complex problems because of their proximity to heart and lungs and exposure of these vital organs following debridement. Principles of reconstruction once a healthy wound bed has been obtained include durable coverage of vital structures with obliteration of dead space with a view to retaining or restoring optimal form and function.

In the case scenario described, a right superiorly based rectus abdominis myocutaneous flap provides the most reliable, well vascularized and non-irradiated option for regional soft tissue reconstruction of the composite chest wall defect (shown). A left vertical rectus abdominis myocutaneous flap is suboptimal in the setting of a relatively compromised superior epigastric vascular pedicle in the setting of known sacrifice of its parent left internal mammary artery (IMA). Latissimus and pectoralis flaps in any form are less reliable in their ability to fully cover inferior third sternectomy defects. While a turnover pectoralis flap can reach the inferior sternum, a left pectoralis turnover flap is furthermore

less reliable in the setting of known sacrifice of its inferior segmental internal mammary perforators in the setting of known IMA sacrifice. Skin re-advancement in the setting of prior radiation and distorted perfusion from prior reduction mammoplasty also invites further unnecessary risk.

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240. A 24-year-old man comes to the office because of a 1-year history of a lesion of the left earlobe following an attempt to pierce his ear at home. A photograph is shown. The patient reports that the lesion is enlarging gradually in size and mildly itchy. Which of the following features most likely characterize this lesion?
- A) It is a hypertrophic scar because it extends beyond the margin of the initial scar
  - B) It is a hypertrophic scar with distinct bundles of collagen oriented parallel to the skin surface
  - C) It is a keloid and has an increased ratio of type I to type III collagen compared with normal scars
  - D) It is a keloid and has increased levels of transforming growth factor beta (TGF- $\beta$ ) and type III collagen
  - E) It is a keloid with distinct bundles of collagen oriented parallel to the skin surface

The correct response is Option D.

All wounds leave scars. Wound healing is mediated by fibroblasts and is divided into three phases: the inflammatory phase (3 to 10 days), fibroblastic (10 to 14 days), and maturation (14 days to one year). During the proliferative phase, immature collagen fibrils are cross-linked and form mature collagen. The amount of collagen in a healing wound reaches a peak in three weeks, but remodeling continues months to years after the initial injury.

The difference between a keloid and a hypertrophic scar is often made clinically. A hypertrophic scar does not transgress the margins of the original wound; a keloid invades the adjacent normal skin. From the history of an ear piercing and the appearance of the lesion, the lesion is clearly a keloid.

Normal skin contains distinct collagen bundles that run parallel to the epithelial surface. The collagen structure in disordered scars such as hypertrophic scars and keloids is present in randomly oriented dense sheets.

Keloid scars contain excess amounts of type III collagen. In normal skin and scars the ratio of type I collagen to type III collagen is 4:1. In keloids the ratio is decreased due to excess type III collagen deposited by fibroblasts.

## REFERENCES:

1. Al-Attar A, Mess S, Thomassen JM, et al. Keloid pathogenesis and treatment. *Plast Reconstr Surg*. 2006 Jan;117(1):286-300.
2. Monstrey S, Middelkoop E, Vranckx JJ, Bassetto F, Ziegler UE, Meaume S, Téot L. Updated scar management practical guidelines: non-invasive and invasive measures. *Plast Reconstr Aesthet Surg*. 2014 Aug;67(8):1017-25.

241. After passing the written examination, a candidate is in the case collection period in preparation for the oral examination. It is the candidate's first year in group private practice, and the candidate has been added to the practice Website. Which of the following is appropriate information to place on the practice Website?

- A) Curriculum vitae, plastic surgery board eligible, and procedures
- B) Curriculum vitae, procedures, and photographs
- C) Curriculum vitae, procedures, and the American Society of Plastic Surgery (ASPS) logo
- D) Photographs, procedures, and the American Board of Plastic Surgery (ABPS) logo
- E) Plastic surgery board eligible, procedures, and the ASPS logo

**Please note: Upon further review, this item was not scored as part of the examination.**

The correct response is Option B.

According to the American Board of Plastic Surgery:

Although in the examination process, candidates may not advertise any status (including board eligible) with the Board until after successfully completing the oral examination.

Candidates also may not represent themselves as active members of the American Society of Plastic Surgeons (ASPS) by statements or use of the Society's Symbol of Excellence. The public can regard this as evidence of certification by the Board. Although the Board may not penalize a candidate for use of the Society Symbol alone, it is recommended that candidates and senior partners contact the marketing department of ASPS to determine adherence to the Society's policies before placing practice advertisements in print.

## **REFERENCES:**

1. The American Board of Plastic Surgery. Booklet of Information, July 1, 2014-June 30, 2015. Available

at: <https://www.abplasticsurgery.org/media/2711/2014-2015-abps-booklet-of-information.pdf>. Accessed January 14, 2016.

242. A 7-month-old female infant is brought to the office because of a large mass on the left side of the neck. Her parents report that the mass has been present since birth and has remained consistent proportionately in size with the child's growth. It has become firmer after a recent upper respiratory tract infection. Examination shows an active child in no distress. The mass measures  $3 \times 2$  cm at the child's left mandibular body and angle going down into the upper neck. It is easily compressible, has no pulse, and causes no pain. Which of the following is the most appropriate next step?

- A) Admission of the infant and propranolol therapy
- B) Angiography and injection of a sclerosing agent
- C) CT angiography
- D) Fine-needle aspirate biopsy
- E) MRI

The correct response is Option E.

