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You may take the In-Service Examination offline, but you must submit your answers online. Select the “Download In-Service Exam (PDF)” link to open and print the pdf version of the exam. There will be notations next to the color pictorials if you do not have a color printer. When you are ready to enter your answers online, initiate your exam by selecting the “Start Exam” link and read and acknowledge the honor code statement. Pause the exam, and then select the “Enter answer sheet” link provided on the website; more specific details are provided below. You may save and print the answer sheet at any time, but do not select “Submit” until all responses have been entered.

Once you have completed your examination offline, follow these steps to enter and submit your answers for scoring.

- Log in to the website.
- Select the “Start Exam” link and read and acknowledge the honor code statement.
- Pause the exam.
- Select the “Enter answer sheet” link.
- Enter your answers in the provided form. If the form already contains answers, these are the answers you previously entered in your online examination or using the answer sheet.
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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.

Please note that choosing to enter your responses through the online answer sheet will limit your ability to view answers and solutions interactively as you complete items.

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American Society of Plastic Surgeons In-Service Examination



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

Material released March 2022.

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The In-Service Examination is comprised of a question and answer examination, individual score sheet, norm table and syllabus which includes questions, answers and references. The materials have been compiled by the ASPS In-Service Examination Committee along with National Board of Medical Examiners professional staff. All questions were reviewed and found to be objective and supported by appropriate review of the literature and align with evidence-based research. Content in this educational activity has been reviewed by peers and professionals to determine that the content is fair, balanced and unbiased.

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HONOR CODE STATEMENT

for the

In-Service Examination



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Section 1: Comprehensive

1. A 26-year-old woman presents for buttock augmentation. BMI is 19.1 kg/m². Due to lack of donor sites for autologous fat transfer, gluteal augmentation with silicone implants is planned. Which of the following is the most common complication following this procedure?

- A) Fat embolism
- B) Hematoma
- C) Infection
- D) Seroma
- E) Wound dehiscence

The correct response is Option E.

Silicone implants can be used to augment the buttocks, especially when there are limited donor sites for autologous fat transfer. The use of silicone implants confers a greater risk for perioperative complications than fat grafting alone. The most common complication is wound dehiscence, which has been reported to occur in 9.6% of patients. Efforts to reduce wound complications have included the use of bilateral parasacral incisions as opposed to one gluteal cleft incision. Complications are more common after subfascial placement than after intra- or submuscular placement. Seroma, infection, and hematoma occur in 4.6, 1.9, and 0.6% of patients, respectively. Fat embolus is a rare but dangerous complication associated with fat grafting, not silicone implants.

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2. Which of the following structures contains apocrine sweat glands?

- A) Areola
- B) Glans penis
- C) Labia minora
- D) Palms of the hands
- E) Vermilion border of the lips

The correct response is Option A.

Sweat glands are of three types: eccrine, apocrine, and apoeccrine. Apocrine glands are located in the areola, axilla, labia majora, scrotum, prepuce, periumbilical, and perianal areas. Their ducts deposit sweat into hair follicles. Apocrine glands start functioning at puberty and secrete a fluid that contains several compounds, some of which are broken down by bacteria to generate odor. Their secretions also contain pheromones. Apocrine glands are thought to be involved in the pathogenesis of hidradenitis suppurativa.

Eccrine sweat glands are distributed throughout the body, except the vermilion border of the lip, nail bed, external auditory canal, nipples, labia minora, glans penis, and clitoris. The palms and soles have the highest density of eccrine sweat glands in the body. Their ducts deposit sweat directly onto the skin surface. This sweat is a clear, colorless, and odorless fluid that contains water and electrolytes. Their main function is temperature homeostasis. They also participate in the barrier function of skin by secreting immunoglobulins. Eccrine glands also contain stem cells that play an important role in skin repair and wound epithelialization. Abnormally increased activity of these glands in response to emotional stimuli results in hyperhidrosis.

Apoeccrine glands share histologic features of both apocrine and eccrine glands and present in the axilla and perianal areas. They secrete watery sweat in response to psychological stress. High numbers of these glands are thought to be an etiologic factor in patients with axillary hyperhidrosis.

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1. Nawrocki S, Cha J. The etiology, diagnosis, and management of hyperhidrosis: a comprehensive review: etiology and clinical work-up. *J Am Acad Dermatol*. 2019;81(3):657-666.

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2. Wenzel FG, Horn TD. Nonneoplastic disorders of the eccrine glands. *J Am Acad Dermatol.* 1998;38(1):1-17; quiz 18-20.
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3. A 43-year-old African American woman presents after undergoing Wise pattern reduction mammoplasty 6 months ago. Examination shows bilateral medial inframammary scars that are raised and pruritic but have not extended beyond the original incision sites. Intralesional injection of triamcinolone (TAC) is planned. Which of the following drugs, when administered in combination with TAC, will improve long-term efficacy?
- A) 5-Fluorouracil
 - B) Diphenhydramine
 - C) Methotrexate
 - D) Tamoxifen
 - E) Verapamil

The correct response is Option A.

This patient has hypertrophic scars. Injection of 5-fluorouracil (5-FU) and TAC has been shown in randomized trials to be superior to TAC alone in the treatment of hypertrophic scars. Studies have used a regimen of 4 mg TAC and 45 mg 5-FU once a week for 8 weeks and showed reductions in Patient and Observer Scar Assessment Scales. In low doses, methotrexate (MTX) has anti-inflammatory effects mediated by adenosine A2 receptors. Oral MTX has shown promise in preventing recurrence of keloids after excision, but no definitive randomized data yet exist. Verapamil has been shown to be inferior to intralesional TAC in a randomized trial. Tamoxifen and diphenhydramine have mechanistic interest in the treatment of hypertrophic scars, but no data currently exist.

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1. Abedini R, Sasani P, Mahmoudi HR, et al. Comparison of intralesional verapamil versus intralesional corticosteroids in treatment of keloids and hypertrophic scars: a randomized controlled trial. *Burns*. 2018;44:1482-1488.
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4. A 55-year-old man presents with ventral incisional hernia of the abdomen. BMI is 32 kg/m². Medical history includes an exploratory laparotomy following a traumatic injury 1 year ago. The abdominal fascia was closed primarily at the end of the procedure. Physical examination shows a fascial deficit 10 cm in width. CT scan demonstrates that rectus muscles are intact bilaterally and 12 cm apart in the periumbilical region. Hernia repair is performed, but the fascia cannot be brought together primarily at the midline. Which of the following operations is most likely to result in the lowest risk for future hernia formation in this patient?
- A) Bilateral component separation
 - B) Bilateral component separation with onlay mesh reconstruction
 - C) Bilateral component separation with underlay mesh reconstruction
 - D) Inlay mesh reconstruction
 - E) Unilateral component separation

The correct response is Option C.

Long-term hernia risk is lowest following primary fascial closure and placement of mesh, either in the retrorectus position or as an underlay. Inlay mesh reconstruction, in which primary fascial closure is not possible and the mesh serves as a bridge, is associated with the highest rates of abdominal hernia formation. Unilateral or bilateral component separation may allow for primary fascial closure, but placement of a mesh augments the repair and reduces hernia recurrence. Regarding onlay mesh placement, in which the mesh is placed superficial to the fascia, hernia recurrence rates have been shown to be higher in obese patients than when the mesh is placed as an underlay.

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5. An otherwise-healthy 45-year-old woman presents for discussion regarding autologous breast reconstruction following mastectomy. Medical history includes abdominoplasty following the birth of her last child. After examination, the surgeon determines that she is a good candidate for bilateral lumbar artery perforator flaps. During the preoperative discussion, the surgeon compares the risks, benefits, and expected outcomes between lumbar artery perforator flaps and deep inferior epigastric artery perforator (DIEP) flaps, which are the surgeon's typical initial choice for autologous tissue transfer. Which of the following complications is associated with lumbar artery perforator flaps when compared with DIEP flaps?

- A) Higher breast dissatisfaction rate
- B) Higher hematoma rate
- C) Higher secondary revision rate
- D) Higher total flap loss rate

The correct response is Option D.

Lumbar artery perforator (LAP) flaps have recently been shown to be a good autologous breast reconstruction option when deep inferior epigastric perforator (DIEP) flaps are not available. LAPs do carry a higher total flap loss rate with reports of 6.6 to 9% compared with less than 2% for DIEPs. Based on the microvascular compromises, which are reported to be more venous than arterial, the take-back rate on LAPs is also expectantly higher than DIEPs. Hematoma and secondary revision rates are very similar between the two groups. Based on BREAST-Q data, the satisfaction rate in the breast reconstruction is also very similar between the two groups. This is not the case in satisfaction rate of the donor site, where responses were lower in LAPs compared with DIEPs. This is likely due to a higher donor site complication rate in the form of seromas and postoperative pain.

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6. An otherwise healthy 55-year-old man is diagnosed with a soft-tissue sarcoma of his mid-anterior leg. Neoadjuvant radiation therapy is performed, followed by wide local excision. A superficial circumflex iliac perforator-based flap is planned for reconstruction of the 10 × 5-cm defect. Which of the following is the main advantage of this flap over a radial forearm flap?
- A) Ability to neurotize the flap
 - B) Ease of flap harvest
 - C) Length of pedicle
 - D) Lower donor site morbidity
 - E) Thickness of flap

The correct response is Option D.

The main advantage of the superficial circumflex iliac perforator-based (SCIP) flap over the radial forearm flap (RFF) is the improved donor site outcome. The SCIP flap can be primarily closed in most cases, whereas most RFF donor sites need a split skin graft to get closure. Additionally, the groin donor site is in a relatively hidden area compared with the RFF. The SCIP flap is a more difficult flap to raise compared with the RFF, and also has a smaller diameter and length of pedicle. Both flaps are known for being raised as thin flaps and can potentially be neurotized, with the SCIP utilizing an intercostal nerve branch, whereas the RFF uses the lateral and/or medial antebrachial cutaneous nerve(s).

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7. A 56-year-old man with a history of liposarcoma of the thigh treated with surgery and radiation presents with a significant contour deformity that he would like corrected. Fat grafting is planned. Which of the following factors has been shown to affect graft take?

- A) Centrifugation speed
- B) Donor site location
- C) Harvesting cannula diameter
- D) Injection cannula diameter
- E) Reinjection speed

Upon further review, this item was not scored as part of the examination.

The correct response is Option E.

A slower rate of fat graft reinjection, which results in a lower shear stress, has been shown to result in increased fat graft survival in a mouse model. Despite the popularity and high volume of fat grafting cases, further studies are needed to define optimal methods for fat graft harvesting, processing, and reinjection. Currently there are no data to support the idea that one donor site is superior to another. Likewise, research has shown that harvesting and injection cannula diameter and centrifugation speed have no significant effect on fat graft survival. Taken in aggregate, the current literature does not support a universal optimized approach to fat grafting but does suggest that gentle handling of the grafts is beneficial.

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8. A 42-year-old woman presents 1 week following exchange of tissue expander for permanent implant, in which skin glue was used for closure. She reports an itchy rash around her incision. Medical history includes right breast cancer, for which she has undergone mastectomy and placement of a pre-pectoral textured tissue expander with acellular dermal allograft coverage. She is afebrile. A photograph is shown. Which of the following is the most likely cause of this rash?
- A) Anaplastic large-cell lymphoma infiltration of the skin
 - B) Antiphospholipid antibody-mediated urticaria
 - C) Cyanoacrylate exposure and dermatitis
 - D) Lymphatic disruption leading to red breast syndrome
 - E) *Staphylococcus aureus* cellulitis

The correct response is Option C.

The patient has recently had surgery and is doing well except for her skin rash. The rash appears to be localized to the incision. Contact dermatitis to surgical adhesives is a common problem. There is growing recognition that surgical glues containing cyanoacrylate may be associated with a 10 to 15% rate of rashes secondary to Type IV allergic hypersensitivity

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reactions. These typically appear within 3 to 7 days and are treated by removal of the surgical glue and topical steroid cream. Patients who have previously been exposed to surgical glue are more at risk for developing sensitivity.

Surgical site infection is a concern following implant placement. However, a Staph cellulitis is typically more diffuse and has a different appearance more consistent with erythema rather than a rash. Antiphospholipid syndrome (APS) may be associated with a rash and other systemic symptoms; however, there is no indication within the history that this patient suffers from that condition. Additionally, the timing and location of the rash along the incision point to other local causes rather than APS. Lymphatic disruption is one theory to explain red breast syndrome, which is a condition that has been reported in relation to acellular dermal matrix placement. This is typically more diffuse and usually occurs in the acute setting following acellular dermal matrix placement. Anaplastic large-cell lymphoma is a rare type of cancer that may be associated with breast implants and may present with swelling and a rash. There is a higher rate of this condition in patients who have had textured devices. The mean onset for this condition is 8 years after exposure to the breast implant. This patient's clinical course is not typical of anaplastic large cell lymphoma.

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9. A 52-year-old man with paraplegia presents with a stage IV right trochanteric pressure ulcer. Examination shows appropriate nutrition by history, laboratory values, and weight stability. He doesn't smoke, has a pressure mattress at home, and has demonstrated compliance with pressure off-loading. At the time of pressure sore excision, which of the following reconstructive options is most appropriate for this patient?
- A) Gluteus V-Y musculocutaneous advancement flap
 - B) Gracilis musculocutaneous flap
 - C) Posterior thigh musculocutaneous flap
 - D) Profunda artery perforator fasciocutaneous flap
 - E) Tensor fascia lata musculocutaneous flap

The correct response is Option E.

The correct flap option for this patient is the tensor fascia lata (TFL) musculocutaneous flap which can be advanced in either a V-Y fashion or as a repositioned flap if the defect is on the posterior aspect of the trochanter. The pedicle to the TFL flap is the ascending branch of the lateral femoral circumflex artery, and the nerve supply to the skin paddle is through the lateral cutaneous sensory nerve of the thigh. The motor branch to the TFL muscle is a branch of the superior gluteal nerve. This musculocutaneous flap can be re-advanced if there is pressure sore recurrence. In the series referenced, 77% of patients reconstructed with this flap for trochanteric pressure sores healed uneventfully, while two-thirds of the remaining patients healed completely with local wound care. The gracilis and profunda artery perforator flaps have an arc of rotation that makes them more suited to ischial wounds and vaginal reconstructive indications. Gluteal advancement flaps are indicated for sacral pressure sore reconstruction, and posterior thigh flaps could reach the trochanteric surgical site but could not be re-advanced.

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10. A 56-year-old woman presents with significant capsular contracture and deformity of her left reconstructed breast 3 years after undergoing bilateral mastectomy, left-sided radiation therapy, and subsequent two-stage implant reconstruction. A photograph is shown. She has a history of abdominoplasty. Which of the following is the most reliable way to achieve an acceptable reconstruction in this patient?
- A) Conversion to prepectoral plane with acellular dermal allograft
 - B) Deep inferior epigastric perforator flap
 - C) Implant exchange with capsulectomy and acellular dermal allograft
 - D) Implant exchange with capsulotomy
 - E) Latissimus dorsi flap with expander

The correct response is Option E.

In this patient with a history of left-sided radiation and a severely contracted and deformed implant, the most reliable way to achieve an acceptable reconstruction would be to convert to some form of autologous reconstruction. Given her prior history of abdominoplasty, a deep inferior epigastric perforator flap is not feasible. A latissimus dorsi flap with an expander is a reliable option. Implant exchange with capsulotomy would have an extremely high risk for recurrence of capsular contracture and deformity. Capsulectomy with acellular dermal allograft replacement would have a fairly high risk for complications due to adding yet more foreign body to a radiated tissue bed, and there would still be a high risk for recurrent capsular contracture. Conversion to a prepectoral plane with acellular dermal allograft would have a potentially higher risk for complications because even more foreign body is required to fully wrap the implant.

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11. A 76-year-old woman presents with swelling of her right reconstructed breast, which was performed with a textured implant 14 years ago. Ultrasound demonstrates an uncomplicated fluid collection. The patient denies pain, fevers, or chills. Enrichment of which of the following cell surface markers within the aspirated fluid is suggestive of breast implant-associated anaplastic large cell lymphoma?
- A) CD3
 - B) CD15
 - C) CD30
 - D) CD34
 - E) CD45

The correct response is Option C.

Breast implant-associated anaplastic large cell lymphoma (BIA-ALCL), a type of T-cell lymphoma, is associated with textured implants. Initial diagnosis is often made following ultrasound. CD30 is a cell surface marker detected on T-cells associated with BIA-ALCL. The other cell surface markers are not associated with BIA-ALCL. These cells are also anaplastic lymphoma kinase (ALK) negative. CD3 and CD15 are nonspecific lymphocyte markers not related to BIA-ALCL. CD34 is an endothelial cell marker. CD45 is a marker expressed on all leukocytes.

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12. A 5-year-old girl with sarcoma of the left femur undergoes resection with a limb salvage approach including an intercalary allograft for bone reconstruction. Allografts are preferred for large segmental defects of the femur and tibia compared with cancellous bone grafts due to which of the following factors?
- A) Higher mechanical strength
 - B) Improved osteoconduction
 - C) Increased graft take
 - D) Lower cost

The correct response is Option A.

Large defects of the femur and tibia are typically reconstructed with intercalary allografts due to their high mechanical strength. This type of reconstruction can be augmented with an intramedullary free fibula flap, which has been shown to reduce long-term complications.

Cancellous bone grafts offer superior osteogenesis, osteoinduction, and graft take in comparison with cortical grafts and allografts. Cost is not a significant consideration in reconstructing these highly complex defects. While an allograft has no donor site morbidity compared with autologous cancellous bone grafts, this is not the primary reason for their use in the described clinical scenario.

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13. An otherwise-healthy 50-year-old man undergoes resection and immediate reconstruction with an anterolateral thigh free flap for recurrent squamous cell carcinoma of the oral cavity. Medical history includes resection, primary closure, and radiation. Intraoperatively, the patient is receiving low-dose phenylephrine infusion for blood pressure maintenance. Which of the following strategies is most likely to decrease the risk for pedicle thrombosis in this patient?
- A) Administration of intravenous fluid boluses to wean off phenylephrine
 - B) Anastomosis to nonradiated recipient neck vessels
 - C) End-to-end anastomosis instead of end-to-side anastomosis
 - D) Intravenous heparin bolus 10 minutes before pedicle ligation
 - E) Venous anastomosis to internal jugular vein instead of the external jugular vein

The correct response is Option B.

Anastomoses performed in radiated fields have higher rates of flap loss as compared with nonradiated recipient neck vessels in head and neck reconstruction. Systemic heparin has not been shown to decrease pedicle thrombosis. However, vessel irrigation with topical heparin has been shown to decrease thrombosis at the anastomosis site in animal models, and therefore, most microsurgeons perform this practice. Vasopressors do not increase the risk for pedicle thrombosis. A recent meta-analysis showed a decreased rate of pedicle thrombosis with perioperative vasopressor administration in head and neck reconstruction, likely due to improved hemodynamics and decreased detrimental effects of fluid overload. There is no difference in pedicle thrombosis rate between end-to-end and end-to-side arterial or venous anastomosis, as shown in a recent meta-analysis. There is no proven difference in vessel patency rates between the internal jugular and external jugular systems.

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14. An 80-year-old man presents with a primary basal cell carcinoma of the left upper lip. Which of the following factors is associated with the highest risk for recurrence?
- A) Desmoplastic subtype
 - B) Perineural involvement
 - C) Poor differentiation
 - D) Primary lesion
 - E) Well-circumscribed borders

The correct response is Option B.

Perineural involvement is the factor most associated with high risk for recurrence of basal cell carcinoma.

Poorly defined borders, a recurrent lesion, an immunosuppressed patient, the site of prior radiotherapy, perineural involvement, and an aggressive histologic subtype (morpheaform, basosquamous, sclerosing, mixed infiltrative, or micronodular) are the factors associated with a high risk for recurrence of basal cell carcinoma.

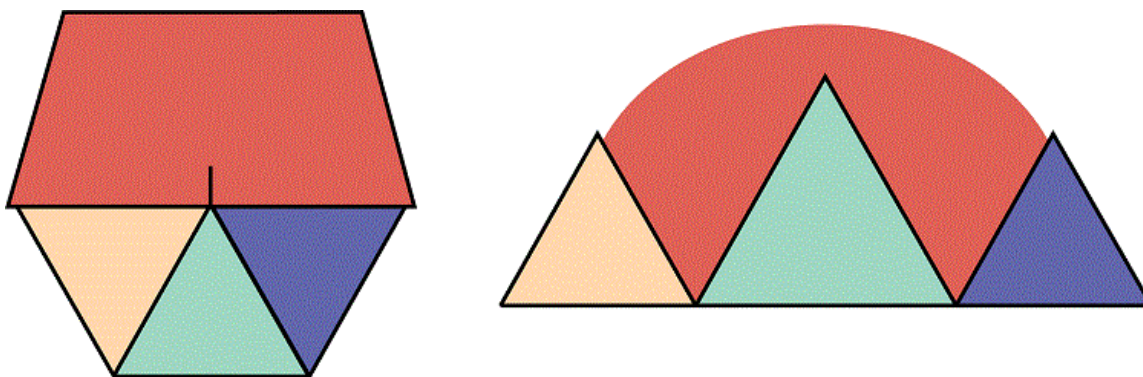
Poorly defined borders, recurrent disease, an immunosuppressed patient, the site of prior radiotherapy or chronic inflammation, a rapidly growing tumor, neurologic symptoms, perineural or vascular involvement, poor differentiation, or adenoid, adenosquamous, or desmoplastic subtypes are the factors associated with a high risk for recurrence of squamous cell carcinoma.

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15. A 24-year-old man presents with a burn contracture of the third web space of the hand. A jumping man (five flap) plasty is planned. In this technique, the final position of the central flap is achieved through which of the following techniques?
- A) 45-degree transposition
 - B) 60-degree transposition
 - C) 75-degree transposition
 - D) V-Y advancement
 - E) Y-V advancement



The correct response is Option E.

In the jumping man or five flap plasty, the central flap is advanced through a Y to V method where the tip of the V is advanced into an incision made in the opposing tissue. There are different modifications to this technique for local flap lengthening of flexion contractures. Traditionally, the lateral limbs are designed with 60-degree angles to the central limb and the opposing limbs are designed more obtusely to prevent ischemia at the base. This type of reconstruction requires laxity of the surrounding skin and is therefore most often employed in places like the medial canthus, web spaces of the feet and hands, or the axilla.

A V-Y advancement is commonly used in pressure ulcer repair where the base of the V is advanced into the defect to create a Y. This is the opposite of what one is trying to achieve in a jumping man plasty. Transpositions of 75, 60, and 45 degrees are all different variations of z-plasties and are utilized in this local rearrangement, but the central flap is advanced, not transposed/rotated.

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16. A 45-year-old woman presents for bilateral immediate breast reconstruction. An abdominal flap is planned. The patient demands reconstruction with a flap that has the lowest abdominal wall morbidity since she is a yoga and pilates instructor. Which of the following autologous flaps utilized for breast reconstruction results in the lowest rate of abdominal wall morbidity?
- A) Deep inferior epigastric perforator flap
 - B) Free transverse rectus abdominus myocutaneous flap
 - C) Muscle-sparing free transverse rectus abdominus myocutaneous flap
 - D) Pedicled transverse rectus abdominus myocutaneous flap
 - E) Superficial inferior epigastric artery flap

The correct response is Option E.

Of all the abdominally based flaps listed for breast reconstruction, only the superficial inferior epigastric artery (SIEA) flap does not violate the abdominal fascia. Each of the other flaps are associated with abdominal bulge or hernia formation. Pedicled and free transverse rectus abdominus myocutaneous (TRAM) flaps both involve the harvest of significant abdominal muscle and are associated with more abdominal wall dysfunction than with deep inferior epigastric perforator (DIEP) flaps. It is unclear whether there is a difference in abdominal wall morbidity following muscle-sparing free TRAMs versus DIEPs. However, only the SIEA flap offers no muscle dissection or violation of the abdominal fascia.

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17. A 45-year-old woman is undergoing an abdominoplasty. The plastic surgeon plans to perform a regional block to target the anterior divisions of the spinal segmental nerves. Which of the following is the most appropriate abdominal plane for injection of the numbing medication?
- A) Between the external oblique muscle and the internal oblique muscle
 - B) Between the internal oblique muscle and the transversus abdominis muscle
 - C) Between the skin and the external oblique muscle
 - D) Between the transversus abdominis muscle and the peritoneum

The correct response is Option B.

A transversus abdominis plane (TAP) block is best performed between the internal oblique muscle and the transversus abdominis muscle, and it is often used during abdominoplasty surgery and abdominal wall reconstruction surgery.