Differential diagnosis for congenital head and neck mass in a child includes malignancy, branchial remnants, and malformations. History and physical examination suggest a vascular malformation vs. malignancies. Due to the non-emergent nature of the mass, further imaging in the form of an MRI will help elucidate the nature of the mass, specifically to see whether it is a lymphatic malformation or a venous-lymphatic malformation. MRI will also assist in demonstrating which deeper tissues are involved, such as the parotid and the neck vessels. Invasive measures which are also treatment may eventually be required; however, at this time, there is no indication for urgent treatment in the form of angiography and either embolism or sclerosis. Propranolol currently does not have a role in treatment of vascular malformations, although it does have a role in hemangioma management. CT angiography can help define whether it is an arteriovenous malformation; however, clinical examination puts that further down the differential.

## REFERENCES:

1. Flors L, Leiva-Salinas C, Maged IM, et al. MR imaging of soft-tissue vascular malformations: diagnosis, classification, and therapy follow-up. *Radiographics*. 2011 Sep-Oct;31(5):1321-1340.

2. Hovius SE, Borg DH, Paans PR, et al. The diagnostic value of magnetic resonance in combination with angiography in patients with vascular malformations: a prospective study. *Ann Plast Surg*. 1996 Sep;37(3):278-285.
3. Navarro OM, Laffan EE, Ngan BY. Pediatric soft-tissue tumors and pseudotumors: MR imaging features with pathologic correlation: part 1. Imaging approach, pseudotumors, vascular lesions, and adipocytic tumors. *Radiographics*. 2009 May-Jun;29(3):887-906

243. A 2-month-old female infant is brought to the office for evaluation of a hemangioma of the right mid cheek that has been enlarging progressively since 3 weeks of age. Physical examination shows a 1-cm-diameter and 1-cm raised lesion. Which of the following is the most appropriate management at this time?
- A) Intralesional steroid injection
  - B) Surgical resection
  - C) Systemic sirolimus therapy
  - D) Systemic steroid therapy
  - E) Observation

The correct response is Option E.

Hemangiomas are proliferative lesions that occur most often in the first weeks of life and then proceed into a proliferative phase. Involution and spontaneous regression occur for most lesions. The lesions frequently occur on the face, scalp, chest, and back but can occur on the extremities as well. The indications for treatment are related to symptoms or secondary effects such as: bleeding/ulceration, visual obstruction, and impingement on the mouth prohibiting proper feeding. Small lesions without symptoms should be observed and resolution is anticipated. However, if treatment is required, the options include intralesional or systemic steroids, systemic propranolol therapy, and surgical resection. If propranolol is used, it must be initiated cautiously with inpatient observation due to risks of hypoglycemia and bradycardia.

Sirolimus has been found to be helpful for complex lymphatic and vascular malformations. It is not indicated for hemangioma treatment.

**REFERENCES:**

1. Zheng JW, Zhang L, Zhou Q, et al. A practical guide to treatment of infantile hemangiomas of the head and neck. *Int J Clin Exp Med*. 2013 Oct 25;6(10):851-60.
2. MacIsaac ZM, Nayar HS, Gehris R, et al. Treatment for Infantile Hemangiomas: Selection Criteria, Safety, and Outcomes Using Oral Propranolol During the Early Phase of Propranolol Use for Hemangiomas. *J Craniofac Surg*. 2015 Dec 10. [Epub ahead of print].

244. A 65-year-old man comes to the office because of an infected wound to the left plantar region. Medical history includes type 2 diabetes mellitus. Dorsalis pedis and posterior tibial pulses are not palpable but are located with a handheld Doppler probe. Ankle brachial index cannot be obtained because of noncompressible vessels in the left lower extremity, below the knee. Which of the following is the most appropriate next step in evaluating the arterial perfusion of this patient's foot?

- A) Computed tomography arteriography
- B) Magnetic resonance arteriography
- C) Percutaneous arteriography
- D) Repeat ankle brachial index
- E) Toe brachial index

The correct response is Option E.

The most appropriate next step when evaluating the arterial perfusion of this diabetic patient's foot is obtaining a toe-brachial index (TBI). TBI is calculated by dividing the great toe systolic pressure by the brachial systolic pressure. An index of  $>0.7$  is considered normal.

Patients with diabetes mellitus have a higher incidence of peripheral arterial disease than the non-diabetic population. Atherosclerotic lesions in diabetic patients tend to favor the arteries below the knee, which also commonly display medial calcinosis, causing stiffening of the arterial walls, poor compressibility, and an unreliably high ankle-brachial index (ABI). Interestingly, the small vessels of the great toes are usually spared of disease, therefore the diagnostic advantage of TBIs. These features should be taken into consideration whenever assessing arterial blood flow to the distal lower extremity of a diabetic patient.

Percutaneous arteriography is an invasive procedure and should be reserved for when surgical or endovascular therapeutic interventions are anticipated. Computed tomography arteriography and magnetic resonance arteriography may also be used in the diagnosis of peripheral artery disease in the lower extremities, but a normal TBI would most likely preclude their need. Repeating the ABI would most likely render a similar result, as the inability to compress the arteries in the leg is due to stiffened vessel walls.

## REFERENCES:

1. Aerden D, Massaad D, von Kemp K, et al. The ankle--brachial index and the diabetic foot: a troublesome marriage. *Ann Vasc Surg*. 2011 Aug;25(6):770-7.
2. Creager MA, Belkin M, Bluth EI, et al. 2012 ACCF/AHA/ACR/SCAI/SIR/STS/SVM/SVN/SVS Key data elements and definitions for peripheral atherosclerotic vascular disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Clinical Data Standards (Writing Committee to develop Clinical Data Standards for peripheral atherosclerotic vascular disease). *J Am Coll Cardiol*. 2012 Jan 17;59(3):294-357.
3. Hyun S, Forbang NI, Allison MA, et al. Ankle-brachial index, toe-brachial index, and cardiovascular mortality in persons with and without diabetes mellitus. *J Vasc Surg*. 2014 Aug;60(2):390-5.

245. A 45-year-old woman comes to the office for consultation regarding severe breast asymmetry after undergoing lumpectomy and radiation therapy for ductal carcinoma of the right breast 5 years ago. Physical examination shows the radiated right breast is tight and retracted, and the left breast is ptotic. Left-sided mastopexy for symmetry and autologous fat grafting to the radiated breast are recommended. The patient asks if the procedure will be covered by insurance. Which of the following is the most appropriate response?
- A) Fat grafting the right breast will be covered by insurance but the mastopexy will be considered cosmetic and will not be covered
  - B) Insurance companies rarely cover the cost of immediate breast reconstruction
  - C) Insurance may not cover the procedure since insurers are not mandated to pay for reconstruction of lumpectomy defects
  - D) Procedures for both sides will be covered by insurance
  - E) The left-sided mastopexy will likely be covered but the fat grafting will not be covered

The correct response is Option C.

The Women's Health and Cancer Rights Act, signed into law in 1998, requires insurance plans to cover the cost of breast reconstruction after mastectomy. The law includes all stages of reconstruction as well as contralateral procedures to provide symmetry. An often misunderstood aspect of the Women's Health and Cancer Rights Act is that it does not apply to individuals undergoing breast conservation therapy (lumpectomy with radiation). As rates of breast conservation therapy have continued to increase (60% of women with stage I cancers), so have significant lumpectomy defects associated with the untoward effects of radiation. In the clinical scenario presented, the patient should be informed that the corrective operation (fat grafting and mastopexy) might not be covered by her insurance company.

## REFERENCES:

1. Sillah NM, Jee Y, Rao VK, et al. Reconstructive Surgery for Breast Cancer Patients: Have Improved Treatment Modalities Outpaced Current Legislation? *Plast Reconstr Surg*. 2015 Jul;136(1):123e-124e.

2. Xie, Y, Tang Y, Wehby GL. Federal Health Coverage Mandates and Health Care Utilization: The Case of the Women's Health and Cancer Rights Act and Use of Breast Reconstruction Surgery. *J Womens Health* (Larchmt). 2015 Aug;24(8):655-62.

246. A 28-year-old woman is scheduled to undergo office-based outpatient augmentation mammoplasty during general anesthesia. Medical history includes postoperative nausea and vomiting, and motion sickness. In addition to ondansetron 4 mg intravenously, preinduction administration of which of the following drugs is likely to be most effective in this patient?

- A) Aprepitant 40 mg orally
- B) Diphenhydramine 25 mg intravenously
- C) Droperidol 1.25 mg intravenously
- D) Metoclopramide 25 mg intravenously
- E) Promethazine 25 mg orally

The correct response is Option A.

Aprepitant 40 mg should be administered orally 1 to 3 hours before induction of anesthesia.

Postoperative nausea and vomiting is a common complication after receiving general anesthesia. The overall incidence of this complication for all operations and patient populations is approximately 30% and increases to nearly 40% in patients treated at outpatient surgery centers. In patients who are at increased risk, the incidence of postoperative nausea and vomiting can be as high as 70 to 80%. Approximately 65% of all surgical procedures are now done on an outpatient basis and, if untreated, one third of these patients will have this complication. No antiemetic is universally effective in the prevention and treatment of postoperative nausea and vomiting. Each additional prophylactic antiemetic will decrease its incidence by approximately 25%.

Aprepitant is a highly selective, brain-penetrant, neurokinin-1 receptor antagonist with a long half-life and clinical efficacy against opioid-induced vomiting. It is the first in its class to be approved for this indication. Neurokinin-1 receptor antagonists act by blocking the binding of substance P at the neurokinin-1 receptor in the brain stem emetic center and gastrointestinal tract. Because of its mechanism of action and long half-life, it is most effective when administered as prophylaxis before surgery in patients who are at high risk for postoperative nausea and vomiting.

The remaining drugs all have short durations of action and are most effective when administered postoperatively. Ondansetron is a serotonin (5-HT<sub>3</sub>) receptor antagonist that exerts its effect on the chemoreceptor trigger zone and vagal afferents in the gastrointestinal tract. Droperidol blocks dopamine receptors and has an efficacy equivalent to that of ondansetron. Promethazine is a phenothiazine that acts primarily via central antidopaminergic mechanism. Metoclopramide blocks dopamine receptors in the central vomiting center and can block serotonin receptors at high doses.

## **REFERENCES:**

1. Kolodzie K, Apfel CC. Nausea and vomiting after office-based anesthesia. *Curr Opin Anaesthesiol*. 2009 Aug;22(4):532-538.
2. Vallejo MC, Phelps AL, Ibinson JW, et al. Aprepitant plus ondansetron compared with ondansetron alone in reducing postoperative nausea and vomiting in ambulatory patients undergoing plastic surgery. *Plast Reconstr Surg*. 2012 Feb;129(2):519-526.