The three major muscles of the anterolateral abdominal wall are the external oblique muscle, the internal oblique muscle, and the transversus abdominis muscle. The innervation of the anterolateral abdominal wall is provided by the thoracoabdominal nerves and the ilioinguinal and iliohypogastric nerves. The TAP block targets these nerves in the plane between the internal oblique muscle and the transversus abdominis muscle.

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18. An otherwise healthy 25-year-old woman has a diffuse, microcystic, lymphatic malformation in her pelvis and perineum. It involves the skin and subcutaneous tissues of the region, along with diffuse involvement of the pelvic muscles. Which of the following would be the most effective treatment for her condition?

- A) Intralesional steroid injection
- B) Propranolol therapy
- C) Sclerotherapy
- D) Sirolimus therapy
- E) Surgical excision

The correct response is Option D.

The most effective and reasonable treatment option would be systemic sirolimus therapy. Recent studies have shown that sirolimus is extremely effective in treating and clinically reducing the size of venous (90%) and lymphatic malformations (LM) (95%). It is especially useful in treating vascular tumors associated with Kasabach-Merritt phenomenon (96%, along with 93% normalization of coagulopathy).

Propranolol therapy and intralesional steroid injection are treatments for hemangiomas, not malformations. Sclerotherapy would be useful in macrocystic LM but not microcystic LM. Surgical excision would be too destructive an option in this case given the location, diffuse nature of the disease, and the structures involved.

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19. A 24-year-old man with a history of opioid use disorder is scheduled to undergo closed reduction and percutaneous Kirschner wire fixation of a right fifth metacarpal fracture. The patient is placed on an enhanced recovery after surgery (ERAS) protocol. Which of the following medications used to treat pain binds to voltage-gated calcium channels?
- A) Acetaminophen
 - B) Gabapentin
 - C) Ketamine
 - D) Lidocaine
 - E) Oxycodone

The correct response is Option B.

Gabapentin is a structural analogue of the neurotransmitter gamma-aminobutyric acid and has high affinity to voltage-gated calcium channels at presynaptic terminals of hyperexcited neurons through reduction in depolarization-influx of calcium required for release of excitatory neurotransmitters, including glutamate, noradrenaline, dopamine, and serotonin. The exact nature of its analgesic effect is incompletely understood. Contemporary evidence demonstrates that perioperative administration in conjunction with an ERAS protocol is associated with a significant reduction in postoperative opioid use.

Lidocaine is an amide local anesthetic that decreases the excitation threshold of nociceptive afferent neurons by decreasing neuronal membrane permeability through voltage-gated sodium channels. The inhibition of neuronal depolarization results in blockade of pain transmission.

Oxycodone is a semi-synthetic opioid that is primarily the mu-opioid receptor agonist that opens calcium-dependent inward-rectifying potassium channels, which causes hyperpolarization and reduced excitability of neuronal ascending pain pathways.

Acetaminophen was previously believed to exert its analgesic effect by inhibiting cyclooxygenase enzymes 1 and 2. Recent investigations demonstrated that the main analgesic mechanism is the metabolite p-aminophenol, which crosses the blood-brain barrier and is converted to N-acylphenolamine (AM404). AM404 then acts on the

transient receptor potential vanilloid subtype 1 (TRPV1) and cannabinoid 1 receptors in the brain and terminals of C-fibers in the spinal dorsal horn. Both the brain and spinal dorsal horn are critical to pain pathways and modulate nociceptive transmission. Therefore, acetaminophen induces analgesia by acting on the brain and spinal cord.

Ketamine is a noncompetitive antagonist to the N-methyl-d-aspartate (NMDA) receptors. The NMDA receptor is involved in the amplification of pain signals, central sensitization, and opioid tolerance. The ketamine molecule is hydrophilic and lipophilic, allowing it to cross the blood-brain barrier to exert its NMDA antagonist effects in the brain and spinal cord.

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20. A 67-year-old retired landscaper with Fitzpatrick type I skin has a 5-year history of numerous flat erythematous scaly skin lesions (>20) on his bald scalp. He reports several new skin lesions of similar appearance on routine follow-up. Examination of several specimens obtained on shave biopsy shows cellular atypia above the basement membrane zone with overlying parakeratosis. He has no prior history of skin malignancy. Which of the following is the most appropriate initial treatment?
- A) Cryotherapy
 - B) Systemic pembrolizumab
 - C) Topical 5-fluorouracil
 - D) Wide local excision
 - E) Observation

The correct response is Option C.

Actinic keratosis is a pre-malignant skin lesion that occurs on sun-exposed skin. Risk factors for actinic keratosis include advanced age, male sex, cumulative sun exposure, and fair skin type. The risk of progression from actinic keratoses to invasive squamous cell carcinoma is 0.025 to 16% per year, and the calculated lifetime risk for progression across a 10-year follow-up is approximately 6 to 10%.

The goals of the treatment are to eliminate clinical and subclinical actinic keratoses, minimize their risk for malignant transformation to invasive squamous cell carcinoma, and obtain acceptable cosmetic outcomes.

Topical field-directed therapy is the most appropriate initial next step in treatment of multiple, widespread actinic keratoses within an area of chronic sun damage. Topical medications include 5-fluorouracil (5-FU), imiquimod, diclofenac sodium, and ingenol mebutate. 5-Fluorouracil is an FDA-approved topical chemotherapeutic pyrimidine analog to treat multiple undetectable and clinically detectable actinic keratosis, and it is associated with a clearance rate of 84%. The mechanism of action is interference of DNA synthesis by inhibiting thymidylate synthetase. The one to two times per day application for 2 to 4 weeks is well tolerated with local skin reactions: pain, pruritus, burning, erythema, erosion, and inflammation.

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Despite ongoing observation with routine skin examinations, the patient presented with additional actinic skin lesions. While observation may offer a nontreatment option, actinic skin lesions may undergo malignant change over time. Therefore, topical field-directed therapy is the best initial treatment option for widespread actinic keratoses.

Cryotherapy is a lesion-directed treatment option for a few individual actinic keratoses. It is a destructive modality often using liquid nitrogen (-195°C or -319°F) that is better tolerated when less than 15 lesions are present. Clearance rates range from 39 to 99.8% with the use of cryotherapy. Common adverse effects include mild discomfort, scarring, and dyschromia.

Wide local excision is a directed therapy for individual malignant lesions, and it is therefore not appropriate in this patient due to the extensive nature of this benign condition.

Pembrolizumab is a systemic immune checkpoint inhibitor of PD-1 that treats metastatic or unresectable cutaneous melanoma.

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21. A 15-year-old girl is referred to the office because of a 7-month history of asymptomatic, rapid enlargement of the right breast. Physical examination shows a large, palpable mass occupying the lower half of the right breast. There is marked nipple-areola complex stretching and prominent dilated veins. Photographs are shown. Mammogram and ultrasound show a dense, circumscribed, homogeneous 15-cm mass in the right breast. Which of the following is the most likely diagnosis?
- A) Carcinoma
 - B) Cyst
 - C) Giant fibroadenoma
 - D) Juvenile breast hypertrophy
 - E) Phyllodes tumor

The correct response is Option C.

This patient has a fibroadenoma, the most common breast neoplasm in adolescent females. Giant fibroadenoma are typically solitary, firm, nontender, and present as a rapid asymmetric breast enlargement with prominent overlying veins and occasional pressure-induced skin ulceration. These lesions are larger than 5 cm and present at or soon after the onset of puberty. These lesions are typically treated with enucleation using breast reduction techniques for optimal symmetry with the contralateral breast. Mastectomy is not indicated, and no other adjuvant therapy is necessary. Smaller fibroadenomas may be watched conservatively, with minimal risk for malignant transformation. Surgical intervention is

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indicated in cases of mastodynia, neck/back pain secondary to large size, difficulty with clothing due to asymmetry, and to alleviate patient concern.

The differential diagnosis would include phyllodes tumor, breast hypertrophy, or cystic enlargement. Carcinoma would be unlikely in this age demographic. Phyllodes tumors are large, benign tumors that typically occur in the perimenopausal patient. They are histologically distinct from fibroadenomas, and transformation of a fibroadenoma to a phyllodes tumor is exceptionally rare.

Juvenile breast hypertrophy may present as unilateral or bilateral breast enlargement. The enlargement is diffuse without evidence of a discrete mass or nodularity. Juvenile breast hypertrophy typically presents in early puberty, rarely regresses spontaneously, and is much more severe than simple breast hypertrophy. The underlying cause is attributed to estrogen stimulation at the onset of the first menses. Treatment is reduction mammoplasty.

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22. A 36-year-old woman, gravida 1, para 1, with a history of cesarean delivery is evaluated for a painless, firm, 6-cm wide subcutaneous mass that is fixed to the anterior abdominal wall with no associated symptoms. The mass was noted after pregnancy. Tumor markers are within normal limits. She has a family history of familial adenomatous polyposis (FAP) syndrome. Which of the following tumors is the most likely diagnosis?
- A) Dermatofibrosarcoma protuberans
 - B) Desmoid
 - C) Lipoma
 - D) Lymphoma
 - E) Neurofibroma

The correct response is Option B.

Abdominal wall tumors are rare, accounting for less than 10% of all soft-tissue tumors. Desmoid tumors and soft-tissue sarcomas account for 45% and 40%, respectively, of all abdominal wall tumors. Desmoid tumors, also known as aggressive fibromatosis, are characterized by unpredictable progression or spontaneous regression, but lack the ability to metastasize. The majority of desmoid tumors arise from sporadic mutations in *CTNNB1*, whereas 10% arise in association with an *APC* mutation in familial adenomatous polyposis (FAP) syndrome. Abdominal wall desmoid tumors demonstrate an increased prevalence in women of childbearing age.

Dermatofibrosarcoma protuberans (DFSP) is an uncommon, locally aggressive abdominal wall tumor with low metastatic potential. DFSP originates from cutaneous tissues and is limited to superficial structures. The majority of abdominal wall DFSP occur in adults aged 20 to 50 years with similar sex distribution, and tumors are small (<5 cm) with characteristic purple or blue discoloration.

Neurofibromas appear as soft, skin-colored papules or small, subcutaneous nodules. The majority of neurofibromas are localized and arise from sporadic neurofibromin 1 gene (*NF1*). While the plexiform type is pathognomonic for hereditary neurofibromatosis caused by germline mutations in the neurofibromin 1 gene (*NF1*) or neurofibromin 2 gene (*NF2*).

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Lipomas are common benign tumors composed of mature adipose cells. Lipomas usually develop on the trunk or proximal limbs as discrete rubbery masses in the subcutaneous tissues that present at any age. Among solitary cutaneous lipomas, 60% display clonal alterations, which are not associated with presentation of multiple lipomas. There is an increased prevalence of solitary lipomas in women, and multiple lipomas occur more frequently in men.

Primary abdominal wall lymphoma is a rare extra-nodal presentation with increased prevalence among male patients. Extra-nodal disease may present at all ages, but more than 75% of patients are over age 50 years. Patients with atypical lymphoma may not present with fever, night sweat, weight loss or anemia. Lactate dehydrogenase tumor marker is observed in extra-nodal lymphoma. Most soft-tissue lymphomas are of B-cell origin.

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23. A 50-year-old woman with sarcoma of the right lateral chest wall has completed neoadjuvant radiation. Surgical resection is performed and results in a 6-cm diameter skeletal defect of the chest wall. Soft-tissue reconstruction only is planned. Soft-tissue only reconstruction is indicated because of which of the following factors?
- A) Lateral defects do not need skeletal reconstruction
 - B) Radiation is a contraindication for skeletal chest wall reconstruction
 - C) Radiation renders the chest wall stiff, and thus large skeletal defects are well tolerated
 - D) Reconstruction should be staged after margin confirmation on final pathology
 - E) Skeletal reconstruction should not be performed in oncologic resections

The correct response is Option C.

The goals of skeletal chest wall reconstruction are restoration of chest wall stability and protection of intrathoracic structures. Large chest wall defects can result in flail segments with impairment of ventilatory mechanics. The lateral thoracic wall is most susceptible to such alterations since it is the most mobile part of the chest wall. There is general consensus that skeletal chest wall reconstruction is indicated if four or more ribs are resected or if lateral defects are ≥ 5 cm. Total sternectomy defects disrupt the chest wall ring and increase dependence on abdominal breathing and may cause chronic chest wall pain; as such, they are considered by some to be indications for skeletal reconstruction. Posterior chest wall defects under the scapula (above the fourth rib) and anterior chest wall wounds under the pectoralis major do not require skeletal reconstruction since sufficient rigidity and protection is provided by these structures. Posterior defects around the area of the scapular tip may cause scapular entrapment and thus require skeletal reconstruction. Radiation fibrosis renders the chest wall stiff, and thus larger skeletal defects are well tolerated. Oncologic resections are not a contraindication for skeletal reconstruction. Skeletal reconstruction is most commonly performed with prosthetic materials, like synthetic meshes, biologic meshes and osteosynthesis materials. Radiation is not a contraindication for skeletal chest wall reconstruction. Reconstruction is performed at the same time as resection.

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24. A 75-year-old man presents with an abnormal skin lesion. Biopsy confirms Merkel cell carcinoma. Which of the following best describes the characteristics of this skin cancer?
- A) The behavior is aggressive with high rates of lymph node spread and local recurrence
 - B) The plantar surface of the foot is the most common location for this lesion
 - C) This disease is more common amongst patients of African descent
 - D) This lesion frequently arises within the setting of a chronic wound
 - E) Topical chemotherapeutic agents are the primary method for managing this condition

The correct response is Option A.

Merkel cell carcinoma (MCC) is an uncommon skin cancer which has aggressive behavior. MCC usually presents as a painless red nodule that is rapidly growing. Elderly patients are more commonly affected by MCC, and it is believed that sun exposure is a major risk factor. There are several studies that suggest involvement of the polyomavirus in the pathogenesis of MCC. Patients with immunosuppression are also at relatively higher risk for MCC. This is an aggressive skin cancer with early and frequent involvement of the regional lymph nodes. Patients with large tumors or regional spread are at high risk for distant metastasis. This disease is significantly more common in lighter-skinned patients than in dark-skinned patients. The head and neck region is the most common site for MCC. A Marjolin's ulcer is a rare and aggressive type of squamous cell carcinoma arising in the setting of a chronic wound. Once a diagnosis has been established, treatment of MCC typically involves wide local excision and lymph node mapping. Many of the treatment strategies for MCC are similar to melanoma given the similar aggressive clinical behavior.

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25. A 45-year-old woman underwent nonsurgical facial rejuvenation 2 days ago. The procedure included injection of neuromodulators into the forehead and glabella and hyaluronic acid into the tear troughs, nose, cheeks, and lips. The patient reports worsening pain, and discoloration of the nasal tip is noted. Which of the following is the most appropriate next step in management of this complication?

- A) Antibiotic therapy
- B) Aspirin therapy
- C) Hyaluronidase injection
- D) Hyperbaric oxygen therapy
- E) Warm compress application

The correct response is Option C.

This patient has pustulation, erythema, and pain, which indicate intravascular injection and tissue ischemia. Complications with hyaluronic acid are categorized as early (<14 days), late (14 days to 1 year), or delayed (>1 year). Early but rare complications are frequently due to either infection (bacterial or viral) or the much-feared tissue necrosis/embolism. Avoiding these complications with careful technique and knowledge of anatomy is paramount, but understanding proper management of complications is also critical. This patient has signs of tissue necrosis, and the most critical intervention is to inject hyaluronidase (HYAL), an enzyme that catalyzes hyaluronic acid hydrolysis. Hyaluronidase should be injected immediately and liberally and titrated for effect to reverse signs and symptoms such as pallor, livedo reticularis pattern, erythema, and pain. Consider repeating daily as needed. There is no need to attempt to cannulate the vasculature since hyaluronidase will diffuse into the tissue. This product should be readily available to any clinician using hyaluronic acid fillers. Allergic reactions to hyaluronidase can also be noted (especially in patients with history of insect venom allergy).

Warm compresses, aspirin, and hyperbaric oxygen have all been advocated as adjunct measures when there is suspicion of vascular compromise to soft tissue. They are supplemental but not the primary treatment of choice. There are no clinical studies to support hyperbaric oxygen, but animal models suggest it is useful for ischemic injuries.

Empiric antibiotics are appropriate for early acute infection especially if there is obvious abscess or nonfluctuant cellulitis. However, the pustules and erythema in this patient are due to intravascular injection. Antibiotics may be added but should not be the primary or sole treatment plan.

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26. A 40-year-old woman with cancer of the right breast undergoes a bilateral skin-sparing mastectomy and immediate reconstruction with placement of submuscular tissue expanders. After completion of the bilateral mastectomies, the breast skin flaps appear to be dusky with some bruising of the skin edges. Which of the following pharmacologic agents has been shown to decrease the rate of mastectomy flap necrosis?

- A) Indocyanine green
- B) Lidocaine with epinephrine
- C) Nitroglycerin paste
- D) Papaverine

The correct response is Option C.

Nitroglycerin paste has been shown to decrease the rate of mastectomy flap necrosis.

Topical nitroglycerin ointment application has been shown in a prospective randomized clinical trial to decrease the incidence of mastectomy flap necrosis in immediate tissue expander breast reconstruction.

Papaverine is incorrect since it is a vasodilator that relaxes smooth muscles in blood vessels. This agent is useful during microvascular surgery to decrease vasospasm of arteries and veins but has not been used to decrease the rates of mastectomy flap necrosis.

Indocyanine green is incorrect since it is a dye used for diagnostic purposes during fluorescence angiography. It can be administered intravenously and be used to assess tissue perfusion intraoperatively, which can be helpful for diagnosis of mastectomy flap necrosis. It does not change tissue perfusion, however.

Lidocaine with epinephrine is incorrect since it is an analgesic agent with a vasoconstrictor. This can be used intraoperatively for pain control and hemostasis. At more dilute concentrations, it can be used for tumescent injection during mastectomy. This has not been shown to decrease the rates of mastectomy flap necrosis.

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27. A 62-year-old woman undergoes left mastectomy with axillary lymph node dissection and tissue expander reconstruction. A drain is placed adjacent to the tissue expander and in the axilla. An intravenous catheter is placed in her left arm, and blood pressure is measured from same arm. BMI is 42 kg/m². Which of the following risk factors is most significantly associated with lymphedema in this patient?
- A) Compression from a blood pressure cuff
 - B) Drain placement in the axilla
 - C) Obesity
 - D) Placement of an intravenous catheter
 - E) Tissue expander reconstruction

The correct response is Option C.

Obesity (BMI >30 kg/m²) is the most significant risk factor for lymphedema from the listed choices. Patients who undergo axillary lymphadenectomy and radiation are at an approximately 30% risk for acquiring lymphedema. Obese individuals are at higher risk. In addition, obesity-induced lymphedema is a phenomenon in which patients who reach a BMI of 50 to 60 kg/m² have a high risk for lymphedema, in particular bilateral lower extremity lymphedema, without any other inciting events.

Compression from a blood pressure cuff is unlikely to cause lymphedema. Lymphedema is primarily treated with compression (pneumatic, static). Evidence is lacking that an intravenous catheter increases the risk for lymphedema. Tissue expander reconstruction or any breast reconstruction does not increase the risk for lymphedema and neither does drainage tube placement.

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28. A 77-year-old man is anticipated to have a 4-cm lateral segmental defect of the mandible after undergoing extirpation of an oral tumor. Reconstruction of the mandibular defect with an iliac crest bone graft is planned. Which of the following should be considered a CONTRAINDICATION to the use of nonvascularized bone graft for mandible reconstruction in this patient?
- A) Defect greater than 3 cm
 - B) Defect involving the mandibular body
 - C) Extirpation of a malignant lesion
 - D) Need for adjuvant radiation therapy
 - E) Patient age greater than 75 years

The correct response is Option D.

In most cases, vascularized bone flaps provide a reconstruction superior to autologous bone grafts in the treatment of segmental mandibular defects. However, they require more operative time, a longer hospital stay, and specialized surgical teams, and they have the potential for greater donor morbidity. There is evidence that for many cases, bone grafts can be used with acceptable results. Patients undergoing radiotherapy for malignant tumors have a significantly lower success rate with bone grafting than those undergoing vascularized bone flaps. While associated with a need for radiation, a diagnosis of malignancy itself does not predict graft failure. Lateral defects have similar outcomes whether bone grafts or flaps are used, likely due to the lower torsional forces in these regions than at the symphysis. While there is no consensus on the optimal maximal graft length, many consider 6 cm to be the maximum advisable length for a bone graft in this context. Microsurgical free tissue transfer can be successfully accomplished in patients in their 70s and 80s, albeit with a higher rate of complications. Age should not be considered an absolute contraindication in this case.

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29. A 35-year-old African American woman presents with multiple draining sinus tracts and nodular abscesses in the bilateral inframammary folds, groins, and axillae. She has failed topical and oral antibiotic therapies. Medical history includes type 2 diabetes mellitus, obesity, and keloid scarring. Which of the following is the most appropriate initial treatment for this patient?
- A) Adalimumab therapy
 - B) Incision and drainage
 - C) Radiotherapy
 - D) Skin-tissue-saving excision with electrosurgical peeling (STEEP) procedure
 - E) Wide excision and skin grafting

The correct response is Option A.

This patient has hidradenitis suppurativa characterized by multiple nodules, abscesses, tunnels, and scars most commonly in the axillae, inframammary folds, groin, perigenital, and perineal region. Significant advances in medical therapy have decreased the need for surgical intervention. The disease is classified according to the Hurley classification: stage I as transient nonscarring inflammatory lesions; stage II as separate lesions consisting of recurrent abscesses with tunnel formation and scarring, and single or multiple lesions separated by normal-looking skin; and stage III as coalescent lesions with tunnel formation, scarring and inflammation. This patient is stage II. Mild disease is often treated with topical antibiotics (e.g., clindamycin) and/or resorcinol, while moderate disease may benefit from oral antibiotics (e.g., tetracycline 500 mg twice daily). Refractory disease may benefit from antibody therapy and/or surgical intervention.

Adalimumab (Humira) is a recombinant human igG1 anti-TNF monoclonal antibody that binds the proinflammatory cytokine TNF-alpha. It was approved by the FDA in 2016 for the treatment of moderate to severe disease where patients have required long-term antibiotics or rapid flares upon cessation of antibiotics. Alternative agents include infliximab (Remicade), anakinra (Kineret), ustekinumab (Stelara), dapsone, or acitretin (Soriatane).

Radiotherapy is incorrect. There are no randomized trials comparing radiotherapy with medical or surgical therapy, but it can be effective and well-tolerated for focal areas such as the scalp. The risk for secondary cancer is minimal but not negligible; therefore, radiotherapy is not considered a front-line option.

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Surgical incision and drainage is indicated for fluctuant abscesses but not effective for inflamed nodules since there is no collection of fluid to drain.

Skin-tissue-saving excision with electrosurgical peeling (STEEP) or deroofing removes unhealthy tissue with step-wise tangential excisions and preserving normal tissue to heal via secondary intention. There is significant postoperative morbidity and risk for scarring with higher recurrence rates. Given this patient's history for keloid scarring, this is not the best option.

Wide excision is associated with lower recurrence rates but higher morbidity (e.g., infection, bleeding, contractures). This can be effective in patients with areas of limited disease but should be reserved for patients with severe disease refractory to nonsurgical therapies when large total body surface area is involved. Nonsurgical options should be fully explored in this patient given the keloid history.

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30. A 65-year-old woman presents with a malignant melanoma of the right ankle that requires resection resulting in exposed bone. Her thighs are too bulky as donor sites for ankle skin resurfacing. Reconstruction with a free fascio-cutaneous scapular flap is planned. Through which of the following anatomic landmarks will the pedicle for this flap pass?

- A) Anterior triangle of the neck
- B) Posterior triangle of the neck
- C) Quadrangular space
- D) Subclavian triangle
- E) Triangular space

The correct response is Option E.