247. A 35-year-old woman comes to the office to discuss a recent diagnosis of breast cancer. Recent mammography showed diffuse microcalcifications throughout the breast, and needle biopsy showed infiltrating ductal carcinoma. On physical examination, some retraction of the skin in the lower outer quadrant of the breast is noted. She wears a size 36C brassiere. The patient reports that she is currently considering whether to have lumpectomy and radiation therapy or mastectomy. Which of the following features of this clinical scenario is a CONTRAINDICATION to breast conservation therapy?

- A) Breast size
- B) Mammographic findings
- C) Patient age
- D) Skin retraction on physical examination of the breast
- E) Tumor pathology

The correct response is Option B.

Breast conservation therapy (BCT) refers to breast conserving therapy followed by moderate-dose radiation to eradicate microscopic residual disease. The goal is to provide the equivalent survival of mastectomy while maintaining a cosmetically acceptable appearance with a low rate of recurrence.

When considering breast conservation therapy or mastectomy, the needs and desires of each patient should be addressed. Age alone is not a contraindication to BCT, but overall health and comorbidities should be considered. Histologic subtype and pathology are not contraindications to BCT as long as the tumor is not diffuse and can be safely excised with negative margins. Similarly, breast size needs to be considered along with tumor size and location, but “small” or “large” breasts are not indications or contraindications. While retraction of the skin, nipple, or breast parenchyma is not an absolute contraindication to BCT, as long as negative margins can be safely removed, the cosmetic impact of their involvement should be considered.

There are few absolute contraindications to BCT, but they include:

- Multicentric disease with two or more tumors in separate quadrants of the breast such that they cannot be encompassed in a single excision
- Diffuse malignant microcalcifications on mammography

- A history of prior radiation in the same breast or chest wall
- Pregnancy
- Persistently positive margins despite re-excision

## **REFERENCES:**

1. Nijenhuis MV1, Rutgers EJ. Who should not undergo breast conservation? *Breast*. 2013 Aug;22 Suppl 2:S110-4.
2. S. Litière, G. Werutsky, I.S. Fentiman, E. Rutgers, M.-R. Christiaens, E. Van Limbergen et al. Breast conserving therapy versus mastectomy for stage I-II breast cancer: 20 year follow-up of the EORTC 10801 phase 3 randomised trial. *Lancet Oncol*, 2014 Apr: 412-419.

248. A 22-lb (10-kg), 18-month-old male infant is brought to the emergency department because of second- and third-degree thermal burns on the torso and lower extremities. Examination shows burns on 30% of the total body surface area. Administration of which of the following solutions is most appropriate for initial resuscitation of this patient?

- A) Hypertonic saline
- B) Normal saline
- C) Normal saline with 5% dextrose
- D) Ringer's lactate
- E) Ringer's lactate with 5% dextrose

The correct response is Option E.

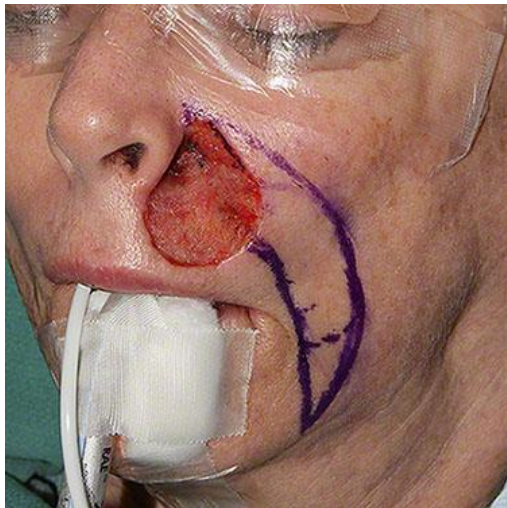
Fluid resuscitation is critical to combat the inflammatory response that occurs after a large burn and prevent the patient from going into shock. Burn injury leads to a combination of hypovolemic and distributive shock resulting from generalized microvascular injury and interstitial third spacing. The goal of fluid resuscitation is to ensure end-organ perfusion while avoiding intracompartmental edema. Ringer's lactate solution is a relatively isotonic solution that has been advocated as the key component for almost all resuscitation strategies during the first 24 to 48 hours. It is preferable to isotonic normal saline in large-volume resuscitation because its lower sodium concentration (130 mEq/L vs 154 mEq/L) and higher pH concentration (6.5 vs 5.0) are closer to physiologic levels. Ringer's lactate also has the potential added benefit of the buffering effect of metabolized lactate on the associated metabolic acidosis.

Toddlers in particular are susceptible to inadequate fluid resuscitation and should be monitored closely to ensure adequate urine output of at least 1 mg/kg/hr. In children with burns greater than 15% total body surface area, weighing less than 20 kg and younger than 2 years of age, 5% dextrose should be added to the resuscitation fluid to prevent life-threatening hypoglycemia. These younger patients have lower hepatic glycogen reserves that can be quickly depleted after such significant injuries.

Hypertonic saline and colloid solutions have been advocated and successfully used by some in large-volume resuscitation, but their use still remains controversial and not universally accepted in initial resuscitation.

## REFERENCES:

1. Armour AD, Billmire DA. Pediatric thermal injury: acute care and reconstruction update. *Plast Reconstr Surg*. 2009 Jul;124(1 Suppl):117e-127e.
2. Grunwald TB, Garner WL. Acute burns. *Plast Reconstr Surg*. 2008 May;121(5):311e-319e.



249. A 55-year-old woman has a 3-cm defect after excision of a basal cell carcinoma. A nasolabial flap is elevated, rotated, and inset into the lip defect. Photographs are shown. Plans are made to divide and inset the base of the flap, which contains the pedicle, in 3 weeks. In addition to CPT code 11643 (excision of malignant lesion including margins, face, ears, eyelids, nose, lips; excised diameter 2.1 to 3.0 cm), which of the following is the most appropriate CPT code for this procedure?

**CPT code Description**

- 13152 repair, complex, eyelids, nose, ears and/or lips 2.6 to 7.5 cm
- 14060 adjacent tissue transfer or rearrangement, eyelids, nose, ears and/or lips; defect 10 sq cm or less
- 15576 formation of direct or tubed pedicle, with or without transfer; eyelids, nose, ears, lips, or intraoral
- 15732 muscle, musculocutaneous, or fasciocutaneous flap; head and neck
- 15740 flap; island pedicle

- A) 13152
- B) 14060
- C) 15576
- D) 15732
- E) 15740

The correct response is Option C.

The correct CPT code is 15576, formation of direct or tubed pedicle, with or without transfer; eyelids, nose, ears, lips, or intraoral. CPT codes 15570 to 15650 are used to describe distant pedicled skin flaps, in contrast to adjacent tissue flaps. The nasolabial flap is a pedicled flap based on the angular branch of the facial artery. Although the nasolabial flap comes from the cheek, the correct code for this situation is based on the recipient site (lip) when the flap is attached in transfer. If this flap were elevated but delayed, then the code would be based on the donor site (15620, formation of direct or tubed pedicle, with or without transfer, forehead, cheeks, chin, mouth, neck, axillae, genitalia, hands, or feet).

Complex repairs do not involve the formation of a pedicled flap and do not create a donor site, although they do include undermining. Adjacent tissue transfer involves movement of tissue directly adjacent to the flap, such as in rotation flaps or transposition flaps. Adjacent tissue transfers are usually not staged procedures, while distant flaps (15570-15650) are often staged. The nasolabial flap is not a muscle, myocutaneous or fasciocutaneous flap. Examples of flaps included in the 15732 code include temporalis muscle flaps, temporo-parietal fascia flaps, and sternocleidomastoid muscle flaps. Island pedicle flaps are cutaneous flaps transposed into a nearby but not immediately adjacent defect, with a pedicle that incorporates an anatomically named axial vessel, and are transferred through a tunnel underneath the skin and sutured into the recipient site defect. While some nasolabial flap reconstructions are performed as island pedicle flaps, this one was not. The pedicle was left intact and division was planned at a later stage. Note that codes for excision of the basal cell cancer cannot be used in conjunction with adjacent tissue transfer (14XXX) or complex repair (131XX) series of codes.

## REFERENCES:

1. Janevicius R. CPT Corner: Clarifications on island pedicle flap code 15740. *Plastic Surgery News*. 2013 Jan-Feb:12.
2. Janevicius R. CPT Corner: Pedicle flap CPT codes describe distant flaps. *Plastic Surgery News*. 2009 Aug:12.

250. A 42-lb (19-kg), 5-year-old girl is brought to the emergency department because of multiple lacerations of the face after being bitten by a dog. Intravenous sedation is administered by the emergency room physician. The plastic surgeon initiates repair of the lacerations by infiltrating an infusion of 60 mL of 0.5% lidocaine with 1:200,000 epinephrine. Ten minutes after the procedure begins, the patient begins to have a seizure. Pulse oximetry and vital signs are within normal range. Which of the following is the most appropriate next step in management?

- A) Administer epinephrine
- B) Administer propofol
- C) Initiate lipid emulsion therapy
- D) Secure the airway and ventilate with oxygen
- E) Transfer the patient to the PICU

The correct response is Option D.

The seizure in this scenario is related to lidocaine toxicity. A seizure in this scenario can be related to head trauma, but the mechanism of injury is not likely to have caused an intracranial injury. Hypoxia can also cause a seizure but is unlikely with a functioning pulse oximeter showing good oxygen saturation and normal vital signs. Lidocaine toxicity is the most likely cause. The safe limit of lidocaine dosage is 7 mg/kg when given with epinephrine. This patient received 60 mL of 0.5% lidocaine, or 300 mg (0.5% solution contains 5 mg/cc). The safe limit for this patient is 133 mg ( $19 \times 7$ ). The first signs of lidocaine toxicity in an awake and conscious patient is tinnitus. Seizures and cardiac arrhythmias follow. Treatment is supportive with establishment of an airway and vascular access. Lipid emulsion is provided intravenously due to the lipophilic nature of the local anesthetic and therefore hastens elimination. Epinephrine toxicity causes tachyarrhythmias and hypertension. Lidocaine is an amide anesthetic.

Administration of epinephrine would be appropriate if anaphylaxis from the preservative in the local anesthesia were suspected. This would present with hypotension and tachycardia. Propofol would stop the seizures, but is contraindicated due to its confounding effects on cardiac arrhythmias in the face of lidocaine toxicity. Lipid emulsion therapy will hasten the clearance of the excess of lidocaine, however, it is first most important to secure the airway and ventilate.

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1. Wolfe JW, Butterworth JF. Local anesthetic systemic toxicity: update on mechanisms and treatment. *Curr Opin Anaesthesiol*. 2011 Oct;24(5):561-6.
2. Tierney KJ, Murano T, Natal B. Lidocaine-Induced Cardiac Arrest in the Emergency Department: Effectiveness of Lipid Therapy. *J Emerg Med*. 2016 Jan;50(1):47-50.