The pedicle for the scapular fasciocutaneous flap is the circumflex scapular artery arising from the subscapular system. The circumflex scapular artery travels through the triangular space bordered laterally by the long head of the triceps, the teres minor above and teres major below. The posterior circumflex humeral vessels travel within the quadrangular space, which is adjacent to the triangular space and is bordered by the teres minor above, teres major below, long head of the triceps medially, and the humerus laterally. The anterior triangle of the neck is bordered superiorly by the mandible, laterally by the sternocleidomastoid muscle, and medially by the midline of the neck. The contents of the anterior triangle include cranial nerves VII, IX to XII, and the carotid arteries and internal jugular vein. The posterior triangle of the neck is bordered by the trapezius muscle posteriorly, the sternocleidomastoid muscle anteriorly, and the middle third of the clavicle inferiorly. The posterior triangle of the neck contains the external jugular vein, the brachial plexus, regional lymph nodes, third part of the subclavian artery, as well as the suprascapular vessels and cervical branches of thyrocervical trunk. The posterior triangle of the neck is divided by the inferior belly of the omohyoid muscle into the occipital triangle above and subclavian triangle below. The subclavian triangle is bounded by the sternocleidomastoid, omohyoid, and the clavicle.

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31. A 10-year-old boy undergoes a free fibular flap reconstruction following an 8-cm resection of a chondrosarcoma on his right humerus. Which of the following best describes the primary mechanism of bone healing?

- A) Endochondral ossification
- B) Osteoconduction
- C) Osteogenesis
- D) Osteoinduction

The correct response is Option C.

Osteogenesis is the formation of new bone by osteoblasts at the host-graft interface. This is the primary mechanism by which a vascularized bone graft heals. The vascular pedicle permits the bone graft and its osteocytes to remain perfused independent of its recipient bed. Increased osteocyte survival leads to decreased bone remodeling and maintenance of bone mass and strength. Advantages of a vascularized bone graft include reconstruction of large bone defects (>6 to 8 cm) and the ability to withstand hostile recipient environments, such as irradiation and infection.

Osteoconduction (creeping substitution) is the process in which a material acts as a scaffold for bone growth, extracellular matrix, and blood vessels. Cortical bone grafts and demineralized bone matrix are examples of autogenous and exogenous osteoconductive methods.

Osteoinduction is the process of direct stimulation of mesenchymal stem cells at the recipient site by bone morphogenetic protein (BMP) to differentiate into osteoprogenitor cells. This is the primary mechanism of action for BMP and cancellous bone grafts.

Endochondral ossification is the process by which the cartilaginous soft callus covering a fracture is transformed into bone.

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32. A 15-year-old boy presents with a giant congenital nevus of the calf. He has a history of lymphoma treated successfully with chemotherapy. His BMI is 28 kg/m². Placement of a tissue expander with staged excision and advancement flap reconstruction is planned. This patient's risk of expander-related complications is highest due to which of the following factors?

- A) Age
- B) Elevated BMI
- C) Expander location
- D) History of malignancy
- E) Male sex

The correct response is Option C.

This patient's risk factor for expander-related complications is the device being implanted in an extremity. Several large studies have shown that the scalp and extremities are the locations with the highest rate of complications. The patient's BMI of 28 kg/m² is not a significant risk factor (if anything, a recent study shows that low BMI is associated with higher risk). A history of treated malignancy does not mean this patient is immunocompromised or increase their risk. Biological sex is not generally found to be a risk factor, although one recent study found that female sex was associated with higher risk for expander-related complications. Younger age has been found to be a risk factor in some studies; however, this patient is a teenager.

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33. A 79-year-old farmer presents with a lesion on the back of his neck. Examination shows the lesion is flat and pink and rough to the touch. Which of the following is the estimated rate of malignant transformation for an actinic keratosis?

- A) 1%
- B) 10%
- C) 25%
- D) 50%
- E) 75%

The correct response is Option B.

While the true rate of malignant transformation of actinic keratosis remains unknown, best estimates report the progression rate to squamous cell or basal cell carcinoma is 10%. As a result, treatment for these lesions is recommended through a variety of modalities. The most commonly used method of treatment for patients with solitary or few lesions is cryotherapy. Other options include curettage and topical therapies. For multiple lesions of field cancerization of an anatomical area, topical fluorouracil (5-FU), imiquimod, or photodynamic therapy with photosensitizers are more often used.

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34. During surgical exploration for a failing free flap, a surgeon revises the anastomosis, performs mechanical thrombectomy with a Fogarty catheter, and injects the flap with tissue plasminogen activator (tPA). Which of the following is the mechanism of action of tPA in fibrinolysis to increase flap survival and decrease fat necrosis?
- A) Activates plasmin binding to fibrin
 - B) Converts plasminogen to plasmin
 - C) Forms a complex with plasminogen
 - D) Inhibits plasminogen activator inhibitor type-1

The correct response is Option B.

Tissue plasminogen activator (tPA) is a protease that cleaves a peptide bond in plasminogen, converting it to plasmin. tPA and urokinase have similar mechanisms in converting plasminogen to plasmin through cleavage. Plasmin is an enzyme that lyses the cross-linking between fibrin molecules and therefore breaks up clot formation. Streptokinase, which is derived from *Streptococcus* and is no longer commercially available in the United States, forms a complex with plasminogen, which then converts to plasmin. Plasminogen activator inhibitor type-1 (PAI-1) binds to tPA and inactivates it by forming a complex. An inhibitor of PAI-1 would facilitate the pathway of fibrinolysis, but tPA does not act in this manner.

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35. A 53-year-old man underwent excision and primary closure with extensive wide subcutaneous undermining for squamous cell carcinoma of the leg 7 days ago. Examination shows margins are positive, and reexcision resulting in a wound with exposed tendon with no peritenon is noted. Which of the following is the most appropriate reconstructive option for this patient?
- A) Bipedicled advancement flap
 - B) Keystone flap
 - C) Mustardé rotational flap
 - D) Split-thickness skin graft
 - E) V-Y advancement flap

The correct response is Option A.

The appropriate reconstructive option from the given choices for this patient would be bipedicled advancement flap. It is important to understand the blood supply to local skin flaps. The bipedicled advancement flap is a random pattern flap with perfusion from the dermal/subdermal plexus. Unlike a standard, single-pedicle random pattern flap, the bipedicled flap maintains skin connections in two directions allowing for a 2:1 length-to-width ratio. The donor defect of the bipedicled flap is typically skin grafted to minimize opposing tension on the flap and allow for greater advancement. The wide subcutaneous undermining 7 days prior would have allowed for the "delay phenomenon," potentially making the flap more reliable.

The extensive wide subcutaneous undermining during initial primary closure likely injured perforators to the skin. The V-Y advancement flap is typically islandized during closure and would be compromised by adjacent wide undermining. Similarly, a keystone flap would be compromised if the skin was delaminated from the underlying tissues. An adjacent perforator flap is perfused by a cutaneous perforator (septocutaneous or muscular) which likely would have been injured during wide undermining. Split-thickness skin graft is not appropriate because there is no peritenon on the tendon. A Mustardé rotational flap is used for cheek advancement.

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36. A 32-year-old woman presents for evaluation of abnormal vaginal drainage from a rectovaginal fistula. Medical history includes multiple childbirths with episiotomies and two failed fistula repair attempts with local tissue leading to soft tissue loss within the perineal body and rectovaginal septum. Physical examination is difficult secondary to pain and shows a significant degree of inflammation in the vaginal and anorectal area. Her anal sphincter function is preserved, and she has had no other medical problems or previous surgeries. Which of the following is the most appropriate management strategy for this patient?
- A) Abdominal perineal resection (APR) with pedicle vertical rectus abdominus muscle (VRAM) flap
 - B) Intestinal diversion with an ostomy
 - C) Placement of acellular dermal matrix along the posterior vaginal wall
 - D) Placement of a seton into the fistula
 - E) Rotation of a pedicle sartorius muscle flap into the defect

The correct response is Option B.

Rectovaginal fistulas are bothersome conditions and may be challenging to fix. Fistulas may result from local trauma including childbirth, surgical injury, or infection. If the cause is unclear, the patient should be evaluated for the possibility of inflammatory bowel disease or cancer. In this case, the fistula is a result of local trauma from childbirth and surgical episiotomies. The examination demonstrates that the perineal body and rectovaginal septum are significantly damaged with loss of tissue in the area. Additionally, there is significant inflammation in this area. In severe or refractory cases with suboptimal tissue conditions, a diverting intestinal ostomy may be valuable in controlling the stream of enteric contents away from inflamed tissue and the anticipated repair. Given the loss of tissue in this area, a flap will be needed. While there are a number of options, the gracilis muscle flap remains the most common flap for this purpose.

The sartorius muscle has segmental perfusion and is not amenable to transposition into the perineum. Various approaches have been tried for fistula repairs including bioprosthetics. However, given the extensive damage in the area it is unlikely that a nonvascularized option will work. Conservative measures, such as seton placement, may be useful for infection control but will not lead to closure given the significant inflammation and tissue loss. Finally, abdominal perineal resection is typically reserved for patients with cancer or severe benign disease with loss of anal sphincter function and continence.

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37. A 19-year-old woman presents with bilateral lower extremity edema, which developed 2 years ago. Physical examination shows pitting edema involving the entirety of the lower extremities with involvement of the feet. Positive Stemmer's sign is noted. BMI is 27 kg/m². She is a recent immigrant from India. Which of the following is the most likely cause of this patient's swelling?

- A) Filariasis
- B) Lipedema
- C) Lymphedema praecox
- D) Lymphedema tarda
- E) Podoconiosis

The correct response is Option A.

The most common cause of lymphedema worldwide is filariasis. It is an infection caused by the round worm *Wuchereria bancrofti*. The infection is transmitted by mosquito bite, which deposits larvae on the skin. The larvae migrate into the lymphatics and cause lymphatic blockage. The disease is endemic in India and sub-Saharan Africa. The lower extremities are most commonly affected.

Primary lymphedema is a developmental hypoplasia of the lymphatic system. It is a rare condition affecting 1 in 100,000 people. The most common site of involvement is the lower extremities. It is classified according to the time of onset: congenital lymphedema presents at or around birth, lymphedema praecox presents at or shortly after puberty, and lymphedema tarda presents after age 35 years. Mutation of vascular endothelial growth factor C has been identified in approximately 30% of primary lymphedema patients.

Podoconiosis is the second most common cause of tropical lymphedema. The cause is chronic exposure in barefoot walkers to soil containing high concentrations of silica. The silica particles are absorbed by the skin and collect in lymphatic vessels. This results in subendothelial lymphatic edema which gradually progresses to fibrosis and obstruction. The lower extremity lymphedema is ascending and bilateral, although it is usually asymmetric. The disease is seen in Africa, Central America, and India. Individuals afflicted with the disease have a genetic susceptibility to silica-induced lymphatic inflammation.

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Morbid obesity can cause lymphedema by obstruction of lymphatics by the high amounts of adipose tissue. Individuals with BMI greater than 60 kg/m² are at high risk.

Lipedema is abnormal subcutaneous accumulation of fat, and it is frequently mistaken for lymphedema. It occurs in women, with onset in the second and third decades, and is thought to have a genetic component. It involves the buttocks, thighs, and legs, and it spares the ankles and feet, resulting in a characteristic "cuff sign." Patients also have tenderness and easy bruising of the affected areas. Lipedema can progress to lower extremity venous hypertension and lymphatic dysfunction.

The most common cause of lymphedema in the United States is secondary to oncologic therapy. Lymphadenectomy results in impairment of normal lymphatic flow. Radiation results in destruction of lymphatics and may also impair their regeneration. Breast cancer treatment is the most common cause, with upper extremity lymphedema developing in 4 to 49% of patients undergoing axillary lymphadenectomy and 5 to 7% of patients undergoing axillary sentinel lymph node biopsy. The incidence of lymphedema in patients undergoing treatment for upper extremity melanoma is 5% and lower extremity melanoma is 28%.

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38. An otherwise healthy 45-year-old woman undergoes bilateral breast reconstruction with free deep inferior epigastric perforator-based flaps. Only the medial deep inferior epigastric vein was anastomosed to the medial internal mammary vein using a 3.5-mm venous coupler. Her right breast flap has become increasingly congested. The cutaneous Doppler signals are strong, and examination of the pedicle shows good flow through both arterial and venous anastomoses. There is no kinking or hematoma. Which of the following is the most appropriate next step in management?
- A) Additional anastomosis of the lateral deep epigastric vein
 - B) Additional anastomosis of the superficial inferior epigastric vein
 - C) Revise the arterial anastomosis
 - D) Revise both anastomoses
 - E) Revise the venous anastomosis

The correct response is Option B.

The most appropriate next step in management is to supercharge the flap using an additional anastomosis of the superficial inferior epigastric vein. This is a clinical example of persistent superficial venous system dominance. This is due to either the superficial system being the dominant venous drainage of the abdominal wall and the absence of connections between the superficial and deep venous systems, or the lack of an adequate number of perforators in the flap. In either case, the venous blood is not getting from the superficial system into the deep system, which is the egress given that the deep system is the only system anastomosed.

There is no technical issue with the anastomosis or venous thrombosis; therefore, revising the deep anastomoses is not required. Rather, it is an intra-flap venous system issue that requires the superficial system to be drained somehow. This is accomplished by anastomosing the superficial inferior epigastric vein to either the deep system in the flap or to another drainage system in the chest like the intercostal system. It is interesting to note that the two reasons for the above issue (i.e., inadequate perforator selection or anatomic lack of communicating vessels between the superficial and deep system), though distinct entities, clinically present similarly and are treated in the same way. The incidence of venous congestion secondary to persistent superficial system dominance is about 0.9%.

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39. A 35-year-old woman presents with midline wound dehiscence with tissue necrosis 2 weeks after undergoing uneventful abdominoplasty. A photograph is shown. The patient reports that she did not stop smoking before surgery as instructed. Which of the following mechanisms has the greatest impact on delayed wound healing in this patient?
- A) Decreased catecholamine production
 - B) Decreased leukocyte function
 - C) Decreased levels of hemoglobin
 - D) Increased fibrinogen production
 - E) Increased microvascular vasoconstriction

The correct response is Option E.

Cigarette smoking is a leading cause of preventable death and disability in the United States. Over the past 20 years, several studies have demonstrated an increased risk of postoperative complications following plastic surgical procedures including rhytidectomy, breast reconstruction, digital replantation, muscle flaps, and body contouring procedures.

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Tobacco smoke is a complex mix of particulate matter, volatile acids, and gases. There are over 4000 different compounds in cigarette smoke, many of which are toxic, mutagenic, and carcinogenic. Tobacco-induced vasoconstriction is mediated directly and indirectly by nicotine, a colorless, odorless, and poisonous alkaloid.

Elevated cellular levels of nicotine cause direct microvascular vasoconstriction. Indirect pathways of vasoconstriction include the enhancement of thromboxane A₂ and stimulation of catecholamine release. Random skin flaps, such as abdominoplasty, rhytidectomy, and mastectomy flaps, are predominantly supplied by the subdermal plexus, which is very sensitive to sympathomimetic agonists such as catecholamines.

Smoking also increases carboxyhemoglobin levels, which shifts the oxygen-hemoglobin saturation curve to the left. The net result is decreased oxygen-carrying capacity by direct competitive inhibition from carbon monoxide. Other effects caused by smoking include decreased prostaglandin I₂ (prostacyclin) production, increased platelet aggregation and blood viscosity, decreased collagen production, decreased red blood cell deformability, increased fibrinogen production, and decreased leukocyte function (mediated by hydrogen cyanide). The net effect is a prothrombotic state with impaired inflammation that also contributes to slow wound healing. Although fibrinogen production is increased and leukocyte function is reduced, the primary mechanism by which wound healing is impaired is related to the nicotine-induced vasoconstriction of the subdermal plexus.

Rhytidectomy patients who smoke are 12.5 times more likely to develop skin necrosis compared with nonsmokers. One study showed a 47.9% rate of wound healing problems in abdominoplasty patients who smoked compared with 14.8% in nonsmokers. Another large study of patients undergoing free transverse rectus abdominis musculocutaneous (TRAM) breast reconstruction showed no difference in free flap survival in those patients who smoked, but the smoking population had a significantly higher rate of mastectomy skin flap loss, abdominal donor site complications, and hernias. Active smoking is not only a risk factor for wound complications, but the overall number of cigarettes smoked in a lifetime can affect the rate of wound infections. One study showed a risk for infection of 14.3% in patients who claimed to have stopped smoking 4 weeks before their abdominoplasty compared with 1.2% of nonsmokers. This study also showed higher infection rates were associated with more years of smoking, a higher number of cigarettes smoked per day, and a higher number of estimated cigarettes smoked during a lifetime. Current recommendations for smokers who desire elective cosmetic surgery are to avoid smoking and all nicotine products for 2 to 4 weeks before and after surgery.

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40. A 45-year-old woman undergoes bilateral nipple-sparing mastectomy with immediate tissue expander reconstruction for T3N2 breast cancer. She completes radiotherapy and resumes expansion in the office 4 months after surgery. Her husband calls the office noting that the patient is reporting headache and requests additional pain medication when she suddenly demonstrates seizure activity. She is taken to the emergency department for immediate evaluation and stabilization. Which of the following imaging modalities should be used with caution for this patient?
- A) CT scan
 - B) Fluoroscopy
 - C) MRI
 - D) Positron emission study
 - E) Ultrasound

The correct response is Option C.

The majority of breast tissue expanders include a ferromagnetic port and are currently labeled as MRI-unsafe due to the potential interaction with the magnetic field of the machine. There are reports of several MRI-related complications: malposition, pain or burning sensation, polarity reversal, port dislodgement, and thermal injuries. However, several subsequent studies have demonstrated modifications to minimize risks in patients requiring diagnostic MRI of either the contralateral breast, perforator mapping, or evaluation of brain/spine metastases. This patient may need MRI evaluation of the brain to diagnose metastatic disease of the brain. While some imaging technicians may be unwilling to perform MRI due to the warnings, studies suggest use of a 1.5T MRI, saline filling, and prone positioning are effective strategies to minimize risks and safely perform MRI rather than explant the device(s).

CT scanning can be safely performed with no contraindication due to expanders. Positron emission studies also do not interfere with expanders. Ultrasound is frequently used to safely assess and treat possible fluid collections or infections associated with expanders. Despite her previous radiation therapy, fluoroscopy can still be safely performed while taking care to minimize radiation exposure to critical structures.

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41. A 15-year-old boy presents with a history of a traumatic laceration to the dominant right wrist after punching a window 4 weeks ago. He has numbness and weakness in the median nerve distribution. On operative exploration of the wound, there is a complete transection of the median nerve and a 4-cm gap between the proximal and distal ends. Which of the following is the best method of nerve reconstruction?
- A) Polyglycolic acid nerve tube placement
 - B) Saphenous vein grafting
 - C) Sural nerve grafting
 - D) Transposition of the median nerve and primary nerve coaptation

The correct response is Option C.

The best method of nerve reconstruction is sural nerve grafting. An autologous sural nerve graft is the best choice for a nerve gap of 3 cm or greater. Multiple cables would likely be required to reconstruct the entire diameter of the median nerve and restore sensory and motor function.

Transposition of the median nerve and primary nerve coaptation is incorrect since the nerve gap is too large for a tension-free nerve repair, even with transposition of the median nerve at the wrist.

Saphenous vein grafting is incorrect since the size of the nerve defect warrants nerve grafting rather than vein grafting. Vein grafting could be used for an associated vascular injury of this size to the radial or ulnar artery.

Polyglycolic acid (PGA) nerve tube placement would be more appropriate for a nerve gap less than 3 cm. This serves as a scaffold for nerve regeneration.

The indications for nerve allograft reconstruction are expanding the subject of ongoing research.

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42. An otherwise healthy 45-year-old woman develops an infection following implant-based breast reconstruction. Which of the following gram-negative species is most likely to be involved with the infection?

- A) *Enterobacter* spp
- B) *Escherichia coli*
- C) *Proteus* spp
- D) *Pseudomonas* spp
- E) *Staphylococcus* spp

The correct response is Option D.

The most likely gram-negative species associated with implant-based breast reconstruction infection is *Pseudomonas* spp.

In general, gram-positive organisms (about 70%) are most commonly associated with such infections, in which *Staphylococcus* species are the most commonly cultured (51%). Gram-negative species are associated with about 27% of the infections, of which *Pseudomonas* were the most commonly cultured. These data guide the empiric antibiotics that should be used initially at presentation. *Staphylococcus* species are the most common bacteria involved with breast implant infections; however, they are gram-positive bacteria.

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43. A 23-year-old man comes to the clinic with a prominent sternum and anterior protrusion of the costal cartilages. He has no cardiopulmonary concerns but is bothered by the aesthetic appearance of the chest. The plastic surgeon plans to correct this deformity with splitting of the pectoralis major muscles, resection of the cartilage, and plating with bioresorbable materials. Which of the following is the most appropriate CPT coding for this repair?
- A) 21740 (reconstructive repair of pectus excavatum or carinatum, open)
 - B) 21740 (reconstructive repair of pectus excavatum or carinatum, open) and 21600 (excision of rib, partial)
 - C) 21742 (reconstructive repair of pectus excavatum or carinatum; minimally invasive approach, without thoracoscopy)
 - D) 21742 (reconstructive repair of pectus excavatum or carinatum; minimally invasive approach, without thoracoscopy) and 21600 (excision of rib, partial)
 - E) 21743 (reconstructive repair of pectus excavatum or carinatum; minimally invasive approach, with thoracoscopy)

The correct response is Option A.

The most appropriate CPT coding for correction of pectus carinatum is 21740.

CPT code 21740 includes the surgical approach, costal cartilage resection, osteotomies, internal fixation, and soft-tissue closure. CPT code 21600 is not reported separately, since this would be unbundling. CPT codes 21742 and 21743 refer to the minimally-invasive approaches, with and without thoracoscopy, respectively.

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44. A 70-year-old man presents with a 2-cm keratoacanthoma involving the left ear. Medical history includes melanoma of the left cheek. Which of the following is an indication for Mohs micrographic surgery over conventional excision in this patient?

- A) Anatomic location of lesion
- B) Diagnosis of keratoacanthoma
- C) History of previous melanoma
- D) Male biological sex
- E) Patient age

The correct response is Option A.

Mohs micrographic surgical technique has demonstrated cure rates of 97% for primary squamous cell carcinomas and up to 95% for recurrent squamous carcinomas. In this particular patient, the strongest indication for utilization of the Mohs technique is the involvement of the patient's ear. Keratoacanthomas are epithelioid neoplasms of sun-exposed skin. Classically, they appear as a solitary papule that rapidly increases in size with a crateriform center. Because they can undergo spontaneous involution, some groups feel keratoacanthomas should be classified as a benign growth. However, there is strong evidence that keratoacanthomas are a distinct variant of squamous cell carcinoma. They have been reported to demonstrate invasion and aggressive behavior, including perineural invasion in up to 2.5 to 14% in the head and neck. Because squamous cell carcinoma involvement of the ear increases the risk for recurrence and metastasis, Mohs micrographic surgery is indicated in this patient. Patient age, patient sex, history of previous melanoma, and the diagnosis of keratoacanthoma are not indications for Mohs excision.

Other indications for Mohs technique include the following:

1. Recurrent basal cell/squamous cell carcinomas
2. Locations prone to recurrence—"H-zone" of the face: periorbital, periauricular, temple, upper lip, nose/nasolabial fold, and chin
3. Tumors involving critical structures such as the eyelid or lip
4. Functionally important areas such as the genitals, perianal location, hands, and feet
5. Tumors arising in sites of previous irradiation therapy
6. Large tumors, >2 cm
7. Lesions with ill-defined tumor margins

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8. Histologic aggressive subtype (morpheaform, basosquamous, perineural, and invasive/poorly differentiated squamous cell carcinoma)
9. Tumors arising in immunosuppressed patients, such as transplant recipients or patients with genetic predisposition (basal cell nevus syndrome, xeroderma pigmentosum)

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45. A 30-year-old man presents following sharp, self-inflicted amputation of his penis at the middle of the shaft. After counseling, he elects to undergo penile replantation. Anastomosis of which of the following arteries must be performed to ensure a successful penile replant and survival of the preputial skin?

- A) Cavernosal
- B) Dorsal
- C) External pudendal
- D) Internal pudendal
- E) Urethral

The correct response is Option B.

Penile replantation and survival is based on arterial flow supplied by the anastomosis of the dorsal artery. The preputial skin and glans are perfused by terminal branches from the dorsal artery. The dorsal artery is able to perfuse the remainder of the penis through circumflex arteries. The cavernosal artery, by itself, is insufficient for penile replantation and results in significant skin necrosis. Similarly, the urethral artery does not supply the skin of the penis. The internal and external pudendal arteries both provide blood supply to the penile shaft but are not present at the middle of the shaft.

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46. A 16-year-old girl is referred to the clinic by her pediatrician for correction of breast asymmetry. The patient reports that her right breast has always been smaller. Physical examination shows mildly shortened right fingers and a Tanner III right breast. Examination shows that the left breast is Tanner IV and no masses. Which of the following is the Mathes and Nahai Classification of the muscle most likely involved in this congenital disorder?
- A) Type I
 - B) Type II
 - C) Type III
 - D) Type IV
 - E) Type V

The correct response is Option E.

The pectoralis major has a dual blood supply from both a dominant primary pedicle (pectoral branches of the thoracoacromial artery) and secondary segmental perforators (internal mammary/thoracic perforators).

The absence of the pectoralis major muscle and associated hand deformity is pathognomonic for Poland syndrome. The etiology is unclear but suspected due to vascular interruption during embryogenesis. The diagnosis is often delayed until puberty when asymmetric breast development is noted. Brachydactyly, syndactyly, or ectrodactyly are common and can present with various severity.

Type I flaps have a single dominant blood supply (e.g., rectus femoris or gastrocnemius muscles). Type II flaps have a dominant and minor vascular pedicle (e.g., gracilis or soleus muscles). Type III flaps have 2 dominant pedicles (e.g., pectoralis minor, rectus abdominis and serratus muscles). Type IV flaps only have segmental blood supply (e.g., sartorius or tibialis anterior muscles).

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47. An 18-month-old infant is evaluated for a 1-cm red lesion of the upper back. The lesion was noted at 2 weeks of age and rapidly enlarged over the next 6 months. The mass remained stable but has started to slowly shrink and fade over the past 6 months. Which of the following is the most appropriate next step in management of the lesion?
- A) Embolization followed by resection 24 to 48 hours later
 - B) Oral propranolol
 - C) Punch biopsy
 - D) Sclerotherapy
 - E) Observation

The correct response is Option E.

The lesion described is an infantile hemangioma. This tumor is in the involution phase in a nonproblematic area. The most appropriate next step in management for this lesion is observation. Infantile hemangiomas are benign vascular tumors that affect 5% of the population. They typically appear at 2 weeks of age in contrast to vascular malformations (e.g., venous malformations, lymphatic malformations, arteriovenous malformations) which are present at birth. They enter a proliferative phase of rapid growth, plateau, and begin involution around age 12 months. Involution is complete by age 4 years in 90% of patients. Most infantile hemangiomas are not problematic and do not require treatment. Following involution, a residual fibrofatty area can be excised if it is bothersome. Concerning hemangiomas, such as near the eyelid, can cause obstructive visual symptoms. Problematic hemangiomas can be treated to slow progression and shrink the lesion. This is most effective early in the proliferative phase. Those lesions can be treated pharmacologically with oral propranolol. Focal symptomatic lesions can be injected with corticosteroids. Topical timolol may be used for small, superficial lesions. Pulse dye laser can be used to treat telangiectasias that remain after involution. Sclerotherapy is the treatment for vascular malformations and macrocystic lymphatic malformations. Embolization followed by resection is the treatment for symptomatic arteriovenous malformations. A punch biopsy is not indicated for this lesion, which is following the classic growth pattern of a classic infantile hemangioma in the involution phase.

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48. A 25-year-old man is brought to the emergency department with a large degloving injury with exposed tibia and ankle joint (Gustilo Type IIIB) sustained during a motorcycle collision. After multiple debridements, the plastic surgeon is consulted 6 days later. Routine laboratory testing shows a platelet count of 1.5 million/mL, increased from normal range on admission. Free flap reconstruction is planned. Which of the following is the most appropriate next step in management in this patient?
- A) Consult hematology for bone marrow biopsy
 - B) Delay reconstruction until platelet count is within normal range
 - C) Initiate antiplatelet therapy
 - D) Proceed with free tissue transfer

The correct response is Option C.

Antiplatelet therapy should be initiated to minimize the risk for flap loss in this patient. This patient has a reactive thrombocytosis which can commonly occur following trauma, infection, inflammation, or major surgery (e.g., post-splenectomy). This temporary elevation in platelet count is usually transient and peaks at approximately 2 weeks after injury. The traditional pharmacologic agents for microvascular thrombosis have minimal (e.g., aspirin) or no anti-platelet effects (e.g., heparin, hirudin, and thrombolytic agents). There are no guidelines or standards of care, but Hollenbeck et al. advocate for administration of glycoprotein IIb/IIIa antagonists (e.g., abciximab, tirofiban, and eptifibatide), which block the final common pathway for platelet aggregation. Thienopyridines (e.g., clopidogrel) often reach steady state after 4 to 7 days, which would further delay surgery. Platelet apheresis has also been described to reduce platelet count and secondary flap salvage.

Acute trauma patients with elevated preoperative platelet counts are at higher risk for both intraoperative and postoperative microvascular complications (especially arterial thrombosis). Proceeding with free tissue transfer without any precautions is high risk for failure.

A hematology consult and bone marrow biopsy is not necessary since the hypercoagulable state is usually self-limited but can take several weeks. This is not a chronic medical condition requiring further workup or treatment.

Multiple studies suggest that patients with complex open fractures requiring soft-tissue coverage have improved outcomes with early free flap coverage, so it is not appropriate to wait until after this condition resolves. The platelet elevations can peak at approximately 2 weeks, which would delay reconstruction and increase morbidity. Delaying reconstruction increases the risks for infection, nonunion, and ultimately failure of limb salvage.

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49. A 25-year-old man is brought to the emergency department because of a sharp traumatic amputation at the mid-humerus level. The intact amputated part is placed in a plastic bag. The patient is brought to the operating room for attempted replantation with a warm ischemia time of 4 hours. He is hemodynamically stable. Which of the following is the most appropriate next step in management?
- A) Arterial repair to restore inflow
 - B) Arterial shunt to restore inflow
 - C) Bone fixation
 - D) Bone shortening
 - E) Revision amputation and immediate targeted muscle reinnervation

The correct response is Option B.

Upper limb amputations proximal to the wrist tolerate a maximum warm ischemia time of 4 to 6 hours due to the large muscle mass. Beyond this time, muscles start undergoing irreversible myonecrosis. In this patient, with a warm ischemia time at the upper limit tolerable, the most urgent order of business is to restore perfusion. This can rapidly be achieved with a temporary shunt placed from the proximal arterial stump to the arterial stump in the amputated part. This maneuver will result in bleeding from the unrepaired veins, and therefore the patient will need a transfusion. This venous egress also drains the lactic acid out of the body, thus preventing cardiovascular collapse due to metabolic acidosis. Bone shortening should then be performed so that healthy vessels and nerves are obtained for anastomosis. Rigid bone fixation is then performed. Tendons and muscles are then repaired. Vascular repair is then performed between healthy vessel ends, preferably primarily but with vein grafts if needed. Nerve repair is then performed between healthy nerve ends. If a large segment of nerve is damaged due to severe soft tissue loss, the nerve ends are tagged for future repair after the soft tissue has stabilized. Replantation should be attempted if patient hemodynamics and medical conditions permit. Although the incidence of postoperative pain in replanted patients is 39 to 79%, the functional outcome of a replanted upper extremity is better than an amputation. Furthermore, several studies have demonstrated higher patient satisfaction with replantation than with prosthesis. Amputation with targeted muscle reinnervation is not appropriate at this initial stage since replantation for limb salvage is a viable option in this case.

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50. A 65-year-old woman presents with a basal cell carcinoma of the lower nasal dorsum. A photograph is shown. Mohs micrographic surgery is performed, and the patient is left with a 2 × 2-cm defect with exposed cartilage. The patient desires the best cosmetic outcome but refuses more than one procedure. Which of the following is the most appropriate option to accommodate the patient's wishes?

- A) Dorsal nasal flap
- B) Full-thickness skin graft
- C) Healing by secondary intention
- D) Paramedian forehead flap

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The correct response is Option A.

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The correct option for this particular patient is an axial frontonasal or dorsal nasal flap as demonstrated in the photographs. When immediate local tissue is insufficient for primary repair of nasal defects, one is forced to look for additional tissue for a proper reconstruction. The ideal reconstruction would utilize the remaining nasal skin if possible, in order to match the texture and color of nasal skin. This is especially true in the middle and lower third of the nose. The axial frontonasal flap is a modification of the original flap described by Rieger and is based on a branch of the angular artery near the medial canthus. Because of the axial nature, the flap can be mobilized through both a wide or narrow skin bridge, or even as an island flap if necessary. The flap provides a sizable amount of skin with similar color and texture for the dorsum and in some cases the nasal tip as well. Limitations of the flap include a maximal defect diameter of 2.0 to 2.5 cm, possible nasal ala or tip retraction, and possible skin thickness mismatch where the thicker glabellar skin that has been mobilized inferiorly meets the thinner medial canthal skin.

Healing by secondary intention would be difficult with exposed cartilage and would be cosmetically and functionally unacceptable with this particular wound. In some cases, a full-thickness skin graft for a small superficial defect can provide excellent results; however, graft take is unpredictable with prolonged healing and in some cases leave a patch-like result. In this situation, a full-thickness skin graft would have difficulty healing with exposed cartilage. Even if perichondrium were intact to allow for proper healing, the discrepancy in skin thickness would be cosmetically unacceptable to this patient. Paramedian forehead flaps are the gold standard for large, complex defects of the nasal tip and ala, but require at least two to three stages and would not be an option for this patient.

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Section 2: Hand and Lower Extremity

51. A 30-year-old man presents with an injury to the ulnar nerve at the elbow. Examination shows an 8-cm nerve gap. Reconstruction with distal nerve transfers at the level of the wrist (motor) and palm (sensory) is planned to restore intrinsic function and finger sensation. If the proximal nerve gap is not repaired, which of the following deficits will most likely persist?
- A) Decreased elbow flexion strength
 - B) Decreased finger extension strength
 - C) Decreased sensation in the first web space
 - D) Decreased sensation on the dorsal hand

The correct response is Option D.

Distal to the elbow, the ulnar nerve supplies motor innervation to the flexor carpi ulnaris as well as the flexor digitorum profundus to the ring and small fingers, before heading toward the hand, where it supplies most of the intrinsic muscles of the hand (hypothenar muscles, ulnar two lumbricals, interossei, adductor pollicis, deep head of the flexor pollicis brevis). Along the way, it sends off a sensory branch to the dorsal hand; this branch arises about 7 cm proximal to the wrist crease. The most common nerve transfer for motor restoration is transfer of the nerve to pronator quadratus (distal anterior interosseous nerve) to the ulnar motor branch at the wrist. Sensory nerve transfers within the palm can restore sensation to the ulnar digits. However, these distal reconstructions will not restore sensation to the dorsal ulnar hand.

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52. A 35-year-old woman presents after traumatic amputation of the dominant thumb through the trapezium. Which of the following is the most appropriate method for reconstructing the function of the thumb in this patient?

- A) Bone graft with free forearm flap
- B) Great toe transfer
- C) Groin flap followed by great toe transfer
- D) Pedicled radial forearm flap including vascularized bone
- E) Pollicization

The correct response is Option E.

A functioning thumb requires adequate length, good sensation without tenderness, stability, and positioning to meet the other digits. Many authors state that positioning of the thumb is the most important factor to optimize thumb function. Pollicization is the only choice that can restore the basal joint. The index metacarpal-phalangeal joint becomes the new basal joint. The intrinsic muscles of the digit become the intrinsic muscles to position the thumb. Pollicization also provides excellent sensation if the index or ring finger that is used has good sensation prior to transfer. Second toe transfer can be done, but it requires another flap such as a groin flap to provide adequate soft-tissue coverage of the web and base of the thumb, and ideally it requires metacarpal base for stabilization. Removing the great toe metatarsal has unacceptable consequences on ambulation. Osteoplastic reconstruction with a bone graft and flap coverage is not adequate for reconstruction of a carpometacarpal-level amputation.

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53. Following a fall 2 hours ago, a 23-year-old man reports increasing tingling and pain in the left thumb and index finger. X-ray studies of the left wrist are shown. Attempts at reduction fail. Which of the following is the most appropriate next step in management for this patient?
- A) Closed reduction and percutaneous pinning
 - B) Exploration and wrist arthrodesis
 - C) External distractor placement
 - D) Open reduction and internal fixation
 - E) Proximal row carpectomy

The correct response is Option D.

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This patient has sustained a Mayfield III greater arc perilunate injury. The x-ray studies show a scaphoid waist fracture along with a disruption of Gilula's lines. The lateral view shows the lunate in its fossa with the remaining carpus displaced dorsally. In a closed injury, attempted reduction in the emergency department, often accompanied by sedation, is an appropriate first step. If reduction is successfully performed and the patient has minimal median nerve symptoms, they can be safely discharged home with plans to return within the week for repair. If reduction is not possible, as in this case, then the patient should be admitted to the hospital for open reduction and internal fixation in the form of screw fixation of the scaphoid fracture and scapholunate ligament tear versus K-wire fixation.

In this case, given the patient's worsening median nerve compression symptoms, acute carpal tunnel syndrome should be considered, and a carpal tunnel release should be performed concurrently with the open reduction and internal fixation. If the resources are not available to perform definitive repair of the bone and joint injury, acute carpal tunnel release is still needed to preserve viability of the median nerve. If the nerve and bony procedures can be done concurrently, by using the volar approach, the carpal tunnel can be easily accessed and released during the approach to reach the displaced lunate. Following this, often a dorsal approach is used to address concurrent scaphoid injuries.

Proximal row carpectomy is reserved for those missed injuries with chronic pain and instability. This patient presents with an acute injury so this would not be recommended. Similarly, wrist arthrodesis is also reserved for chronic injuries in those who have painful and unstable joints, but this would also be a poor choice in this patient.

While some authors use staged reconstruction with a distractor to address soft tissue shortening in late presentations, the two-stage approach would not be necessary in an acute injury like this.

Closed reduction and percutaneous pinning would be difficult since reduction attempts in the emergency department have been unsuccessful, and it would not address the carpal tunnel.

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54. A 25-year-old woman presents with Volkmann contracture. Examination shows the patient has supple fingers but no active flexion of the wrist or digits. MRI shows fibrosis of the volar forearm compartment. Electromyography shows no motor action potentials in the forearm flexor musculature. Which of the following is the most appropriate management of this patient to restore extrinsic finger flexion?

- A) Flexor digitorum superficialis to flexor digitorum profundus tendon transfer
- B) Flexor pronator slide
- C) Free gracilis functioning muscle transfer
- D) Pronator teres to extensor carpi radialis brevis tendon transfer
- E) Z-lengthening of the flexor tendons in the forearm

The correct response is Option C.

This patient has developed Volkmann ischemic contracture, and there has been muscle fibrosis resulting from ischemia of the volar compartment. At this point, there is no functioning flexor muscle. The most appropriate management is thorough debridement of the volar forearm muscles and free functioning muscle transfer to restore extrinsic finger flexion.

Flexor digitorum superficialis to flexor digitorum profundus tendon transfer is a useful treatment to open a nonfunctional hand due to severe spasticity. Pronator teres to extensor carpi radialis brevis tendon transfer is a tendon transfer used to restore wrist extension, not flexion. Flexor pronator slide or lengthening of the flexor tendons is only indicated when there is a contracture but still some functioning muscle. Z-lengthening of the flexor tendons also relies on a mild to moderate contracture and the presence of functioning flexor muscle.

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55. An upper trunk (C5-C6) brachial plexus injury is most likely to result in dysfunction of which of the following muscles?

- A) Biceps
- B) Flexor carpi ulnaris
- C) Pectoralis minor
- D) Trapezius
- E) Triceps

The correct response is Option A.

Upper trunk brachial plexus injuries are associated with the classic "waiter's tip" posture: the shoulder is adducted and internally rotated at rest. The elbow is extended, the forearm is pronated, and the wrist and digits are held in flexion. Impacted nerves include the axillary, musculocutaneous, and suprascapular nerves. The musculocutaneous nerve innervates the biceps and brachialis muscle. Loss of function of these muscles results in deficits of elbow flexion and forearm supination.

The flexor carpi ulnaris is innervated by the ulnar nerve, which originates from the medial cord of the brachial plexus and carries innervation from C8-T1.

The pectoralis minor is innervated by the medial pectoral nerve from the medial cord of the plexus and carries nerve fibers from C8 and T1.

The trapezius is innervated by the spinal accessory nerve (cranial nerve XI).

The triceps is innervated by the radial nerve, which originates from the posterior cord of the brachial plexus and has contributions from C5-T1.

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56. Targeted muscle reinnervation allows for increased type of which of the following prosthetic controls for an above-elbow amputee?

- A) Cable
- B) Electromyographic
- C) Passive
- D) Switch

The correct response is Option B.

Upper limb amputation is a devastating loss, more so than lower limb amputation. The level of amputation portends increased functional loss, i.e., forearm-level amputees maintain more functional capacity than above-elbow amputees. Many patients with upper extremity amputations rely on their prosthetic for daily functional demands. Patients with an above-elbow amputation have less muscles to exert control of a prosthetic, which makes multiple simple movements difficult and compound movements especially challenging.

There are multiple types of prostheses for the upper extremity. There are passive prosthetics, which are frequently cosmetic but may allow for a stable post for the other extremity. Functional prosthetics are body-powered (via cable controls) or externally powered (myoelectric, switch control). Body-powered prostheses use the remnant body motions through a harness (i.e., scapular and humeral motion for a transhumeral amputee) via cable to control motion and the force of a terminal device. These are simple devices that do not require as much maintenance and have more longevity, but they are limited in terms of functionality.

Myoelectric prostheses use the remnant muscle contractions via electromyographic (EMG) capture for prosthetic control. The more independent discrete electromyographic signals there are, the more potential functional options of the prosthetic there are. If there are minimal/limited EMG sensor options, then switch control can be used. Switch control is when small switches are turned on/off to increase control for separate components of a prosthetic. Switch control can be combined with myoelectric control to increase functionality for higher level amputees. For example, a transhumeral-level amputee can use switch control to position the elbow, while EMG signals from the biceps and triceps control wrist/hand motion.

Targeted muscle reinnervation (TMR) uses nerve transfers to "hyperreinnervate" muscles to allow for increased distinct electromyographic signals as well as increased amplification of signals, increasing control sites for prosthetic functionality. A good example is using residual peripheral nerves of transhumeral amputees, such as the median, radial, and ulnar nerves, to increase independent control of each biceps and triceps head as well as brachialis. TMR therefore allows for increased EMG control of a myoelectric prosthetic.

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57. A 35-year-old, right-hand–dominant man presents with a 4-month history of right upper extremity weakness. The patient reports a history of sudden onset shoulder pain that began without trauma. The pain improved, but he has developed difficulty abducting the shoulder, externally rotating the shoulder, and flexing the elbow. MRI shows hourglass constrictions of the brachial plexus. Electrodiagnostic studies demonstrate the involvement of multiple peripheral nerves. Which of the following is the most likely diagnosis?

- A) Brachial plexus avulsion
- B) Guillain-Barré syndrome
- C) Parsonage-Turner syndrome
- D) Rotator cuff injury
- E) Transverse myelitis

The correct response is Option C.

Acute brachial neuritis, also known as neuralgic amyotrophy or Parsonage-Turner syndrome, is an uncommon but well-recognized clinical entity. Patients characteristically present with acute-onset unilateral severe shoulder and/or arm pain that radiates, followed by progressive weakness and atrophy of the muscles in the shoulder girdle and arm. Pain is the initial symptom for 90% of patients. The etiology of the syndrome is thought to be idiopathic; however, it has been reported in various clinical situations, including post surgery, post infection, during pregnancy, during vigorous exercise, post trauma, and post vaccination. Patients exhibit significant variability in presentation regarding nerve involvement, muscle involvement, the extent of recovery, and recurrence. Diagnosis is made by clinical examination and supported by electrodiagnostic studies and imaging. Electrodiagnostic studies show multiple peripheral nerve lesions, rather than a brachial plexus localization. Parsonage-Turner syndrome is considered self-limited and is often managed conservatively; however, recovery may be protracted and incomplete, and a large percentage of patients never fully recover (30%). Surgical exploration has become more common for patients who do not show clinical or electrodiagnostic signs of recovery after several months. Nerve imaging will demonstrate hourglass constrictions, which are neurolysed at the time of exploration, sometimes in conjunction with nerve transfer.

These patients usually have full shoulder range of motion; additionally, imaging does not correlate with rotator cuff injury.

Avulsion of the brachial plexus would have a prodrome of trauma, and diagnosis would point to root involvement as opposed to more distal nerve pathology.

Guillain-Barré syndrome is usually preceded by infection or other immune stimulation that induces an aberrant autoimmune response targeting peripheral nerves and their spinal roots. These patients traditionally present with symmetric acute flaccid paralysis that can progress to respiratory failure.

Transverse myelitis describes a heterogeneous group of inflammatory disorders that are characterized by acute or subacute motor, sensory, and autonomic (bladder, bowel, and sexual) spinal cord dysfunction (traditionally bilateral), which does not correlate with this patient's presentation.

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58. A 26-year-old man presents with silicone rods in the flexor tendon sheaths of middle and ring fingers. Medical history includes saw injury resulting in flexor tendon debridement. Second stage flexor tendon reconstruction using an expendable donor tendon graft from the lower leg is planned. Which of the following is the most appropriate description of the location for this tendon at the ankle?
- A) Anterior to the lateral malleolus
 - B) Anterior to the medial malleolus
 - C) In the anterior compartment
 - D) In the lateral compartment
 - E) Lateral to the Achilles tendon
 - F) Medial to the Achilles tendon

The correct response is Option F.

The most appropriate description of the location of the tendon at the ankle is medial to the Achilles tendon.

The plantaris tendon can present an expendable donor tendon from the lower leg for tendon grafting. The plantaris is a small, thin rudimentary muscle with a long tendon. It acts in plantar flexion at the ankle and flexion at the knee, and harvesting does not leave any donor site deficits.

The plantaris originates in the popliteal fossa and travels along the posterior aspect of the calf between the soleus and gastrocnemius muscles to insert in the medial calcaneus. Although there may be some variability in the nature of its insertion, typically the plantaris tendon joins with the Achilles tendon and is found just medial to the Achilles tendon at the ankle in the superficial posterior compartment.

It is present in about 90% of people and is found at a higher incidence than the palmaris longus tendon. The plantaris can provide up to double the length of tendon graft compared with the palmaris longus, and it would be a good choice for reconstructing multiple tendon defects where greater length is needed.

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59. A 55-year-old man presents with a fungating mass of the right shoulder that has been enlarging for the past 12 years. A photograph is shown. Medical history is unremarkable. The patient reports that he spent his youth working outside. He has a history of smoking. Which of the following is the most significant risk factor for development of this lesion in this patient?

- A) *CDK4* mutation
- B) Previous use of topical steroids
- C) Smoking history
- D) Sun exposure

The correct response is Option D.

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The patient presents with a nodular ulcerated basal cell carcinoma to the right shoulder. Basal cell carcinoma is the most common malignancy in the United States due to the increase in sun exposure and tanning salons. The most common risk factor for basal cell carcinomas is sun exposure. Generally, they do not metastasize and are resectable, but do lead to large oncologic resections if left to progress, as is the case in the patient described. Smoking history, although important, does not have a major impact on the risk for basal cell cancer. Marjolin ulcers are a variant of squamous cell carcinoma that results from the chronic inflammatory process that follows burns and is not a risk factor for basal cell carcinoma. Immunosuppression is a risk factor for basal cell carcinomas, but it is not as great as sun exposure and this patient has no history of immunosuppression. Other risk factors for basal cell carcinoma include being male and of older age, but these are not listed as possible choices. A mutation in the *CDK4* gene is linked to familial melanoma and would have no relation to the basal cell tumor in this patient. Topical steroid use has no known impact on risk for development of basal cell carcinoma.

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60. Which of the following best describes the origin and insertion of the lumbrical muscles?

	Origin	Insertion
A)	Flexor digitorum profundus tendon	lateral band
B)	Flexor digitorum profundus tendon	proximal phalanx
C)	Flexor digitorum superficialis tendon	lateral band
D)	Flexor digitorum superficialis tendon	proximal phalanx
E)	Metacarpal bone	lateral band

The correct response is Option A.

The lumbrical muscles are intrinsic muscles of the hand. They arise from the flexor digitorum profundus tendon and insert into the radial lateral band of the extensor mechanism. Their origin and insertion both attach to muscle/tendon rather than bone, which makes them unique compared with other muscles, which typically originate from and insert into bone.

No muscles arise from the flexor digitorum superficialis tendon. The interosseous muscles originate from the metacarpal shafts and insert into the proximal phalanges.

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61. A 34-year-old woman presents with a 1-year history of progressive ankle and dorsal foot pain and paresthesias in the first dorsal web space. Electrodiagnostic study is significant for changes in the extensor digitorum brevis muscle. Which of the following nerves is the most likely source of this patient's symptoms?
- A) Deep peroneal
 - B) Saphenous
 - C) Superficial peroneal
 - D) Sural
 - E) Tibial

The correct response is Option A.