**Thank you for your participation.**

|    |     |     |     |     |     |
|----|-----|-----|-----|-----|-----|
| 1  | (A) | (B) | (C) | (D) | (E) |
| 2  | (A) | (B) | (C) | (D) | (E) |
| 3  | (A) | (B) | (C) | (D) | (E) |
| 4  | (A) | (B) | (C) | (D) | (E) |
| 5  | (A) | (B) | (C) | (D) | (E) |
| 6  | (A) | (B) | (C) | (D) | (E) |
| 7  | (A) | (B) | (C) | (D) | (E) |
| 8  | (A) | (B) | (C) | (D) | (E) |
| 9  | (A) | (B) | (C) | (D) | (E) |
| 10 | (A) | (B) | (C) | (D) | (E) |
| 11 | (A) | (B) | (C) | (D) | (E) |
| 12 | (A) | (B) | (C) | (D) | (E) |
| 13 | (A) | (B) | (C) | (D) | (E) |
| 14 | (A) | (B) | (C) | (D) | (E) |
| 15 | (A) | (B) | (C) | (D) | (E) |
| 16 | (A) | (B) | (C) | (D) | (E) |
| 17 | (A) | (B) | (C) | (D) | (E) |
| 18 | (A) | (B) | (C) | (D) | (E) |
| 19 | (A) | (B) | (C) | (D) | (E) |
| 20 | (A) | (B) | (C) | (D) | (E) |
| 21 | (A) | (B) | (C) | (D) | (E) |
| 22 | (A) | (B) | (C) | (D) | (E) |
| 23 | (A) | (B) | (C) | (D) | (E) |
| 24 | (A) | (B) | (C) | (D) | (E) |
| 25 | (A) | (B) | (C) | (D) | (E) |
| 26 | (A) | (B) | (C) | (D) | (E) |
| 27 | (A) | (B) | (C) | (D) | (E) |
| 28 | (A) | (B) | (C) | (D) | (E) |
| 29 | (A) | (B) | (C) | (D) |     |
| 30 | (A) | (B) | (C) | (D) | (E) |
| 31 | (A) | (B) | (C) | (D) | (E) |
| 32 | (A) | (B) | (C) | (D) | (E) |
| 33 | (A) | (B) | (C) | (D) | (E) |
| 34 | (A) | (B) | (C) | (D) | (E) |
| 35 | (A) | (B) | (C) | (D) | (E) |
| 36 | (A) | (B) | (C) | (D) | (E) |
| 37 | (A) | (B) | (C) | (D) | (E) |
| 38 | (A) | (B) | (C) | (D) |     |
| 39 | (A) | (B) | (C) | (D) |     |
| 40 | (A) | (B) | (C) | (D) |     |
| 41 | (A) | (B) | (C) | (D) | (E) |
| 42 | (A) | (B) | (C) | (D) | (E) |
| 43 | (A) | (B) | (C) | (D) | (E) |
| 44 | (A) | (B) | (C) | (D) | (E) |
| 45 | (A) | (B) | (C) | (D) | (E) |
| 46 | (A) | (B) | (C) | (D) | (E) |
| 47 | (A) | (B) | (C) | (D) | (E) |
| 48 | (A) | (B) | (C) | (D) | (E) |
| 49 | (A) | (B) | (C) | (D) | (E) |
| 50 | (A) | (B) | (C) | (D) | (E) |
| 51 | (A) | (B) | (C) | (D) | (E) |
| 52 | (A) | (B) | (C) | (D) | (E) |

|     |     |     |     |     |     |
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| 53  | (A) | (B) | (C) | (D) | (E) |
| 54  | (A) | (B) | (C) | (D) | (E) |
| 55  | (A) | (B) | (C) | (D) | (E) |
| 56  | (A) | (B) | (C) | (D) |     |
| 57  | (A) | (B) | (C) | (D) | (E) |
| 58  | (A) | (B) | (C) | (D) | (E) |
| 59  | (A) | (B) | (C) | (D) | (E) |
| 60  | (A) | (B) | (C) | (D) | (E) |
| 61  | (A) | (B) | (C) | (D) | (E) |
| 62  | (A) | (B) | (C) | (D) | (E) |
| 63  | (A) | (B) | (C) | (D) | (E) |
| 64  | (A) | (B) | (C) | (D) | (E) |
| 65  | (A) | (B) | (C) | (D) | (E) |
| 66  | (A) | (B) | (C) | (D) | (E) |
| 67  | (A) | (B) | (C) | (D) | (E) |
| 68  | (A) | (B) | (C) | (D) | (E) |
| 69  | (A) | (B) | (C) | (D) | (E) |
| 70  | (A) | (B) | (C) | (D) | (E) |
| 71  | (A) | (B) | (C) | (D) | (E) |
| 72  | (A) | (B) | (C) | (D) | (E) |
| 73  | (A) | (B) | (C) | (D) | (E) |
| 74  | (A) | (B) | (C) | (D) | (E) |
| 75  | (A) | (B) | (C) | (D) | (E) |
| 76  | (A) | (B) | (C) | (D) | (E) |
| 77  | (A) | (B) | (C) | (D) | (E) |
| 78  | (A) | (B) | (C) | (D) | (E) |
| 79  | (A) | (B) | (C) | (D) | (E) |
| 80  | (A) | (B) | (C) | (D) | (E) |
| 81  | (A) | (B) | (C) | (D) | (E) |
| 82  | (A) | (B) | (C) | (D) | (E) |
| 83  | (A) | (B) | (C) | (D) | (E) |
| 84  | (A) | (B) | (C) | (D) | (E) |
| 85  | (A) | (B) | (C) | (D) | (E) |
| 86  | (A) | (B) | (C) | (D) | (E) |
| 87  | (A) | (B) | (C) | (D) | (E) |
| 88  | (A) | (B) | (C) | (D) | (E) |
| 89  | (A) | (B) | (C) | (D) | (E) |
| 90  | (A) | (B) | (C) | (D) | (E) |
| 91  | (A) | (B) | (C) | (D) | (E) |
| 92  | (A) | (B) | (C) | (D) | (E) |
| 93  | (A) | (B) | (C) | (D) |     |
| 94  | (A) | (B) | (C) | (D) | (E) |
| 95  | (A) | (B) | (C) | (D) | (E) |
| 96  | (A) | (B) | (C) | (D) | (E) |
| 97  | (A) | (B) | (C) | (D) | (E) |
| 98  | (A) | (B) | (C) | (D) | (E) |
| 99  | (A) | (B) | (C) | (D) | (E) |
| 100 | (A) | (B) | (C) | (D) | (E) |
| 101 | (A) | (B) | (C) | (D) | (E) |
| 102 | (A) | (B) | (C) | (D) | (E) |
| 103 | (A) | (B) | (C) | (D) | (E) |
| 104 | (A) | (B) | (C) | (D) | (E) |