Anterior tarsal tunnel syndrome, also known as deep peroneal nerve (DPN) entrapment, is the result of compression of the DPN at the superior border of the inferior extensor retinaculum at the ankle joint and beneath the extensor hallucis longus tendon. Entrapment can occur as a result of wearing tight-fitting shoes or boots. It is important to rule out exertional anterior compartment syndrome or common peroneal nerve entrapment as the cause of symptoms. The nerve can also experience traction injury caused by chronic ankle instability due to ankle sprains.

The DPN travels in the leg between the extensor digitorum longus (EDL) and tibialis anterior and distally between the EDL and extensor hallucis longus just proximal to the ankle before dividing into the lateral and medial branches, 1.3 cm proximal to the ankle joint. The lateral branch innervates the extensor digitorum brevis (EDB) and the tarsometatarsal (TMT) and metatarsophalangeal joints. The medial branch, a sensory branch, travels to the first dorsal web space and has a dorsomedial cutaneous branch to the second toe and a dorsolateral cutaneous branch to the great toe. Entrapment of the medial branch can occur from the extensor hallucis brevis (EHB) tendon, as it travels over the nerve at the first and second TMT joints. Patients typically present with pain along the dorsum of the foot with intermittent numbness radiating to the first dorsal web space. A Tinel sign may be elicited over the superior and inferior retinaculum along the DPN, resulting in tingling over the first dorsal web space of the foot. The EDB can be weak or atrophied. Patients may also report aching and tightness along the ankle joint or numbness at the first dorsal web space when the ankle is placed in plantar flexion with the toe extended. Electrodiagnostics should be ordered to confirm the diagnosis and location of the entrapment.

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62. A Froment sign is created by retained function of which of the following muscles?

- A) Adductor pollicis
- B) Extensor pollicis brevis
- C) Extensor pollicis longus
- D) Flexor pollicis brevis
- E) Flexor pollicis longus

The correct response is Option E.

Ulnar nerve injuries are particularly devastating and have significant sensory and motor functional consequences. Proximal to the elbow, the expected motor deficits include absence of the flexor carpi ulnaris, the flexor digitorum profundus to the middle/ring/small fingers, the hypothenar muscles (opponens digiti minimi, abductor digiti minimi, flexor digiti minimi brevis), the third and fourth lumbrical muscles, the dorsal and palmar interosseous muscles, the adductor pollicis, and the deep head of the flexor pollicis brevis. A Froment sign is observed when the patient attempts to pinch but is unable to activate the adductor pollicis (ulnar innervated) and compensates by activating the flexor pollicis longus by flexing the interphalangeal joint (median nerve innervated). Extensor pollicis longus (EPL), extensor pollicis brevis (EPB), and flexor pollicis brevis (FPB) are not involved in the thumb interphalangeal joint flexion that produces Froment sign.

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63. A 70-year-old woman presents with injury to the left hand sustained while cleaning a jammed lawnmower. The tendons have been avulsed from the forearm. A photograph is shown. While waiting for transport to surgery, the patient reports worsening forearm pain in the ipsilateral extremity. X-ray studies show no fracture of the forearm. In addition to operative intervention for the hand site, which of the following is the most appropriate next step in management?

- A) CT scan with contrast
- B) Forearm muscle fascia release
- C) Perform an axillary nerve block
- D) Ulnar nerve neurolysis
- E) Upper extremity angiography

The correct response is Option B.

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This patient has sustained a severe avulsion-type mechanism of amputation and has developed subsequent acute compartment syndrome of the forearm secondary to avulsion of multiple flexors at their musculotendinous junctions at the forearm. This led to intracompartmental hematoma within the forearm flexors and subsequent edema, leading to increased intracompartmental pressure. When the intracompartmental pressures become significantly increased, the perfusion gradient is decreased, with subsequent capillary collapse and ischemia. This is a surgical emergency in addition to the amputated hand warranting myofascial release of the forearm compartments. If left untreated, not only will the patient's pain be uncontrolled, but her overall morbidity will be worsened.

In the setting of compartment syndrome, additional radiologic tests are not warranted, and while a nerve block could control the pain, it does not address the underlying cause of the patient's symptoms. Angiography is not appropriate to evaluate or treat compartment syndrome. Ulnar nerve release will not treat the compartment syndrome.

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64. A 51-year-old man presents for evaluation of nerve injury following varicose vein stripping of the left leg. Which of the following findings would be expected with saphenous nerve injury in this patient?
- A) Anesthesia around the left medial malleolus
 - B) Hypersensitivity along the dorsum of the left foot
 - C) Inability to dorsiflex the left foot
 - D) Increased insertional activity in the tibialis anterior muscle
 - E) Numbness near the left lateral heel

The correct response is Option A.

Nerve injury is a relatively rare but significant complication of varicose vein stripping. Knowledge of anatomy can help identify which nerve is involved in most injuries. Injury to the saphenous nerve would cause anesthesia over the medial calf and medial malleolus. Injury to the deep peroneal nerve would cause weakness in dorsiflexion and would result in increased insertional activity on electromyography of the tibialis anterior. Hypersensitivity on the dorsal foot or numbness over the lateral heel would come from an injury to the superficial peroneal nerve and the sural nerve, respectively.

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65. A 54-year-old man presents to the emergency department with increasing right forearm pain and a rapidly enlarging pulsatile mass 4 days after suture repair of a proximal right volar forearm laceration. At the time of injury, significant blood loss in the field and pulsatile bleeding in the emergency department was noted. The hand is perfused, and sensation is grossly intact to pinprick. Which of the following is the most appropriate next step in management?
- A) Incision and drainage of the laceration at bedside
 - B) Inpatient admission for observation
 - C) Magnetic resonance angiography
 - D) Needle manometry
 - E) Operative exploration

The correct response is Option E.

The history and presentation are concerning for a ruptured pseudoaneurysm. Although the patient's hand is perfused, the rapid onset of pain and swelling is concerning for active bleeding. Appropriate management would consist of operative exploration and repair of the injured vessel. Imaging studies can confirm the diagnosis in the setting of a post-traumatic pulsatile mass, but they would not be appropriate in the emergent setting described. Observation would result in ongoing hemorrhage, which could be life-threatening or result in a compartment syndrome. Bedside incision and drainage could result in bleeding in an uncontrolled environment. Needle manometry is employed to provide adjunctive data in the assessment of potential compartment syndrome, but it would not be appropriate in the setting of potential uncontrolled hemorrhage.

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66. A 16-year-old boy presents with clubbing of all digits of both hands. Medical history includes cyanotic congenital heart disease. Which of the following is the most likely cause of the abnormal appearance of the nail in this patient?

- A) Hypertrophy of the distal phalanx
- B) Hypertrophy of nail keratin
- C) Increased vascular connective tissue
- D) Reduction of collagen in the distal finger
- E) Tenosynovial hypertrophy

The correct response is Option C.

Digital clubbing has been recognized since 400 BC. It is associated with numerous systemic disorders including cardiac, pulmonary, malignant, thyroid, and gastrointestinal conditions, as well as autosomal dominant hypertrophic osteoarthropathy in healthy individuals.

Characteristic findings include the profile sign or Lovibond angle (the nail makes a greater than 180-degree angle as it exits the eponychial fold) and an increase in the distal phalangeal to interphalangeal depth ratio.

The complete pathophysiology is not fully understood. However, theories include abnormal arteriovenous anastomoses, growth hormone abnormalities, and megakaryocyte production of platelet-derived growth factor. Whatever the mechanism, sampling of the tissues demonstrates an increase in vascular connective tissue, causing the appearance.

Although nail shape is altered, this is unrelated to nail keratin deposition. With long-standing clubbing, collagen is deposited in the digit and likely is irreversible. Clubbing is associated with increased blood flow except in familial cases. The tenosynovium is not part of clubbing. The distal phalanx bone is unaltered in clubbing.

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67. The lower extremity difference known as mirror foot is most likely linked to which of the following derangements in embryologic development?

- A) Duplication of the apical ectodermal ridge
- B) Duplication of the zone of polarizing activity
- C) Loss of the apical ectodermal ridge
- D) Loss of the signal from ventral ectoderm
- E) Loss of the zone of polarizing activity

The correct response is Option B.

The zone of polarizing activity (ZPA) is responsible for differentiation in the anteroposterior axis. Regulation of this entity involves the sonic hedgehog and Hox b-8 proteins. Loss of the ZPA results in absence of posterior elements in the developing limb. Duplication of the ZPA leads to mirror hand and mirror foot type anomalies. The apical ectodermal ridge (AER) is the primary driver for proximal-distal limb growth. The AER is highly regulated by fibroblast growth factor, and loss of AER function leads to arrested limb development. Ventral (bone morphogenetic proteins and Engrailed-1) and dorsal (Wnt7) signaling factors are antagonistic; disruption of these signals will affect dorsal-volar patterning but also proximal-distal growth of the limb.

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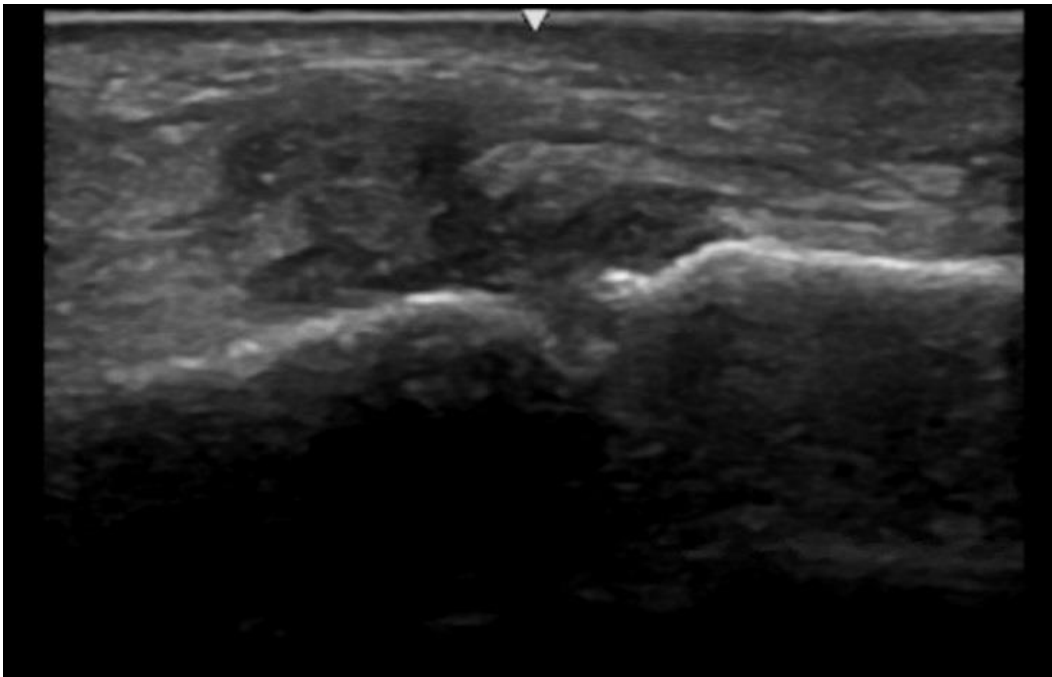
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68. A 45-year-old, left-hand–dominant man presents to the emergency department with right thumb pain after a fall while hiking. X-ray studies are shown. Physical examination shows the thumb is swollen, bruised, and tender to palpation. The metacarpophalangeal joint demonstrates laxity of 40 degrees with a firm endpoint on valgus testing. To determine if nonoperative management is an option, which of the following additional tests should be ordered?

- A) Arthrography
- B) CT scan
- C) Electrodiagnostic studies
- D) Triple-phase bone scan
- E) Ultrasonography



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The correct response is Option E.

An ultrasound will be the most effective way to diagnose a Stener lesion, which would necessitate surgical intervention for this patient. Stener lesions are a unique type of ulnar collateral ligament injury in which the dorsal adductor aponeurosis becomes interposed between the ruptured distal end of the ligament and its insertion at the proximal phalanx. This prevents healing of the ligament, and thus these injuries cannot be treated closed. Ulnar collateral ligament injuries that demonstrate no endpoint on valgus stress testing generally require operative management. Those that demonstrate some laxity with a firm endpoint can be treated with cast immobilization as long as there is no Stener lesion. Stress view x-ray study will show full versus partial disruption of the ligament but will not identify the presence or absence of a Stener lesion. Some consider MRI to be the most sensitive modality for detection of these lesions; however, criticisms of MRI include its cost and delay in availability. Arthrography can be used to identify capsular injury but cannot detect the collateral ligament displacement with high accuracy. CT scan will not be able to resolve the ligament position clearly. Ultrasonography is cost-effective, dynamic, and easy to obtain. Ultrasonography has been shown to have a positive predictive value of 87 to 100% when used to identify Stener lesions. On the imaging examination, an uninjured collateral ligament will appear as a hypoechoic arc. In a Stener lesion, the arc will be disrupted with displacement or a large gap between the two ends, as seen in the image.

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69. A 12-year-old, left-hand–dominant boy presents for examination of a scald burn of the right hand sustained 1 year ago. Examination shows a boutonniere deformity of the ring finger with very thin skin overlying the dorsum of the joint. Surgical correction of the joint deformity is planned. Coverage with which of the following flaps is most appropriate for this patient?

- A) Atasoy
- B) Homodigital island
- C) Moberg
- D) Reverse cross finger
- E) Thenar

The correct response is Option D.

The reverse cross finger flap is the only flap from among the choices that would reach the dorsal proximal interphalangeal joint. This flap transfers pedicled subdermal plexus to the defect, leaving a thin skin flap at the donor site. The recipient site must be skin grafted for completion of coverage. The preferred donor areas are the dorsal aspect of the middle and proximal phalanges of the adjacent fingers. This is usually an obliquely oriented flap located at the dorsum of the middle phalanx about 1 cm longer and about 4 to 5 mm wider than the defect. A thin full-thickness skin flap with intact subdermal vascular plexus is elevated based on the opposite side of the uninjured finger. The flap is based on the side of the uninjured finger closest to the defect. It is elevated at the level of the extensor paratenon, preserving dorsal veins and blood supply. The originally elevated, thin, full-thickness skin flap is then sutured back to cover the donor defect, and the thin subcutaneous flap on the injured finger is covered with a thin full-thickness skin graft.

The homodigital island flap is used to reconstruct pulp defects. The cross finger flap is used to reconstruct volar soft tissue defects including the pulp. The Atasoy V-Y advancement flap is used for finger pulp defects.

The Moberg flap is traditionally used to cover volar amputation defects of the thumb that are normally 1.5 cm in size but no more than 2 cm. This often leads to flexor contractures. The Moberg flap cannot be used to cover the dorsal surface of the ring finger.

A thenar flap would not be able to reach the dorsum of a ring finger PIP joint.

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70. A 16-year-old boy presents with contracture of the proximal interphalangeal (PIP) joint after secondary healing of a volar burn of the right hand. Which of the following types of cell is responsible for contraction of this scar?

- A) Keratinocyte
- B) Langerhans
- C) Melanocyte
- D) Merkel
- E) Myofibroblast

The correct response is Option E.

Secondary wound healing is often aided by contraction. In some cases, this contraction may be excessive, causing cosmetic and/or functional problems such as a joint contracture. Fibroblasts and myofibroblasts are responsible for this contraction. The myofibroblast is a terminally differentiated fibroblast that functions as a smooth muscle-like cell expressing alpha-smooth muscle actin. It decreases its cell length, contracting the extracellular matrix to which it is attached. These cells are found in the dermis and cause ongoing scar contraction.

Myofibroblasts produce more collagen and less collagenase and are found more frequently in hypertrophic scars versus normal human scars. They are also resistant to apoptotic signaling, which may contribute to their preponderance on hypertrophic scars.

The other listed cell types are found in normal skin. Keratinocytes produce keratin. Langerhans cells are dendritic cells specializing in antigen presentation. Melanocytes produce melanin. Merkel cells are involved in mechanoreception.

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71. Which of the following structures is a potential site for compression of the ulnar nerve?

- A) Anconeus epitrochlearis
- B) Lacertus fibrosis
- C) Ligament of Struthers
- D) Pronator teres
- E) Supinator

The correct response is Option A.

Ulnar nerve compression at the elbow is the second most common compression neuropathy of the upper extremity (after carpal tunnel syndrome). There are several sites in this region that can contribute to ulnar nerve compression, including the arcade of Struthers, medial intermuscular septum, Osborne ligament, fascia between the two heads of the flexor carpi ulnaris (FCU), and fascial bands within the FCU distally. The anconeus epitrochlearis is an anomalous accessory muscle that can cause compression of the underlying ulnar nerve at the elbow. The anconeus epitrochlearis, present in 4 to 34% of individuals, originates from the medial epicondyle of the humerus and inserts into the olecranon. If identified during cubital tunnel surgery, this structure is typically released or excised.

The proximal leading edge of the supinator (arcade of Fröhse) can compress the posterior interosseous nerve.

The pronator teres muscle is a potential compression site of the median nerve in the proximal forearm.

The lacertus fibrosis (bicipital aponeurosis) is a potential compression site of the median nerve at the antecubital region.

The superficial radial nerve can be compressed between the tendons of the brachioradialis and extensor carpi radialis longus in the forearm.

The ligament of Struthers is a fibrous band that runs from the tip of the supracondylar process to the medial epicondyle. The median nerve and brachial artery can run through the passage created by the ligament and can be compressed when running through this passage. The

arcade of Struthers differs from the ligament of Struthers in that the arcade is a fascial band that runs from the triceps fascia to the medial intermuscular septum, and it is a potential site of compression of the ulnar nerve.

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72. A 25-year-old man presents with a comminuted tibia plateau fracture sustained during a self-inflicted gunshot wound. A CT scan is shown. During open reduction and internal fixation of the fracture, a 5-cm gap in the common peroneal nerve is noted. Tendon transfer, nerve repair with grafting, and nerve transfer are planned. Which of the following fascicular nerve transfers is most likely to aid in ankle dorsiflexion?
- A) Flexor digitorum longus to soleus
 - B) Flexor digitorum longus to tibialis posterior
 - C) Flexor hallucis longus to tibialis anterior
 - D) Peroneal longus to extensor digitorum longus
 - E) Soleus to extensor digitorum brevis

The correct response is Option C.

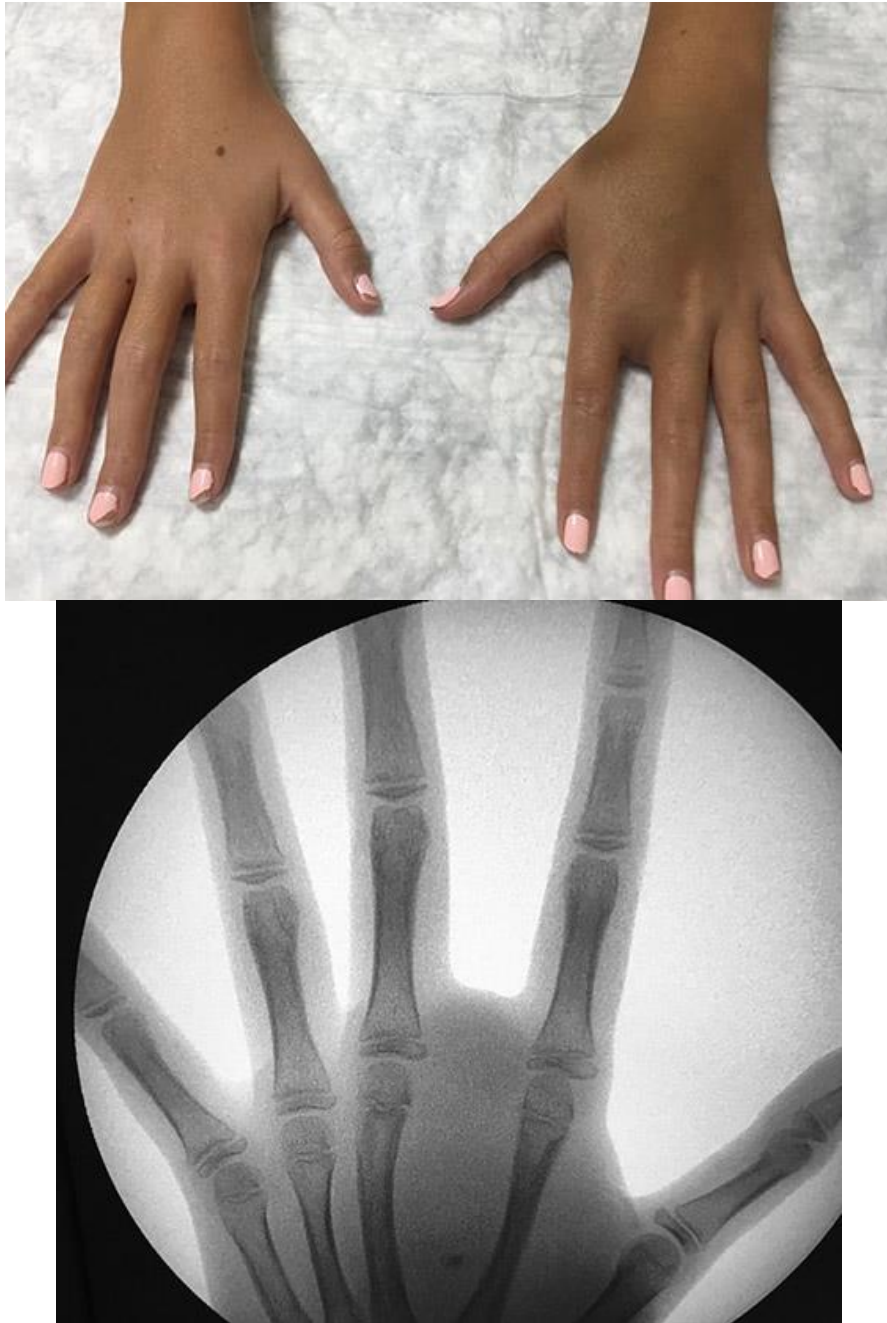
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Common peroneal nerve repairs tend to have less favorable results than their upper extremity counterparts. Traction injuries showed only good outcomes in 42% of patients, whereas sharp injuries showed good results in 61% of patients. Gunshot wounds, on the other hand, showed only 49% good outcomes due to the blast injury. This patient had damage of his nerve from penetrating trauma from the fracture fragments as well as damage from the blast injury. Because of the size of the defect, primary nerve repair would not be feasible. Nerve grafts less than 6 cm have been found to have a more favorable result than those greater than 6 cm. When combined with blast injury, a favorable result has only been found in 31% of patients.

In addition to nerve repairs, tendon transfers of the posterior tibial tendon have been useful for more immediate dorsiflexion. Fascicular nerve transfers have found some success in dorsiflexion. Of the options given, only transfer from the flexor hallucis longus (tibial nerve) to the tibialis anterior (deep peroneal nerve) would result in dorsiflexion. Although flexor digitorum longus is a common donor from the tibial nerve, innervating the soleus would result in plantar flexion and the soleus is also innervated by the tibial nerve, so it was not injured in the gunshot. Transfer from the flexor digitorum longus to the tibialis posterior (tibial nerve) would plantarflex the foot and not dorsiflex it. Although transfer to the extensor digitorum longus can lead to dorsiflexion, transfer from the peroneal longus (superficial peroneal nerve) to extensor digitorum longus would not result in a functional nerve repair, since the peroneal longus is innervated by the damaged nerve. Finally, transfer from the soleus to the extensor digitorum brevis (EDB, deep peroneal nerve) would not be a nearby transfer, nor would the EDB dorsiflex the ankle.

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73. A 13-year-old girl presents with an enlarging mass on the right hand. The patient's mother reports that the child has always had a bruised-appearing birthmark on the hand, but the region started enlarging in the last year. The patient reports aching pain mainly associated with exercise. On examination, the mass increases in size with dependence. A photograph, an x-ray study, and MRI images are shown. Which of the following is the most likely diagnosis?

- A) Arteriovenous malformation
- B) Hemangioma
- C) Lymphatic malformation
- D) Port-wine stain
- E) Venous malformation

The correct response is Option E.

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Vascular anomalies are divided into tumors and malformations. Hemangiomas are a classic example of a vascular tumor. Malformations are present at birth and grow with age. Vascular malformations don't regress with age. They may not be obvious at a young age and become more evident as the patient ages or goes through hormonal changes such as puberty and pregnancy (if female). Other reasons for enlargement include trauma, infection, and thrombosis. Vascular malformations are secondary to an error in the morphogenesis of blood vessels, and they don't enlarge secondary to cellular hyperplasia. There is a normal rate of endothelial cell turnover.

Vascular malformations are characterized by rate of flow and type of predominant tissue in the malformation. Slow-flow vascular malformations include capillary malformations, venous malformations (VMs), and lymphatic malformations (LMs). Fast-flow vascular malformations include arteriovenous malformations (AVMs) or fistulas. Combined vascular malformations aren't uncommon. Most vascular anomalies can be diagnosed by history and clinical examination. However, medical imaging has become an important component for diagnosis and treatment planning.

This patient presents with a vascular malformation based on history, examination, and MRI. The subtype for this patient is consistent with a venous malformation based on findings of phleboliths (blood clots that become hardened and calcified) on MRI and x-ray. VMs are the most common type of vascular malformation. These malformations may be present in all tissue planes but, when present at the subcutaneous level, give the skin a purplish hue that is accentuated with gravity position of the limb. VMs are traditionally compressible, and the purplish hue and fullness of the mass will frequently diminish with limb elevation against gravity. Painful clots and phleboliths are commonly identified and may be sources of pain causing acute presentation. Patients may report chronic aching pain, swelling, and stiffness that is worse in the morning. Phleboliths demonstrated on imaging are pathognomonic for VMs. VMs of the extremity can be associated with undergrowth or overgrowth.

Ultrasonography, MRI, and catheter angiography are frequently used imaging studies to delineate the rate of flow, identify features, and evaluate the extent of malformation. X-ray study or CT scan may be used to assess bony involvement/bony deformation and may show phleboliths appearing as rounded, lamellated calcifications. Ultrasonography with Doppler scan is frequently the first-line imaging study; it can assess the rate of flow (delineate fast/slow flow), depth of the mass, and any feeding vessels. Compressibility of the mass can also be assessed. An ultrasound of a VM usually shows a sponge-like collection of vessels and compression; then release will show inflow of blood into the cavity. Phleboliths, ectatic/dilated vessels, and thickened overlying tissue can all be shown on ultrasonography. MRI of VMs show multilocular, lobulated, septated masses. These are hypo/isointense on T1-weighted sequences and hyperintense on T2 sequences. VMs can be shown to involve nerves, tendons, muscles, joints, and adjacent organs. Phleboliths can also be appreciated on MRI as low-signal regions/flow voids.

The other options wouldn't be the most correct diagnosis for this patient. Hemangioma would be present at birth and grow rapidly (and regress for an involuting hemangioma). An AVM is a high-flow lesion and wouldn't have phleboliths on imaging. An LM is a low-flow lesion and similarly wouldn't demonstrate phleboliths. Neither an AVM nor an LM would appear to have increased size/congestion with dependence. Port-wine stain or capillary malformation is a flat macular cutaneous malformation and wouldn't be characterized by this patient's findings or imaging.

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74. A 25-year-old man presents to the office because of pain and swelling at the base of his dominant right thumb 3 days after a fall from his bicycle. X-ray study shows a Bennett fracture. The patient is scheduled for surgery. In addition to longitudinal traction and volarly directed pressure applied to the dorsal radial metacarpal base, which of the following best describes the appropriate reduction maneuver for this injury?
- A) Abduction and pronation of the thumb
 - B) Abduction and supination of the thumb
 - C) Adduction and flexion of the thumb
 - D) Adduction and pronation of the thumb
 - E) Adduction and supination of the thumb

The correct response is Option A.

A Bennett fracture is an intra-articular fracture-dislocation of the carpometacarpal joint of the thumb that occurs following an axially loading force through a partially flexed metacarpal. A variable-sized volar ulnar fragment of the metacarpal base articular surface remains in position by attachment of the anterior oblique ligament to the trapezium. The larger fragment consisting of the remaining metacarpal base subluxates proximally, radially, and dorsally due to deforming forces from the abductor pollicis longus and the thumb extensors. Deforming forces from the adductor pollicis also cause metacarpal adduction and supination. To counteract the deforming forces of this unstable fracture-dislocation, reduction is attempted by applying axial traction to the extended thumb, palmar abduction, and pronation, while exerting pressure over the metacarpal base in preparation for insertion of Kirschner wires.

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75. A 20-year-old man presents to the emergency department 6 hours after a bicycle accident with an open tibial fracture. The patient was traveling at 10 miles per hour at the time of the accident. The wound is 5 cm in length, and there is moderate contamination. The fracture is a mid-shaft tibial fracture with moderate comminution, with an associated closed fibula fracture. Which of the following Gustilo classifications is most appropriate for this injury?
- A) I
- B) II
- C) IIIA
- D) IIIB
- E) IIIC

The correct response is Option B.

Though it was never designed to predict treatment, the Gustilo classification has stood the test of time as a highly utilized grading system for lower extremity trauma. It is often used to predict the need for flap coverage, to estimate the risk for osteomyelitis, and to guide antibiotic use.

Gustilo Type	Definition
I	open fracture, wound 1 cm in length or less, clean
II	open fracture, wound greater than 1 cm but less than 10 cm in length without extensive soft-tissue damage, moderate contamination
IIIA	open fracture, wound usually greater than 10 cm, extensive contamination, high energy (segmental fractures and farm injuries are automatically IIIA)
IIIB	extensive periosteal stripping; inadequate local tissue for coverage (needs flap)
IIIC	vascular injury requiring repair (regardless of degree of other injuries)

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76. A 26-year-old man undergoes acute flexor pollicis longus laceration repair at the interphalangeal (IP) joint level. The proximal stump cannot be retrieved through the laceration. An incision at the distal forearm is performed. After identifying the flexor pollicis longus at this level, an attempt to retrieve the proximal stump is initially prevented by an attachment of the flexor pollicis longus to an adjacent tendon. Which of the following tendons is most likely involved in this anomalous connection?
- A) Abductor pollicis longus
 - B) Brachioradialis
 - C) Flexor carpi radialis
 - D) Flexor digitorum profundus index
 - E) Flexor digitorum superficialis index

The correct response is Option D.

An anomalous connection between flexor pollicis longus (FPL) and the profundus tendon to the index finger (flexor digitorum profundus-II) was initially described by Linburg and Comstock in 1979. In their initial report, the Linburg-Comstock anomaly was detected on physical examination in one extremity in 31% of patients and in both extremities in 14%. Dissection of 43 cadavers demonstrated the anomaly in at least one extremity of 25% and in both extremities of 6%. This anomalous tendon connection has been described as a source of tenosynovitis, which is alleviated with surgical division of the connection. The connection typically occurs at the level of the distal forearm, proximal to the carpal tunnel. This connection has been blamed for failure of FPL repair due to transmission of inadvertent tension to the repair site.

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77. A 24-year-old man presents with a Leddy and Packer type III avulsion injury to the ring finger flexor digitorum profundus tendon sustained while trying to make a tackle during a pick-up football game. At which of the following levels will the tendon most likely be found during surgical exploration?

- A) A4 pulley
- B) Carpal tunnel
- C) Lumbrical origin
- D) Metacarpal head
- E) Proximal interphalangeal joint

The correct response is Option A.

Avulsion injury of the flexor digitorum profundus (FDP) tendon represents a flexor tendon injury within zone 1 of the flexor tendon sheath. The anatomy of the pulley and vincular systems affects both the level of FDP tendon retraction and the ultimate prognosis. FDP avulsion injuries were classified into three types by Leddy and Packer in 1977. A type I injury describes tendon retraction into the palm, with the tendon tethered by the lumbrical origin. With this injury, both the vinculum profundus longus (VLP) and brevis (VBP) are ruptured. As a result, there is a substantial loss of both the intrinsic (periosteal) and extrinsic (vincular) vascular supply to the tendon. In type II injuries, the FDP tendon retracts to the level of the proximal interphalangeal joint. In this scenario, the VBP is disrupted, but the VLP remains preserved as it arises at the level of the proximal interphalangeal (PIP) volar plate. In type III injuries, retraction to the level of the A4 pulley of the middle phalanx is seen; these injuries are usually defined by an associated large bony fragment incarcerated within the A4 pulley. In direct contrast with type I injuries, both vincula are usually intact in type III injuries because the VBP originates at the distal portion of the middle phalanx. The Leddy and Packer classification has been expanded to include and better classify distinct injury patterns. Type IV injuries are rare and unique in that they include a large avulsion fragment incarcerated at the A4 pulley, along with rupture of the FDP tendon insertion off this osseous fragment, with secondary tendon retraction into the finger or palm. Type V injuries are complex and defined by the presence of concomitant osseous distal phalanx avulsion and distal phalanx fracture.

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78. During index finger pollicization for congenital absence of the thumb (Blauth type V), the first dorsal interosseous muscle of the index finger is used to create the function of which of the following muscles?

- A) Abductor pollicis brevis
- B) Abductor pollicis longus
- C) Adductor pollicis
- D) Extensor pollicis longus
- E) Flexor pollicis longus

The correct response is Option A.

Thumb hypoplasia represents a spectrum of thumb deficiency that may range from mild generalized hypoplasia to complete absence of the thumb. The modified Blauth classification is useful not only for classifying thumb deficiency, but also for guiding management decisions. Index finger pollicization is the procedure of choice for Blauth thumb hypoplasia type IIIB, type IV, and type V.

In pollicization, the index finger is transposed on its neurovascular bundles. The index metacarpal is removed from its base to the epiphysis. The new carpometacarpal joint (CMC) of the thumb is constructed by preserving the metacarpophalangeal joint of the index finger, which is fixed into hyperextension (to avoid hyperextension deformity of new CMC joint). The index metacarpal is positioned in 45 degrees of abduction and 100 to 120 degrees pronation and fixated anterior to the index metacarpal base.

The index finger tendons and muscles are used to construct the functions of the new thumb. The extensor digitorum communis is sutured to the base of the new metacarpal to simulate the abductor pollicis longus. The extensor indicis proprius tendon is shortened and sutured to become the new extensor pollicis longus. Further stability is achieved by transfer of the previously mobilized index dorsal interosseous to the radial lateral band to restore abductor pollicis brevis function. The index palmar interosseous is inserted into the ulnar lateral band to construct the adductor pollicis.

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79. A 35-year-old man undergoes excision of a peripheral nerve sheath tumor from the median nerve of the left wrist. Careful dissection is performed, and the encapsulated tumor is removed uneventfully with complete preservation of motor and sensory function. Pathologic studies show a benign tumor. Which of the following is the most likely tumor type in this patient?

- A) Clear cell sarcoma
- B) Fibroma
- C) Intraneural perineurioma
- D) Neurofibroma
- E) Schwannoma

The correct response is Option E.

Peripheral nerve sheath tumors are relatively uncommon and can present with pain or with motor/sensory deficits in the involved nerve. The majority of peripheral nerve sheath tumors are benign, and the most common benign tumor is a schwannoma. These are well encapsulated, slow-growing tumors comprised of Schwann cells. These usually can be removed without significant disruption of adjacent intact nerve fascicles or significant impact on patient function. Malignant nerve sheath tumors are less common but are more likely to have motor or sensory deficits at the time of presentation.

Neurofibromas are the second most common nerve tumor in the hand. They are distinct from schwannomas in that they involve nerve fascicles. Nerve repair or reconstruction may be required after resection. While the overwhelming majority are solitary, the presence of multiple neurofibromas raises suspicion for underlying neurofibromatosis which carries a high risk for malignant degeneration.

Fibromas are rare benign hand tumors. Dermatofibromas generally present as firm, flesh-colored nodules.

Clear cell sarcoma is a rare soft-tissue sarcoma which occurs most often in the extremities. Its predominant histopathologic feature is the source of its name. These tend to arise from tendons.

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Intraneural perineurioma is a benign neoplasm of the peripheral nerve sheath that typically affects teenagers and young adults and tends to result in a motor-predominant neuropathy. It comprises up to 5% of neural tumors. Treatment typically requires resection and repair or grafting.

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80. A 56-year-old woman presents for examination after undergoing completion amputation through the distal interphalangeal joint of the right middle finger 6 months ago. When she makes a composite fist, the middle finger paradoxically extends at the proximal interphalangeal joint. Which of the following anatomical structures is most likely responsible for this finding?

- A) Central slip
- B) Flexor digitorum profundus
- C) Flexor digitorum superficialis
- D) Lumbrical
- E) Triangular ligament

The correct response is Option D.

The finding described is called the lumbrical plus deformity, which is paradoxical extension of the interphalangeal (IP) joint or joints with active flexion of the digits. The lumbrical muscle originates from the flexor digitorum profundus (FDP) tendon and acts through the lateral bands to extend the IP joints and flex the metacarpophalangeal (MCP) joints. When the proximal end of the FDP tendon retracts, the lumbrical muscle retracts with it, resulting in increased force of MP flexion and IP extension on the affected finger. Since the FDP has a common muscle belly, when a composite fist is made, the unaffected fingers flex and the injured finger extends. In this patient, the injured finger does not flex because the FDP is no longer attached following amputation through the distal IP joint. The central slip and flexor digitorum superficialis are not involved in this pathology. Although the FDP is involved in the pathology, the underlying pathology results from persistent and now dysfunctional pull of the lumbrical muscle. The base of the triangular ligament remains present, but it plays no role in the lumbrical plus deformity.

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81. A 25-year-old woman presents with a Zone II laceration of the left index finger flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP). Repair of the FDP and only one slip of FDS is planned. Compared with repairing both slips of FDS, repair of only one slip of the FDS will result in a decrease of which of the following?

- A) Range of motion
- B) Rate of tendon healing
- C) Resistance
- D) Risk for infection
- E) Strength of FDP repair

The correct response is Option C.

There is a close proximity of the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) tendons in Zone II lacerations. Due to this, adhesion formation is common after injury. Repairing only one slip of the FDS tendon allows for more room within Camper chiasm during motion, which has been found to decrease resistance and improve glide during motion. It has also not been found to limit active range of motion when compared with repairing both FDP and FDS in Zone II. Due to the improvement in glide and decreased resistance, fewer adhesions occur. This also decreases the work of flexion as well. Due to increased adhesion formation with repair of both FDP and FDS in Zone II, there is an increased rate of secondary surgeries for tenolysis. There is no change in the risk for infection or change in the rate of tendon healing with this type of repair compared with repairing both slips of FDS.

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82. A 44-year-old man undergoes excision of the spiral cord at the proximal interphalangeal (PIP) joint for correction of a 60-degree PIP joint contracture. Following excision of the spiral cord, the PIP joint remains contracted to 45 degrees. Which of the following is the most appropriate next step in the correction of the joint contracture?
- A) Release of the A1 pulley
 - B) Release of the central slip
 - C) Release of the pretendinous cord
 - D) Release of the radial slip of the flexor digitorum superficialis tendon
 - E) Release of the volar plate checkrein ligaments

The correct response is Option E.

In addressing the Dupuytren proximal interphalangeal (PIP) joint contracture, it is common to get at least 50% improvement of the PIP joint contracture with release of the spiral cord and the surrounding diseased soft tissues, including the Grayson fascia. If removal of the diseased fascia does not allow full joint extension, the persistent contracture is usually secondary to foreshortening of the flexor tendon sheath and/or capsuloligamentous structures. Incising the flexor tendon sheath at the level of the A3 pulley and the PIP joint may allow additional correction of the contracture. If this does not result in complete passive extension of the joint, the checkrein ligaments of the volar plate are released. This is followed in sequential fashion by release of the accessory collateral ligaments, and the proper collateral ligaments one side at a time, until either the joint can be fully extended to neutral or all structures have been released.

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83. A 35-year-old woman presents with a laceration of the left middle finger from a kitchen knife. Wound exploration in the emergency department prior to closure demonstrates partial flexor tendon laceration. Which of the following is an absolute indication for operative exploration?

- A) Digital artery injury
- B) Injury to the A4 pulley
- C) 20% Laceration of the flexor digitorum profundus tendon
- D) 40% Laceration of the flexor digitorum profundus tendon
- E) Triggering

The correct response is Option E.

In one large meta-analysis, tendon lacerations up to 90% were managed with early protected range of motion. The only absolute indication for surgery from the list is triggering. There is no evidence that repairing the sheath or pulley without bowstringing is necessary. Isolated A4 laceration would not result in bowstringing. Single digital artery injury in the setting of a perfused digit does not necessitate repair.

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84. A 4-month-old male infant is brought to the office with the multiple extremity findings shown in the photographs. Which of the following additional clinical findings is most commonly seen with this condition?

- A) Absence of the sternocostal head of the pectoralis major
- B) Bilateral symmetric anomalies
- C) Clubfoot
- D) Craniosynostosis
- E) Hematopoietic changes

The correct response is Option C.

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This child has constriction ring syndrome (CRS). CRS is a rare occurrence, with the incidence reported from 1 in 1200 to 15,000 births. CRS frequently affects multiple extremities asymmetrically, with an average of three extremities involved, most often at the distal aspect of the extremity. Several characteristics are most often seen in the affected extremities including constriction rings, amputations, lymphedema distal to the ring, and acrosyndactyly (digits are fused distally, but proximally have fenestrations as fusion occurred after apoptosis in utero). Amputation or hypoplasia is usually seen distal to the ring, whereas the proximal aspect is intact and usually well-formed. CRS affecting the hands most frequently affects the index, middle, and ring fingers. Associated anomalies include syndactyly, oligodactyly, clubfoot, limb absences, body-wall defects (e.g., gastroschisis), and craniofacial anomalies, particularly facial clefts.

Symbrachydactyly, which is associated with Poland syndrome, is usually present in one limb. There is true hypoplasia of the affected extremity with absent or rudimentary digits with nubbins and frequent syndactyly. Symbrachydactyly usually impacts the central digits. Poland syndrome is defined by the absence of the sternocostal head of the pectoralis major.

Hematopoietic changes can be seen in radial hypoplasia. Fanconi anemia and thrombocytopenia (thrombocytopenia absent radius syndrome) are both associated with radial hypoplasia.

Children with Apert syndrome (acrocephalosyndactyly) have bilateral relatively symmetric complex syndactyly, symphalangism, and craniosynostosis.

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85. A 5-year-old boy presents with Blauth/Manske Grade IIIa hypoplasia of the thumb, with narrowing of the first web space, hypoplastic thenar muscles, an unstable metacarpophalangeal joint, and a stable carpometacarpal (CMC) joint. Examination shows weakness of grasp of his toys and utensils, and he has failed a 6-month course of therapy. Which of the following is the most appropriate surgical approach to improving the patient's grasp?
- A) Abductor digiti minimi transfer
 - B) Free great toe transfer
 - C) Fusion of the thumb interphalangeal joint
 - D) Pollicization of the index finger
 - E) Thumb CMC ligament reconstruction with tendon interposition arthroplasty

The correct response is Option A.

Blauth developed the classification for thumb hypoplasia, which consists of five grades. Manske expanded the classification system by expanding the definition of grade III into grade IIIa, which has a carpometacarpal (CMC) joint, and grade IIIb, which does not:

- Blauth I thumbs have minimal shortening and narrowing, and they do not require surgical treatment.
- Blauth II thumbs have narrowing of the first web space, hypoplastic thenar muscles, and an unstable metacarpophalangeal (MCP) joint. They are best treated with reconstruction.
- Blauth/Manske IIIa thumbs have type II features, extrinsic tendon abnormalities, and metacarpal hypoplasia with a stable CMC joint. They do well with reconstruction.
- Blauth/Manske IIIb thumbs have type IIIa features plus partial metacarpal aplasia and CMC joint instability. Because of the additional complexity of CMC joint reconstruction, thumb ablation and pollicization is generally recommended.
- Blauth IV thumbs are often referred to as *pouce flottant*, or floating thumb. There is a neurovascular bundle coursing through the stalk of skin connecting the thumb to the hand, and these thumbs have few rudimentary bony or soft-tissue structures. These thumbs are best treated with ablation and pollicization.
- Blauth V dysplasia demonstrates absence of the thumb and require pollicization.

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Blauth II and Blauth/Manske IIIa reconstructive options include the abductor digiti minimi (ADM or Huber) transfer and the flexor digitorum superficialis (FDS) transfer. There is no clear indication of the superiority of one over the other. The use of the ADM diminishes the power of abduction of the small finger but provides some thenar bulk. It is a better pronator of the thumb. The FDS transfer removes a flexor from the ring finger, perhaps decreasing grip strength, and fails to provide any bulk to the thenar eminence. The FDS is superior in providing palmar abduction but pronates less effectively. When additional tissue is needed to stabilize the MCP joint, the FDS can also be used to reconstruct the MCP joint as part of the transfer.

Aside from pollicization, additional reconstructive options for Blauth IIb-V dysplasia include second toe-to-hand transfer with metatarsalphalangeal (MTP) joint arthrodesis if parents and patients decide to keep a five-digit hand. Due to the level of aplasia, harvest of the MTP joint is necessary for anatomic reconstruction. The second and third toes are best used for this level of reconstruction due to the ability to harvest the MTP joint. The great toe cannot be used, as harvest of the MTP joint of the great toe will lead to gait and balance issues. Fusion of the thumb interphalangeal joint and thumb CMC ligament reconstruction and tendon interposition arthroplasty do not address any or all of the issues with the thumb dysfunction.

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86. A 33-year-old man presents with a 2-year history of a 4-mm reddish discoloration underneath the left index fingernail. He reports significant tenderness to pressure directly on the discoloration, but not the surrounding tissue, along with pain in the area that is worse when going outside in the winter and reaching for items in the freezer. A photograph is shown. Which of the following is the most likely etiologic factor in the origin of this patient's mass?
- A) Arthritis at the distal interphalangeal joint
 - B) Capillary malformation
 - C) Growth of myoarterial unit
 - D) Proliferation at the germinal matrix
 - E) Trauma to the nail bed

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The correct response is Option C.

The most likely etiologic factor involved in the origin of this mass is growth of myoarterial unit.

This patient has evidence of a glomus tumor, which is a rare benign tumor that often presents in the subungual region. Glomus tumors arise from the glomus body, which is a myoarterial unit that functions in thermoregulation. Clinical findings include focal tenderness and cold intolerance.

Some tests for glomus tumor include the Love pin test, Hildreth test, and cold-sensitivity test. In the Love pin test, pressure is applied to the area with a pinhead and the area containing the glomus tumor becomes exquisitely painful. In the Hildreth test, pain in the area is relieved by the use of a tourniquet, due to the restricted blood supply. In the cold-sensitivity test, cold water or an ice cube elicits increased pain in the affected area.

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Diagnosis of glomus tumor can be verified with MRI or ultrasonography.
Management consists of surgical excision of the lesion, as shown in the photograph.

Arthritis at the distal interphalangeal joint can give rise to digital mucous cysts, which can demonstrate nail deformity but typically are not painful.

Capillary malformation can result in reddish-appearing vascular tumors, but these would not typically present the sensitivity and cold intolerance seen in glomus tumors.

Proliferation at the germinal matrix can give rise to nail abnormalities, but these typically manifest as abnormalities in the nail plate rather than in the subungual region (i.e., melanonychia, skin cancers).

Trauma to the nail bed can result in subungual hematoma, which can cause pain, but a hematoma typically will resolve and not persist for years.

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87. A 36-year-old man is evaluated for coverage of a 4 × 3-cm middle-third lower extremity soft-tissue defect with an exposed fracture of the mid tibia. Reconstruction with a proximally based medial hemisoleus muscle flap is planned. Which of the following arteries provides the major contribution to the blood supply of this flap?

- A) Anterior tibial
- B) Dorsalis pedis
- C) Medial sural
- D) Peroneal
- E) Posterior tibial

The correct response is Option E.

The soleus muscle is a bipennate muscle that is located in the superficial posterior compartment of the lower extremity, deep to the gastrocnemius muscle. The soleus muscle has a medial head that originates from the posterior aspect of the tibia and a lateral head that originates from the posterior surface of the fibula. The soleus functions in plantar flexion of the foot in conjunction with the gastrocnemius as they unite to form the Achilles tendon. Branches from the popliteal artery contribute to the blood supply of the proximal soleus muscle.

The soleus muscle flap is a reliable local flap for coverage of moderate-sized soft tissue defects of the middle-third of the lower extremity. It is customarily elevated as a muscle-only flap and covered with a split-thickness skin graft. Branches from the posterior tibial artery contribute to the blood supply of the medial hemisoleus muscle flap, which is more reliable when based proximally.

Branches from the peroneal artery contribute to the blood supply of the lateral hemisoleus muscle.

The medial sural artery is the dominant blood supply to the medial gastrocnemius muscle flap.

The anterior tibial artery and the dorsalis pedis artery do not contribute to the blood supply of the medial hemisoleus flap.