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 105 | (A) | (B) | (C) | (D) | (E) |
| 106 | (A) | (B) | (C) | (D) | (E) |
| 107 | (A) | (B) | (C) | (D) | (E) |
| 108 | (A) | (B) | (C) | (D) | (E) |
| 109 | (A) | (B) | (C) | (D) | (E) |
| 110 | (A) | (B) | (C) | (D) | (E) |
| 111 | (A) | (B) | (C) | (D) | (E) |
| 112 | (A) | (B) | (C) | (D) | (E) |
| 113 | (A) | (B) | (C) | (D) | (E) |
| 114 | (A) | (B) | (C) | (D) | (E) |
| 115 | (A) | (B) | (C) | (D) | (E) |
| 116 | (A) | (B) | (C) | (D) | (E) |
| 117 | (A) | (B) | (C) | (D) | (E) |
| 118 | (A) | (B) | (C) | (D) | (E) |
| 119 | (A) | (B) | (C) | (D) | (E) |
| 120 | (A) | (B) | (C) | (D) | (E) |
| 121 | (A) | (B) | (C) | (D) | (E) |
| 122 | (A) | (B) | (C) | (D) | (E) |
| 123 | (A) | (B) | (C) | (D) | (E) |
| 124 | (A) | (B) | (C) | (D) | (E) |
| 125 | (A) | (B) | (C) | (D) | (E) |
| 126 | (A) | (B) | (C) | (D) | (E) |
| 127 | (A) | (B) | (C) | (D) | (E) |
| 128 | (A) | (B) | (C) | (D) | (E) |
| 129 | (A) | (B) | (C) | (D) | (E) |
| 130 | (A) | (B) | (C) | (D) | (E) |
| 131 | (A) | (B) | (C) | (D) | (E) |
| 132 | (A) | (B) | (C) | (D) | (E) |
| 133 | (A) | (B) | (C) | (D) | (E) |
| 134 | (A) | (B) | (C) | (D) | (E) |
| 135 | (A) | (B) | (C) | (D) | (E) |
| 136 | (A) | (B) | (C) | (D) | (E) |
| 137 | (A) | (B) | (C) | (D) | (E) |
| 138 | (A) | (B) | (C) | (D) | (E) |
| 139 | (A) | (B) | (C) | (D) | (E) |
| 140 | (A) | (B) | (C) | (D) | (E) |
| 141 | (A) | (B) | (C) | (D) | (E) |
| 142 | (A) | (B) | (C) | (D) | (E) |
| 143 | (A) | (B) | (C) | (D) | (E) |
| 144 | (A) | (B) | (C) | (D) | (E) |
| 145 | (A) | (B) | (C) | (D) | (E) |
| 146 | (A) | (B) | (C) | (D) | (E) |
| 147 | (A) | (B) | (C) | (D) | (E) |
| 148 | (A) | (B) | (C) | (D) | (E) |
| 149 | (A) | (B) | (C) | (D) | (E) |
| 150 | (A) | (B) | (C) | (D) | (E) |
| 151 | (A) | (B) | (C) | (D) | (E) |
| 152 | (A) | (B) | (C) | (D) | (E) |
| 153 | (A) | (B) | (C) | (D) | (E) |
| 154 | (A) | (B) | (C) | (D) | (E) |
| 155 | (A) | (B) | (C) | (D) |     |
| 156 | (A) | (B) | (C) | (D) | (E) |