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88. A 5-month-old infant presents with nail-patella syndrome. Which of the following is the most likely associated genetic anomaly in this patient?

- A) Bone morphogenetic protein (BMP)
- B) Engrailed-1 (*EN1*)
- C) Fibroblast growth factor receptor-2 (*FGFR2*)
- D) LIM homeobox transcription factor 1 beta (*LMX1B*)
- E) Sonic hedgehog (*SHH*)

The correct response is Option D.

The most likely anomaly is in LIM Homeobox transcription factor 1 beta (*LMX1B*).

This patient presents with nail-patella syndrome, which results in poorly developed nails and kneecaps. Nail-patella syndrome is an autosomal dominant condition associated with mutations in the *LMX1B* gene. This gene is involved in dorsal and ventral limb patterning during embryology.

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

Wnt7a from the dorsal ectoderm induces the transcription factor Lmx-1b, which induces the development of dorsal structures. This transcription factor acts within the Wnt signaling pathway, which is responsible for dorsal-ventral limb development. In the ventral portion of the limb, the Engrailed-1 gene product blocks the Wnt pathway, determining the dorsal-ventral boundary.

Mutation in the *FGFR2* gene can result in Apert syndrome, which is an autosomal dominant condition that presents with complex syndactyly of hands and feet.

Sonic hedgehog acts within the zone of polarizing activity, which is located in the posterior margin of the limb bud and governs growth in the anterior-posterior axis. The sonic hedgehog protein signals development of the limb into radial and ulnar aspects. This is mediated by the Gli family of transcription factors, most importantly Gli3. Alterations in this pathway can result in mirror duplication.

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Bone morphogenetic protein (BMP) is actively involved in multiple areas of upper extremity development, but is not the key anomaly involved in this syndrome. Suppression of BMP is associated with syndactyly.

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89. A 65-year-old woman presents with a slow-growing mass of the hand. Incisional biopsy shows a metastatic tumor. Which of the following is the most likely primary tumor location in this patient?

- A) Breast
- B) Colorectal
- C) Kidney
- D) Lung
- E) Thyroid

The correct response is Option D.

Although smaller case series may show some variability, larger reviews on this topic have been quite consistent. Lung is the most common source of metastasis to the hand, representing 34% of all metastases reported in the most recent large review. Taken together, gastrointestinal tract tumors (esophagus, stomach, and colorectal) are in second place, comprising 25% of the total. Kidney (10%) and breast (5%) round out the top four. Thyroid tumors represent only 2% of metastatic tumors to the hand.

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90. Which of the following is the most commonly affected muscle in patients with Volkmann contracture?

- A) Flexor carpi radialis
- B) Flexor carpi ulnaris
- C) Flexor digitorum profundus
- D) Flexor digitorum superficialis
- E) Pronator teres

The correct response is Option C.

Volkmann contracture results from ischemia and myonecrosis, which leads to secondary fibrosis of the muscles. The most frequently affected muscles are supplied by the anterior interosseus artery in the deep flexor compartment of the forearm—most commonly, the flexor digitorum profundus. Involvement is usually first seen in the ring and small fingers. With more significant ischemia, the flexor digitorum superficialis, flexor carpi ulnaris, flexor carpi radialis, and pronator teres muscles can also be affected.

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91. A 33-year-old woman presents after volar oblique amputation of the distal pulp of the middle finger. Compared with a local flap, which of the following outcomes is most likely if the wound is allowed to heal by secondary intention?

- A) Infection
- B) Lack of sensation at the tip
- C) Longer duration of time until complete healing
- D) Nail deformity
- E) Poor aesthetic appearance of the tip

The correct response is Option C.

These fingertip injuries, if allowed to heal by secondary intention, will often take 4 to 6 weeks to close and may make it difficult or impossible for the patient to return to work expeditiously. It also requires the cooperation of the patient to do dressing changes and keep the wound clean. The sensation of fingertips allowed to heal by secondary intention is usually better than that with flap coverage. With volar oblique amputations, the appearance with secondary healing is most often acceptable other than that the finger will be slightly shortened. Nail deformity can result from injury to the germinal or sterile matrices, which is not the case for this patient. A hook nail is caused by having the nail bed extend beyond the remaining tip of the distal phalanx and most likely will not be a problem with a volar oblique amputation. Infection is unlikely if appropriate wound care is provided.

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92. A 60-year-old woman presents with worsening painful ulceration of a prior healed surgical site of the left lower extremity after undergoing hidradenitis excisions 10 years ago. She reports no trauma and has had no fevers or chills. Examination shows some drainage at the wound site. She undergoes treatment with debridement, antibiotics, and multiple types of dressings without progress of wound healing. Photographs are shown. Which of the following is the most appropriate next step in management?

- A) Debridement and biopsy
- B) Debridement and dermal allografting
- C) Debridement and negative pressure dressing
- D) Excision and coverage with a flap
- E) Excision and skin grafting

The correct response is Option A.

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Marjolin ulcers are malignancies (most commonly aggressive squamous cell carcinoma) that arise from areas of chronic irritation, injury, or unstable scar. These malignancies frequently occur over many years. This malignant degeneration is most commonly associated with burns; however, it can be associated with a multitude of other types of nonhealing wounds such as traumatic wounds, osteomyelitis, pressure sores, any type of ulcer, laceration, venous stasis ulcer, or fistulas. The rate of incidence is approximately 2% in burn scars, with a predilection for the extremities, especially in the lower limbs. There is often a delay in diagnosis, since the appearance of a nonhealing ulcer with heaped-up edges mimics other types of ulcerations. Marjolin ulcer should be ruled out in a chronic nonhealing ulcer in the setting of a long-term scar/injury/burn.

Diagnosis of Marjolin ulcer is typically made by tissue biopsy with pathologic evaluation. Squamous cell carcinoma is the most common type of histology seen in Marjolin ulcer, although basal cell carcinoma, malignant fibrous histiocytoma, malignant melanoma, liposarcoma, fibrosarcoma, eccrine syringofibroadenoma, Merkel cell carcinoma, and keratoacanthoma have all been described. For patients with squamous cell carcinoma (most common type), the degree of differentiation is important prognostically. The risk for metastasis is highly correlated with the degree of differentiation and grade of the tumor. There is early lymph node metastasis in 30% of patients.

Treatment is surgical with wide local excision with pursuit of negative margins. Sentinel lymph node biopsy is frequently pursued. Deeper ulcers involving bone may warrant amputation of the involved extremity.

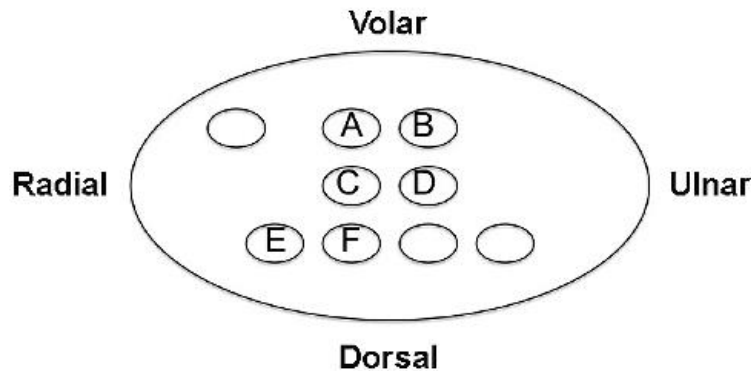
Marjolin ulcer must be diagnosed and treated (or the diagnosis excluded) before considering any other treatments.

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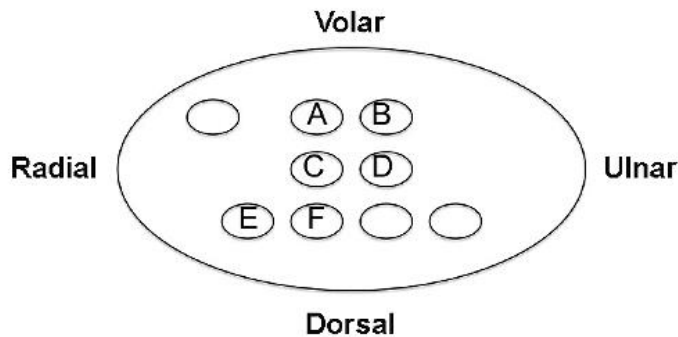
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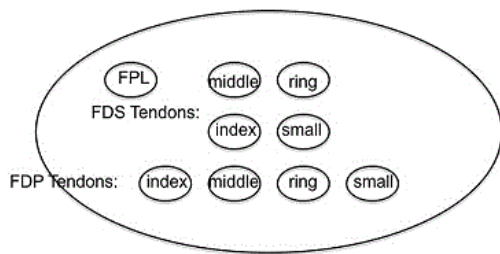
93. A 23-year-old man sustains a stab injury to the volar wrist in the region of the carpal tunnel. Examination shows absence of flexion function at the proximal interphalangeal joint of the index finger when the remaining fingers are held in extension. He retains flexor function of the distal interphalangeal joint of the index finger. A diagram of the carpal tunnel contents is shown. Which of the following is the most likely location of the injured tendon?



- A)
- B)
- C)
- D)
- E)
- F)



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The correct response is Option C.

Finger flexion results from the actions of the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) tendons. The FDS tendon inserts into the middle phalanx and provides for flexion at the proximal interphalangeal (PIP) joint. The FDP tendon inserts into the distal phalanx and is the only tendon that provides flexion at the DIP joints. Because it also crosses the PIP joint, the pull of the FDP tendon can result in flexion at the PIP joint as well. To independently examine the flexor tendons, the FDP tendon can be neutralized by holding the remaining fingers in extension. Due to a common muscle belly, the FDP will not act upon the finger, allowing inspection of the FDS tendon function by evaluating PIP joint flexion in this situation.

The patient has sustained a flexor tendon laceration in the region of the carpal tunnel. On physical examination, there is absence of flexion function at the index finger of the PIP joint when the remaining fingers are held in extension, indicating laceration to the flexor digitorum superficialis of the index finger.

At the level of the carpal tunnel, the flexor tendons travel through a fibro-osseous canal, which contains nine flexor tendons along with the median nerve. The FDS tendons of the middle and ring fingers are most superficial, with the FDS tendons of the index and small fingers deep to them. The FDP tendons lie parallel to each other at the deepest aspects of the carpal tunnel along the bone. The flexor pollicis longus is the most radial structure within the carpal tunnel. The cross-sectional anatomy of the wrist at the level of the carpal tunnel is diagrammed, along with the corresponding tendon locations in the two images shown:

- A – FDS middle
- B – FDS ring
- C – FDS index
- D – FDS small
- E – FDP index
- F – FDP middle

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94. A 65-year-old male laborer presents with worsening pain in the left thumb. An x-ray study is shown. Which of the following is the most important ligament to prevent radial subluxation of the first metacarpal at the carpometacarpal joint?
- A) Anterior oblique
 - B) Dorsal central
 - C) Posterior cruciate
 - D) Transverse metacarpal
 - E) Ulnar collateral

The correct response is Option A.

This patient presents with severe osteoarthritis of the carpometacarpal (CMC) joint of the thumb. The thumb metacarpal is in adduction, and the proximal phalanx is in hyperextension. The complex range of motion of the thumb basal joint is achieved through stability from 16 ligaments. Of the choices given, only the anterior oblique ligament is in the thumb at the basal joint. It has been found to be the most important preventative measure against radial subluxation in cases of CMC arthritis in biomechanical studies. It originates on the volar tubercle of the trapezium and inserts on the thumb metacarpal volarly. In cases of severe thumb CMC arthritis, the progressive ligamentous incompetence of the anterior oblique ligament and dorsal radial ligament allow the thumb metacarpal to migrate dorsally and proximally. The dorsal radial ligament is also important for basal joint stabilization, while the other ligaments of the thumb basal joint are not as important.

The ulnar collateral ligament is located at the metacarpophalangeal (MCP) joint of the thumb, and rupture leads to instability of that joint as seen with gamekeeper's thumb. The dorsal central ligament is not involved in CMC joint subluxation. The deep transverse metacarpal ligaments are located in the hand between the metacarpal heads and assist in supporting the metacarpal arch. The posterior cruciate ligament helps stabilize the knee by preventing the tibia from slipping posteriorly when flexed.

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95. A 32-year-old patient presents for elective right transradial amputation following necrotizing fasciitis. Which of the following is the minimum amount of ulna that must be maintained for proper suspension and fitting of a forearm-based, body-powered prosthesis for this patient?

- A) 2 cm
- B) 5 cm
- C) 8 cm
- D) 11 cm
- E) 14 cm

The correct response is Option B.

The forearm requires a certain amount of motion to position the hand in space. Preservation of motion can in part be achieved by maximizing the length of the amputation stump. In forearm amputation, the forearm supination and pronation are proportionate to the length of the stump. Too close proximity of the amputation to the elbow can decrease forearm rotation, and the socket of the prosthesis may also impede elbow flexion. Preservation of the ulna to a minimum of 5 cm is important for fitting a prosthesis. A minimum of 5 cm of bone distal to a joint is needed to enable prosthetic suspension and preserve the function of that joint in a prosthesis.

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96. An 18-year-old man is scheduled to undergo free fibula flap for mandible reconstruction. The patient reports that he is a track and field athlete. Regarding the function of his great toe, which of the following is the most likely outcome?

- A) Abduction deformity
- B) Decreased flexion strength
- C) Neuropathic pain
- D) Normal extension

The correct response is Option B.

The fibula free flap is commonly used for mandibular reconstruction because of the availability of up to 25 cm of bone. However, donor site morbidity is a significant consideration and is common with this flap. Common motor morbidity includes impaired flexor hallucis longus (FHL) function, with a significant reduction in strength between the affected and unaffected legs. As a result of loss of the FHL and decreased opposition to the long toe flexors, claw toe deformity and weakened dorsiflexion are also common. Gait may be affected by these deformities.

Sensory deficits typically include the peroneal nerve distribution and may cause pain at the operative site or sensory deficits over the dorsum of the foot.

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97. A 19-year-old woman presents with a 2 × 3-cm burn to the left dorsal thumb sustained from brief exposure to hot bacon grease. During the next 24 hours, the burned area becomes erythematous and several blisters containing clear fluid have formed and then ruptured. Examination shows no erythema extending proximally. A photograph is shown. Which of the following is the most appropriate next step in management?

- A) Dry dressing
- B) Hydrogen peroxide soaks
- C) Leave open to air
- D) Topical antibiotic ointment

The correct response is Option D.

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Based on the information provided, this is likely a superficial partial-thickness burn. It is not deep enough or large enough to warrant transfer to a burn center. Local wound care should lead to full resolution, with appropriate follow-up to detect delays in healing. Partial-thickness wounds like this will heal fastest when a moist environment is maintained. Antibiotic ointment or other neutral moisturizing agents (e.g., petrolatum ointment) are appropriate for local wound care. Leaving the wound open to air or covering with a dry dressing will delay healing. Hydrogen peroxide is appropriate for cleansing dirty or infected wounds, but it is not necessary in the scenario presented. Furthermore, sustained use of hydrogen peroxide may delay healing in clean wounds.

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98. A 67-year-old woman underwent cast immobilization for treatment of a minimally displaced left distal radius fracture 5 weeks ago. Two weeks after cast removal, she is unable to extend her thumb. On examination, she is unable to perform retropulsion of the thumb with her palm placed flat on the examination table. Which of the following is the most appropriate next step in management?

- A) Electrodiagnostic studies
- B) Immobilization
- C) Primary tendon repair
- D) Tendon transfer
- E) X-ray study

The correct response is Option D.

This patient is presenting with a rupture of the extensor pollicis longus (EPL) tendon, which occurs in as much as 5% of patients with mildly displaced distal radius fractures about 7 weeks after the initial injury. This is thought to be due to attritional rupture secondary to decreased vascularity. The treatment for this problem is a tendon transfer of the extensor indicis proprius to the EPL. Although some surgeons use a tendon graft, a primary repair is not feasible due to fraying of the EPL. Occupational therapy, immobilization, and further diagnostic studies (including electrodiagnostics and x-ray study) are not appropriate.

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99. In patients with rheumatoid arthritis, the inciting event in the development of a boutonniere deformity of the thumb is which of the following?

- A) Adductor contracture
- B) Attenuation of the extensor pollicis brevis
- C) Carpometacarpal joint synovitis
- D) Extensor pollicis longus subluxation
- E) Metacarpophalangeal joint synovitis

The correct response is Option E.

The boutonniere deformity is the most common deformity of the thumb in rheumatoid arthritis (RA). The pathology originates at the metacarpophalangeal (MCP) joint, at which synovitis results in dorsal hood disruption and attenuation of the extensor pollicis brevis with loss of MCP joint extension and volar subluxation of the proximal phalanx. This is accompanied by secondary subluxation of the extensor pollicis longus (EPL) tendon ulnarly.

This results in increased tension on the extensor mechanism with resultant distal phalanx extension and concomitant proximal phalanx dorsal subluxation. Treatment is predicated on status of joint deformity. If the deformity is able to be reduced passively with adequate joint stability and absent radiographic evidence of joint destruction, then reconstruction is achieved by synovectomy and insertion of the EPL tendon into the base of the proximal phalanx. If the contractures are fixed, then MCP arthrodesis is indicated for treatment of symptomatic deformity.

The Nalebuff classification of thumb deformity in RA identifies six types of deformities:

- Type 1: Boutonniere
- Type 2: Boutonniere with carpometacarpal subluxation
- Type 3: Swan-neck deformity
- Type 4: Gamekeeper deformity
- Type 5: Swan-neck with MCP volar plate laxity
- Type 6: Arthritis mutilans

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RA is a chronic autoimmune disease characterized by inflammation and deterioration of the joints. Synovial proliferation is the hallmark of RA and is often seen early in the course of the disease. There is a progression to synovial pannus formation, periarticular bone demineralization, cartilage destruction, and subchondral osseous erosions. This process is mediated by synovial infiltration of activated T lymphocytes, which promote chronic synovial inflammation.

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100. A 55-year-old laborer presents with radial-sided wrist pain and swelling with activities. A 6-month course of splinting, activity modification, and nonsteroidal anti-inflammatory drugs failed to relieve his symptoms. A wrist x-ray study is shown. Which of the following is the most appropriate surgical option for durable reconstruction in this patient?

- A) Scaphocapitate arthrodesis
- B) Scaphoidectomy with four-corner arthrodesis
- C) Scaphoid open reduction and internal fixation
- D) Scapholunate ligament reconstruction
- E) Scaphotrapezotrapezoid arthrodesis

The correct response is Option B.

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This patient presents with a scaphoid nonunion advanced collapse arthritis pattern (SNAC). The arthritic pattern follows a pattern very similar to scapholunate advanced collapse (SLAC). Watson and Ballet (JHS, 1984) recognized that chronic scapholunate ligament incompetence led to a predictable sequence of arthritic wear at the radioscaphoid junction (scapholunate advanced collapse [SLAC] stages I and II), later progressing to involve the midcarpal joint (SLAC stage III), usually sparing the spherical radiolunate articulation. Four-corner arthrodesis (capitate-lunate-triquetrum-hamate) with scaphoid silicone prosthetic replacement (silicone replacement later omitted) was Watson and Ballet's recommended surgical treatment and preferred over proximal row carpectomy.

The SLAC pattern of arthrosis is thought to be due to traumatic injury to the scapholunate ligament. Calcium pyrophosphate dehydrate crystal deposition disease (CPPD, or pseudogout) has been reported to be a frequent cause of SLAC-type x-ray changes as well. Scaphoid fracture nonunion can lead to a similar degenerative arthritic pattern of the wrist, called scaphoid nonunion advanced collapse (SNAC).

Symptomatic treatment with splints, modalities, and injection may suffice in many patients. There are no studies on the long-term success of nonsurgical treatment for SLAC or SNAC wrist, nor are there any long-term natural history studies. Surgical treatment options for either SLAC or SNAC wrist include partial or complete wrist arthrodesis, proximal row carpectomy (PRC), denervation, or radial styloidectomy. SNAC wrist has the additional potential treatment option of excision of the distal ununited scaphoid fragment. Most studies concerning treatment of SLAC/SNAC wrist have focused on the results of four-corner arthrodesis with scaphoid excision or PRC. Controversy exists concerning whether PRC, or a modification thereof, may be performed when the capitate has arthritic changes.

Scaphocapitate arthrodesis, with resection of the lunate, is a treatment option for late-stage Keinböck disease. Scaphocapitate arthrodesis leaves the radioscaphoid joint in place, making it inappropriate for the patient in this case who has radioscaphoid arthritis. Open reduction and internal fixation of the scaphoid is not indicated here, since the arthritic change noted on x-ray study is the sequela of an old scaphoid fracture nonunion, which has now gone on to advanced collapse arthritis. There does not appear to be too much arthrosis in the scaphotrapeziotrapezoid (STT) joint, with the more likely source of the patient's pain related to the radiocarpal joint, so an STT fusion would not be indicated here. This arthrosis is the result of a chronic scaphoid nonunion with subsequent carpal collapse, so repair of the SL ligament would not be indicated.

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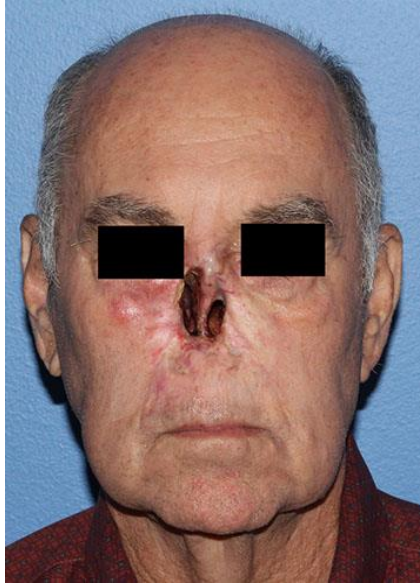
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Section 3: Craniomaxillofacial



101. A 72-year-old patient undergoes a total rhinectomy and partial septectomy for squamous cell carcinoma followed by postoperative radiation therapy. A photograph is shown. He has tried a nasal prosthesis, but he is unhappy with it and wishes to undergo autologous surgical reconstruction. A paramedian forehead flap with rib cartilage grafts are planned for the external nasal skin reconstruction and support, respectively. Which of the following is best suited to replace the nasal lining?

- A) Folded forehead flap
- B) Nasolabial flap
- C) Radial forearm fasciocutaneous free flap
- D) Septal hinge flap
- E) Split-thickness skin graft

The correct response is Option C.

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For restoration following total rhinectomy, all three layers of the external nose must be addressed: lining, support, and cover. Of these options, the radial forearm fasciocutaneous free flap is the preferred method because it provides an ample amount of thin, pliable skin that resists contracture that could lead to nasal obstruction, particularly around the nostrils. The septal hinge flap, based on the anterior ethmoid artery, is not an option because of the loss of the septum. The nasolabial flap tends to be too thick and adds facial scars. A folded forehead flap involves using the forehead flap for both external and internal coverage; this is reasonable for full-thickness reconstruction along the nostril rim, but the flap is stiff and usually not large enough (without removal of a very large quantity of forehead and scalp) to line a defect of this size. Split- and full-thickness skin grafts can be applied as nasal lining to the underside of the forehead flap and then cartilage grafts can be inserted secondarily between the frontalis and external skin; however, they are subject to contracture, which can diminish the ultimate result of nasal reconstruction.

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102. A 2-week-old male newborn with a wide unilateral cleft lip and palate presents for evaluation and surgical treatment planning. To align the alveolar segments, decrease the cleft width, and improve the nasal contour, nasoalveolar molding versus lip adhesion is discussed with his parents. The primary advantage of lip adhesion over nasoalveolar molding is which of the following?

- A) Decreased cost
- B) Decreased scar tissue
- C) Fewer treatment complications
- D) Improved clinical outcome
- E) Increased compliance

The correct response is Option E.

Lip adhesion is the surgical version of nasoalveolar molding (NAM) in terms of accomplishing decreased cleft width and alveolar alignment; however, it does not do much for the nasal contour. The primary advantage of lip adhesion surgery is that it minimizes the burden on the family. It costs more, potentially can create more scar, and has a higher complication rate in the form of either scar or wound dehiscence. There is no proven clinical outcome advantage, and some would argue that because NAM also addresses the nose, the outcome is better, but that will take additional studies to validate.

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103. A 64-year-old man with a T3N2 oropharyngeal tumor of the tongue and tonsillar fossa undergoes transoral robotic surgery (TORS). Which of the following is the most likely advantage of TORS over traditional treatments?