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 157 | (A) | (B) | (C) | (D) | (E) |
| 158 | (A) | (B) | (C) | (D) | (E) |
| 159 | (A) | (B) | (C) | (D) | (E) |
| 160 | (A) | (B) | (C) | (D) | (E) |
| 161 | (A) | (B) | (C) | (D) | (E) |
| 162 | (A) | (B) | (C) | (D) | (E) |
| 163 | (A) | (B) | (C) | (D) | (E) |
| 164 | (A) | (B) | (C) | (D) | (E) |
| 165 | (A) | (B) | (C) | (D) | (E) |
| 166 | (A) | (B) | (C) | (D) | (E) |
| 167 | (A) | (B) | (C) | (D) |     |
| 168 | (A) | (B) | (C) | (D) | (E) |
| 169 | (A) | (B) | (C) | (D) | (E) |
| 170 | (A) | (B) | (C) | (D) | (E) |
| 171 | (A) | (B) | (C) | (D) | (E) |
| 172 | (A) | (B) | (C) | (D) |     |
| 173 | (A) | (B) | (C) | (D) | (E) |
| 174 | (A) | (B) | (C) | (D) | (E) |
| 175 | (A) | (B) | (C) | (D) | (E) |
| 176 | (A) | (B) | (C) | (D) | (E) |
| 177 | (A) | (B) | (C) | (D) | (E) |
| 178 | (A) | (B) | (C) | (D) | (E) |
| 179 | (A) | (B) | (C) | (D) | (E) |
| 180 | (A) | (B) | (C) | (D) | (E) |
| 181 | (A) | (B) | (C) | (D) | (E) |
| 182 | (A) | (B) | (C) | (D) | (E) |
| 183 | (A) | (B) | (C) | (D) | (E) |
| 184 | (A) | (B) | (C) | (D) | (E) |
| 185 | (A) | (B) | (C) | (D) | (E) |
| 186 | (A) | (B) | (C) | (D) |     |
| 187 | (A) | (B) | (C) | (D) | (E) |
| 188 | (A) | (B) | (C) | (D) | (E) |
| 189 | (A) | (B) | (C) | (D) | (E) |
| 190 | (A) | (B) | (C) | (D) | (E) |
| 191 | (A) | (B) | (C) | (D) | (E) |
| 192 | (A) | (B) | (C) | (D) | (E) |
| 193 | (A) | (B) | (C) | (D) | (E) |
| 194 | (A) | (B) | (C) | (D) | (E) |
| 195 | (A) | (B) | (C) | (D) | (E) |
| 196 | (A) | (B) | (C) | (D) | (E) |
| 197 | (A) | (B) | (C) | (D) | (E) |
| 198 | (A) | (B) | (C) | (D) | (E) |
| 199 | (A) | (B) | (C) | (D) | (E) |
| 200 | (A) | (B) | (C) | (D) | (E) |
| 201 | (A) | (B) | (C) | (D) | (E) |
| 202 | (A) | (B) | (C) | (D) | (E) |
| 203 | (A) | (B) | (C) | (D) | (E) |
| 204 | (A) | (B) | (C) | (D) | (E) |
| 205 | (A) | (B) | (C) | (D) | (E) |
| 206 | (A) | (B) | (C) | (D) | (E) |
| 207 | (A) | (B) | (C) | (D) | (E) |
| 208 | (A) | (B) | (C) | (D) |     |

|            |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|
| <b>209</b> | (A) | (B) | (C) | (D) | (E) |
| <b>210</b> | (A) | (B) | (C) | (D) | (E) |
| <b>211</b> | (A) | (B) | (C) | (D) | (E) |
| <b>212</b> | (A) | (B) | (C) | (D) | (E) |
| <b>213</b> | (A) | (B) | (C) | (D) | (E) |
| <b>214</b> | (A) | (B) | (C) | (D) | (E) |
| <b>215</b> | (A) | (B) | (C) | (D) | (E) |
| <b>216</b> | (A) | (B) | (C) | (D) | (E) |
| <b>217</b> | (A) | (B) | (C) | (D) | (E) |
| <b>218</b> | (A) | (B) | (C) | (D) | (E) |
| <b>219</b> | (A) | (B) | (C) | (D) |     |
| <b>220</b> | (A) | (B) | (C) | (D) | (E) |
| <b>221</b> | (A) | (B) | (C) | (D) | (E) |
| <b>222</b> | (A) | (B) | (C) | (D) | (E) |
| <b>223</b> | (A) | (B) | (C) | (D) | (E) |
| <b>224</b> | (A) | (B) | (C) | (D) | (E) |
| <b>225</b> | (A) | (B) | (C) | (D) | (E) |
| <b>226</b> | (A) | (B) | (C) | (D) | (E) |
| <b>227</b> | (A) | (B) | (C) | (D) | (E) |
| <b>228</b> | (A) | (B) | (C) | (D) | (E) |
| <b>229</b> | (A) | (B) | (C) | (D) | (E) |

|            |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|
| <b>230</b> | (A) | (B) | (C) | (D) | (E) |
| <b>231</b> | (A) | (B) | (C) | (D) | (E) |
| <b>232</b> | (A) | (B) | (C) | (D) | (E) |
| <b>233</b> | (A) | (B) | (C) | (D) |     |
| <b>234</b> | (A) | (B) | (C) | (D) | (E) |
| <b>235</b> | (A) | (B) | (C) | (D) | (E) |
| <b>236</b> | (A) | (B) | (C) | (D) | (E) |
| <b>237</b> | (A) | (B) | (C) | (D) | (E) |
| <b>238</b> | (A) | (B) | (C) | (D) | (E) |
| <b>239</b> | (A) | (B) | (C) | (D) | (E) |
| <b>240</b> | (A) | (B) | (C) | (D) | (E) |
| <b>241</b> | (A) | (B) | (C) | (D) | (E) |
| <b>242</b> | (A) | (B) | (C) | (D) | (E) |
| <b>243</b> | (A) | (B) | (C) | (D) | (E) |
| <b>244</b> | (A) | (B) | (C) | (D) | (E) |
| <b>245</b> | (A) | (B) | (C) | (D) | (E) |
| <b>246</b> | (A) | (B) | (C) | (D) | (E) |
| <b>247</b> | (A) | (B) | (C) | (D) | (E) |
| <b>248</b> | (A) | (B) | (C) | (D) | (E) |
| <b>249</b> | (A) | (B) | (C) | (D) | (E) |
| <b>250</b> | (A) | (B) | (C) | (D) | (E) |