- A) Patients undergoing TORS have less dysphagia
- B) Patients undergoing TORS have a lower risk of hemorrhage than with open approaches
- C) There is decreased incidence of postoperative infection
- D) There is no need for reconstruction with a free flap
- E) There is significant improvement in disease-free survival

The correct response is Option E.

Transoral robotic surgery (TORS) has been demonstrated to be comparable or advantageous when compared with nonsurgical treatment. Overall and disease-free survival and quality of life are comparable between TORS patients and patients who received nonsurgical treatment. TORS patients had significantly higher disease-free survival than patients who underwent open approaches in a meta-analysis. Risk of hemorrhage after TORS is 6%, whereas the risk is less than 2% in open approaches. Risk of dysphagia and infection are not significantly different from traditional treatment.

Functional outcomes are significantly less in TORS patients than in patients who received nonsurgical treatment. In one study, only 9% of TORS patients needed gastrostomy tube feeding 1 year post-procedure compared with 31% in the chemotherapy group.

Depending on the size of the defects, patients will need either locoregional or free flaps (radial forearm and anterolateral thigh flaps are the most common) after TORS. The incidence of needing free flaps is lower in TORS, but free flaps are not obsolete in TORS.

Contraindications to TORS include: tumor abuts carotid artery, resection will include greater than 50% of the tongue base or posterior pharyngeal wall, tumor is fixed to the prevertebral fascia, or midline tongue base tumors that can potentially cause injuries to both lingual arteries.

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104. A 6-year-old girl with bilateral cleft lip and palate presents to the office with velopharyngeal dysfunction. Secondary speech surgery is planned. Which of the following procedures carries the highest risk for developing postoperative obstructive sleep apnea?

- A) Conversion Furlow palatoplasty
- B) Palatal lengthening with bilateral buccal flaps
- C) Repeat palate repair with intravelar veloplasty
- D) Sphincter pharyngoplasty
- E) Velopharyngeal augmentation with structural fat grafting

The correct response is Option D.

Multiple techniques have been described for management of velopharyngeal dysfunction (VPD) following primary palatoplasty in patients with cleft palate and cleft lip/palate. These include pharyngoplasty techniques, such as posterior pharyngeal flaps and sphincter pharyngoplasties. These procedures add tissue to the velopharyngeal port and partially occlude airflow. These procedures are the most effective in correcting VPD but carry with them the highest risk for postoperative obstructive sleep apnea (OSA). The incidence of postobstructive OSA following sphincter pharyngoplasty varies between 50 to 69% of patients. Other procedures described include palatoplasty techniques such as intravelar veloplasties, conversion Furlow palatoplasties, and palatal lengthening procedures. These procedures have been shown to correct VPD in 40 to 80% of cases and have varying risks for postoperative OSA, varying from 10 to 54%. Finally, augmentation of the velopharyngeal port with structural fat grafting is successful in correcting mild cases of VPD, but it was recently shown to carry a small (11%) risk for postoperative OSA. Treatment of VPD is nuanced, and all techniques should be considered. Patient factors such as the history of prior palate surgery, physical examination, dynamic assessment of velopharyngeal port function, and patient comorbidities must be considered to select the appropriate procedure in every case.

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105. The periodontal ligament anchors the teeth to the surrounding alveolar bone through attachment to which of the following structures?

- A) Cementum
- B) Dentin
- C) Enamel
- D) Gingiva
- E) Neurovascular bundle

The correct response is Option A.

The dental root is covered by a mineralized layer called cementum. This is anchored to the surrounding alveolar bone by the periodontal ligament (periodontal membrane), which includes Sharpey fibers, to firmly anchor the tooth to the bone as well as sensory fibers. This facilitates the periodontal ligament's functions of stabilizing the tooth, serving as a shock absorber, and allowing proprioception.

The bulk of the dental root is composed of dentin, but it does not directly attach to the surrounding bone.

The neurovascular bundles enter the tooth at the root apex and provide sensation and blood supply, but they are not a strong mechanical source of attachment.

The enamel is the mineralized cover of the dental crown. It is not attached to the free gingiva, which attaches to the periodontal ligament at the cemento-enamel junction.

The gingiva does not directly attach to the bone.

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106. A 15-year-old girl with a history of facial asymmetry reports worsening of her deformity in the past 3 years. It has slowly progressed with upper lip and cheek atrophy, mid-face hyperpigmentation, nasal deviation, and worsening occlusal cant. Photographs are shown. The patient reports migraine but denies any other medical problems. Which of the following is the most likely diagnosis?

- A) Fibrous dysplasia
- B) Goldenhar syndrome
- C) Neurofibromatosis
- D) Parry-Romberg syndrome
- E) Systemic scleroderma

The correct response is Option D.

Parry-Romberg syndrome is a rare craniofacial disease characterized by slow progressive hemifacial atrophy of the skin, subcutaneous tissue, and, in severe cases, bony structures, following ipsilateral branches of the trigeminal (V) nerve. It usually occurs in the first two decades of life, and it is more prevalent in females. It is frequently associated with neurologic and ophthalmologic involvement. The severity of deformity varies depending on the age of onset of disease, being more severe the earlier it starts.

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107. A 59-year-old man is referred to the office with a diagnosis of esophageal adenocarcinoma. After esophagectomy, the surgeon elects to perform a supercharged pedicled jejunal flap for complete esophageal reconstruction. Which of the following is the most likely recipient site complication?

- A) Chylothorax
- B) Fistula
- C) Flap failure
- D) Hematoma
- E) Isolated neck cellulitis

The correct response is Option B.

All of the complications listed in the options have been described in relationship to esophageal reconstruction with a jejunal flap. The most common complication involves abdominal wound infection, occurring in 21% of patients. The most common medical complication is pneumonia, occurring in 18% of the patients.

Regarding the recipient site, in multiple reviews of esophageal reconstruction with jejunal flaps, fistulas have the highest complication rate (up to 14%). The rate of complication for neck cellulitis, hematoma, flap failure, and chylothorax are 5%, 4%, 1%, and 1%, respectively.

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108. A 65-year-old man presents with facial flushing and sweating with eating 4 weeks after undergoing parotidectomy. Which of the following tests will be most likely to establish the diagnosis?

- A) Cottle maneuver
- B) Ice pack test
- C) Jones test
- D) Minor iodine-starch test
- E) Schirmer test

The correct response is Option D.

Auriculotemporal syndrome, or Frey syndrome, can occur after parotidectomy and less commonly after trauma, other facial surgeries (e.g., rhytidectomy), and neck dissection. It results from abnormal innervation (synkinesis) of sweat glands from the postganglionic parasympathetic fibers in the parotid. Symptoms include flushing, sweating, neuralgia, burning, and itching in response to gustatory stimulus. Diagnosis of Frey syndrome is based on clinical history, but the diagnosis can be confirmed with the Minor iodine-starch test: the ipsilateral face is painted with iodine and the patient is challenged with a sialogogue (e.g., lemon juice). Areas of gustatory sweating will turn blue.

The Jones test assesses patency of the lacrimal drainage system. The Cottle maneuver assesses the internal nasal valve. The ice pack test is used to assess myasthenic ptosis. The Schirmer test is a tear production test that can be used to assess dry eyes before blepharoplasty.

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109. An 18-year-old man with a history of cleft lip and palate repair is planning to undergo orthognathic surgery to correct his malocclusion. When counseling the patient regarding complications, which of the following is the most common complication after orthognathic surgery?

- A) Dental injury
- B) Hardware failure
- C) Hemorrhage
- D) Infection
- E) Nerve injury

The correct response is Option E.

Large-scale studies involving hundreds to even thousands of patients have demonstrated the safety and risks associated with orthognathic surgery. Although all of the complications listed in the options have been described during orthognathic surgery, the most common complication is nerve injury ranging from 12.1 to 19%. Infection has been reported from 2 to 3.4%. Hardware failure occurs in up to 2.5% of cases, while dental injuries range from 0.14 to 5%. Significant hemorrhage occurs in 0.5 to 1.4% of cases. Additional complications associated with orthognathic surgery include postoperative temporomandibular joint disorders/condylar disorder, scar problems, and necessity of secondary surgery.

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110. An otherwise healthy 72-year-old woman with right upper eyelid basal cell carcinoma undergoes full-thickness excision that involves 80% of the lid margin. Which of the following is the best option for reconstruction?

- A) Full-thickness skin graft from the contralateral upper eyelid
- B) Hughes tarsoconjunctival flap
- C) Mustarde lower lid switch flap
- D) Primary closure
- E) Tenzel semicircular flap

The correct response is Option C.

Upper eyelid defects greater than 75% can be reconstructed with Mustarde lower lid switch, in which a large full-thickness portion of the lower eyelid is rotated based on the marginal vessels. It is necessary to delay the flap, and it sacrifices a portion of the lower eyelid.

Hughes tarsoconjunctival and Tenzel semicircular flaps are useful to reconstruct full-thickness defects greater than 25% and less than 75%. Full-thickness skin graft from the contralateral upper eyelid is used for partial thickness reconstruction of defects involving more than half of the eyelid, while primary closure is reserved for partial thickness and less than 50% defects, as well as less than 25% full-thickness defects.

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111. A 60-year-old woman is seen in consultation for facial rejuvenation to include her eyelids and perioral region. On history and physical examination, she has dry eyes, dry oral mucosal membranes, and joint problems. Which of the following tests is the most appropriate next step to establish her diagnosis?

- A) Hand x-ray study
- B) Lip biopsy
- C) Schirmer test
- D) Serum antibody marker
- E) Stimulated salivary flow rates

The correct response is Option D.

Sjögren syndrome (SS) presents with a classic triad of xerostomia, keratoconjunctivitis sicca, and polyarthritis. While a Schirmer test is a good way to assess tear production, it is less helpful in the elderly population as tear production declines with age. Salivary flow rates also decline with age and are less predictable. The presence of anti-SSA (Ro) and anti-SSB (La) are present in 60 to 80% of patients, and this is considered diagnostic if present. Lip biopsy is also diagnostic but is more invasive, so it would not be the next step. X-ray studies of the arthritis are nonspecific in terms of diagnosis.

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112. A 70-year-old man with a history of smoking and oromandibular cancer is scheduled to undergo extirpation, virtual planned fibular mandibular reconstruction, and postoperative radiation therapy. The patient strongly wants dental restoration. Which of the following best describes the earliest that dental implants can be safely placed?

- A) Immediately
- B) After radiation therapy
- C) After failure of dentures
- D) One year postoperatively
- E) Never

The correct response is Option A.

Patients undergoing oromandibular reconstruction have functional as well as oncologic challenges. Being able to restore dentition in a timely fashion allows for improvement in oral feeding and articulation. Given the poor prognosis for many patients and risk for infection and osteoradionecrosis, many in the field either delayed placement of osteointegrated implants or generally dissuaded use of them altogether. With better ability to plan virtual reconstruction and involvement of an organized multidisciplinary team including extirpative and reconstructive surgery, as well as oral surgery and radiation oncology involvement, immediate dental restoration is possible with a high success rate.

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113. A 5-year-old boy with 22q11.2 deletion syndrome presents with velopharyngeal dysfunction. He is noted to have a submucous cleft palate and hypernasality. His parents are interested in improving his resonance, and surgical intervention is offered. Which of the following surgical options has the lowest success rate in improving resonance?

- A) Furlow palatoplasty
- B) Mandibular advancement
- C) Posterior wall augmentation
- D) Sphincter pharyngoplasty
- E) Superiorly based posterior pharyngeal flap

Upon further review, this item was not scored as part of the examination.

The correct response is Option C.

Patients with 22q11.2 deletion syndrome are at a high risk for velopharyngeal dysfunction (VPD). VPD can be caused by several factors including submucosal cleft palate, neuromuscular coordination issues, and palatopharyngeal disproportion. Treatment of VPD in the 22q11.2 deletion patient population remains controversial. Studies have demonstrated improvement of VPD with all of the above modalities. A systematic review demonstrated that fat injection of the poster wall resolved VPD in a range of 0 to 17% of patients. This was the lowest of the surgical options noted. Controversy remains regarding the utility of Furlow palatoplasty in 22q11.2 deletion syndrome with resolution of VPD reported between 18 to 75%. Sphincter pharyngoplasty and pharyngeal flaps success rates are traditionally reported to have success rates above 50%. Mandibular advancement is not used as a treatment for VPD.

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114. An 8-year-old boy is brought to the clinic for evaluation of a congenital ear deformity characterized by an unfolded antihelix. During the embryological period, which of the following structures failed to develop appropriately?

- A) First pharyngeal cleft
- B) First pharyngeal pouch
- C) Second pharyngeal arch
- D) Third pharyngeal arch
- E) Third pharyngeal pouch

The correct response is Option C.

The ear development starts during the third month of gestation from six hillocks that arise on the first and second arches.

The first pharyngeal cleft develops into the external auditory meatus. The second through fourth pharyngeal clefts are usually obliterated due to the expansion of the second pharyngeal arch.

The first pharyngeal pouch develops into the auditory tube and middle ear cavity. The second through fourth pharyngeal pouches are not related to ear development, nor is the third pharyngeal arch. The second pouch becomes the palatine tonsils' crypts, while the third pouch forms parathyroid glands and thymus. The fourth pouch differentiates into parathyroid glands and parafollicular cells of the thyroid gland. The cartilaginous component of the third pharyngeal arch gives rise to part of the hyoid bone.

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115. A 2-month-old female infant presents with a raised, nonpulsatile, vascular lesion of the lower lip that has worsened progressively since it first appeared soon after birth. A photograph is shown. Her parents deny history of trauma, but since monitoring, report increased tenderness, bleeding, and difficulty with feeds. Which of the following is the most appropriate first step in treatment?

- A) Beta-adrenergic blocker administration
- B) Embolization
- C) Laser therapy
- D) Surgical excision
- E) Topical corticosteroid administration

The correct response is Option A.

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Beta-adrenergic blockers, including oral propranolol (Hemangeol), would be the best first-line treatment due to the size and location of the hemangioma. Such medications can act to limit growth, decrease bulk, and prevent complications of the hemangioma in a time-sensitive manner.

Embolization is often employed in treatment of arteriovenous and lymphatic malformations. It is typically the treatment of choice for complications of larger vessels, rather than the capillaries comprising a hemangioma.

Laser therapy is beneficial in the treatment of port-wine stains and telangiectasia post involution of hemangiomas. The hemangioma described in the vignette is clearly in the proliferative phase, making it too large, thick, and deep to respond well to laser therapy alone.

Surgical excision is not a viable option in this case due to the extensive size and location of the hemangioma. The treatment is not emergent, since the patient described remains stable, and more conservative options should be exhausted before resorting to resection.

Topical corticosteroid is not preferred in this case due to the large size and location of the hemangioma. Topicals should not be applied to the intraoral mucosa, and corticosteroids would be too slow-acting to improve significant symptoms such as bleeding and poor feeding.

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116. A 25-year-old man was assaulted 72 hours ago and presents with a noncomminuted, minimally displaced right angle fracture of the mandible. The plastic surgeon plans to perform open reduction and internal fixation. Which of the following factors is most likely to place the patient at greatest risk for a postoperative complication?

- A) Perioperative ampicillin-sulbactam administration
- B) Placement of two mini-plates
- C) Postoperative maxillomandibular fixation
- D) Sex of patient
- E) Time to operative intervention

The correct response is Option B.

In multiple studies, the use of a single plate along either the oblique ridge or the lateral cortex demonstrates the lowest incidence of complications for this type of fracture. Specifically, placement of two mini-plates has been associated with an increased risk for postoperative complication. Postoperative maxillomandibular fixation has not been shown to influence the incidence of complications. Furthermore, time to operative intervention and the sex of the patient have not been shown to increase the complication rate. Factors such as smoking and the number of fractures have been associated with an increased risk for complication with mandible fractures. Finally, perioperative ampicillin-sulbactam administration has been shown to decrease the risk for complications in this patient population.

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117. A 16-year-old girl presents to the clinic 3 years after onset of a right unilateral Bell palsy with a chief complaint of absence of commissure elevation and asymmetry of the nasolabial fold when she smiles. She has undergone no previous treatment. Which of the following procedures is most likely to result in spontaneous smile animation with emotion on the affected side?
- A) Cross-facial nerve grafting from the unaffected left face to the distal facial nerve branches on the affected right face
 - B) In-line temporalis muscle transfer
 - C) Single-stage gracilis free flap with neurotomy to the right-sided motor nerve to the masseter muscle
 - D) Two-stage reconstruction with cross-facial nerve grafting from the unaffected left face followed by functional gracilis muscle free flap to the right face

The correct response is Option D.

Dynamic reconstruction options that restore the smile function to the face following facial (VII) nerve injury can be categorized as those restoring innervation to the native mimetic musculature and procedures including a muscle transfer. The decision to reinnervate the native facial musculature or to perform a muscle transfer is dictated by the elapsed time since the start of facial paralysis. In cases where facial paralysis is present for less than 12 months, the native musculature may be reinnervated. After 24 months of paralysis, muscles become irreversibly atrophic and a muscle transfer is necessary. In the case described, the facial paralysis has been present for 3 years and the native mimetic muscles can no longer be successfully reinnervated. Therefore, cross-face nerve grafting from the contralateral face to the distal facial nerve on the affected side will not be successful and does not represent a viable treatment for this patient.

Strategies for smile restoration can also be classified as those powered by the facial (VII) nerve and those powered by other cranial nerves. In-line temporalis transfer represents a direct transfer of the temporalis muscle, which is innervated by the trigeminal (V) nerve. Additionally, the nerve to the masseter muscle is another branch of the trigeminal (V) nerve commonly used to reinnervate functional muscle transfers such as a gracilis free flap. To activate both of these reconstructions, patients must actively clench their jaw. With therapy and practice, some patients may achieve the ability to smile without clenching the jaw, but a spontaneous smile with emotion is achieved by few patients.

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Innervation from the facial (VII) nerve, whether ipsilateral or contralateral, is more likely to generate a spontaneous emotional smile compared with reconstructions powered by other cranial nerves. In the case described, the ipsilateral facial nerve does not represent a viable source of innervation, but a staged procedure using input from the contralateral facial nerve to innervate a microvascular gracilis muscle transfer represents a viable procedure to restore spontaneous smile function for this patient.

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118. A 3-month-old infant presents with scaphocephaly and sagittal suture ridging. Spring-assisted cranioplasty with an endoscopic approach is planned. Which of the following is an advantage of this procedure over open cranial vault remodeling procedures?
- A) Decreased need for additional surgeries
 - B) Greater control of bony movements
 - C) Improved aesthetic outcomes
 - D) Less blood loss
 - E) Lower risk for developing neurocognitive impairment

The correct response is Option D.

Spring-assisted cranioplasty or spring-assisted synostosis surgery is a technique to address sagittal craniosynostosis. This procedure is similar in approach to suturectomy/helmet procedures, which involve removal of the fused suture via small incisions, often with the assistance of an endoscope. In spring-assisted cranioplasty, however, no helmet is applied to the skull to reshape it. Rather, two to three stainless steel springs are placed between the now separated parietal bones that are widened over time as the springs expand. These springs need to be removed around 4 months later in a short second operation. Compared with more traditional open cranial vault reconstruction procedures, spring-assisted cranioplasty is associated with decreased blood loss, shorter operative time (even including the second surgery) and hospital stay, and comparable aesthetic and neurocognitive outcomes. The surgeon is, however, compromising control of the postoperative outcome in favor of the smaller surgical footprint and the guaranteed second surgery required to remove the springs.

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119. Which of the following best describes the growth pattern of the calvarium relative to a fused suture?

- A) Oblique
- B) Parallel
- C) Perpendicular
- D) No relation

The correct response is Option B.

Virchow's law states that bone surrounding a prematurely fused suture only grows parallel to the suture, while growth perpendicular to the suture is restricted. This contributes to the characteristic patterns of cranial shape in the various types of synostoses. Sagittal fusion yields a skull that is long in the anteroposterior direction and narrow bitemporally. Metopic fusion yields a triangular-shaped skull due to constriction caused by the anterior, medial metopic suture. Unilateral coronal synostosis yields an asymmetric skull, notably for a trapezoidal appearance from the overhead inspection. While there may be some ridging above and below the affected suture, this does not represent the growth of normal calvarial bone.

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120. A tumor that has metastasized to the mandible in a 70-year-old man is most likely to have originated from which of the following anatomic sites?

- A) Colon
- B) Kidney
- C) Lung
- D) Testis

The correct response is Option C.

The mandible is an uncommon site for metastatic tumor spread and is usually evidence of more widespread disease. They may arise from numerous sources and usually present with the discovery of a new nodular mass with or without ulceration. Imaging studies demonstrate radiolucent/hypodense lesions. In male patients, the most common age range is the fifth to seventh decades. In men, the most common primary site is the lung; in women, it is the breast. Of note, the posterior mandible appears to be the most common bony site of involvement. The mean survival time is 8 months.

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121. A 50-year-old man presents with a 3-cm ulcerated oropharyngeal mass that has appeared and gradually enlarged over the past 4 months. Physical examination is otherwise unremarkable. CT scans of the neck and chest and liver function testing are within normal limits. In addition to biopsy of the mass, which of the following tests is most appropriate for this patient?
- A) CT angiography of the head and neck
 - B) P-16 protein expression test
 - C) Sentinel lymph node biopsy
 - D) Serum IgA levels for Epstein-Barr virus
 - E) Urine cotinine assay

The correct response is Option B.

This patient's lesion is concerning for oropharyngeal squamous cell carcinoma (SCC). To establish a diagnosis and direct treatment, fine-needle aspiration biopsy of the mass should be the next step in this patient's workup. In addition to histologic examination, the specimen should be tested for p16 expression, which is a marker for HPV-associated cancer. HPV can infect the oral cavity and pharynx and cause oropharyngeal and, more rarely, oral SCC. HPV-positivity has important prognostic value and is staged differently than non-HPV-positive SCC's. HPV-associated oropharyngeal SCC has a relatively indolent course and a better prognosis than non-HPV-associated oropharyngeal SCC. Treatment for early stage disease may either be radiation with or without chemotherapy and/or immunotherapy or surgery, including transoral robotic surgery. Survival and recurrence rates are similar for the two treatment strategies. The HPV vaccine protects against the types of HPV that cause oropharyngeal cancers.

Epstein-Barr virus (EBV) is implicated in the development of nasopharyngeal carcinoma (as well as certain types of lymphoma), not oropharyngeal cancer. While not used for diagnosis, measurement of EBV DNA may be done before and after treatment to monitor response.

Oropharyngeal cancers are not especially vascular, unlike juvenile nasopharyngeal angioma, which occurs in the nasopharynx and nasal cavity, not the oropharynx, so CT angiography is not indicated.

Sentinel lymph node biopsies are used to assess for occult lymph node metastases in the clinically N0 neck. Their use in squamous cell cancer is controversial and would not be the next step in making the diagnosis.

Urine cotinine assay is a test for cotinine, a byproduct of nicotine used to evaluate exposure to tobacco. While tobacco is an important risk factor for head and neck cancer, its use is not helpful in making a diagnosis or directing treatment.

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122. Which of the following cephalometric planes extends from the most superior aspect of the external auditory canal through the inferior orbital rim?

- A) Facial plane angle
- B) Frankfort horizontal plane
- C) Nasion-pogonion plane
- D) Sella-nasion plane

The correct response is Option B.

Numerous points, angles, and planes may be identified on a standard cephalogram. The sella is the midpoint within the sella turcica. The nasion is the most anterior point of the frontonasal suture in the midsagittal plane. The pogonion is the most forward-projecting point on the anterior surface of the chin. The Frankfort horizontal is a line extending from the porion (the superior extent of the ear canal) to the orbitale (inferior extent of the orbit). The Frankfort horizontal was originally introduced at an anthropological conference in Frankfurt, Germany, in 1884. It is used to orient the craniofacial skeleton and serve as a relation to other descriptive planes. The facial plane angle extends from the nasion to the pogonion. It is used to measure the degree of protrusion or retrusion of the lower jaw.

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123. A 3-month-old infant presents with flattening of the left forehead, and asymmetry of the orbits and face. He has early evidence of right-sided astigmatism and ocular torticollis. A CT scan is shown. The parents are considering two options: endoscopic suturectomy and helmet therapy at age 3 months or fronto-orbital advancement (FOA) at age 9 months. Compared with endoscopic suturectomy and helmet therapy, FOA is more likely to result in which of the following surgical outcomes?
- A) Greater need for revision
 - B) Greater postoperative facial symmetry
 - C) Less operative morbidity
 - D) Lower overall cost
 - E) More severe strabismus

The correct response is Option E.

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Surgical intervention is recommended for most patients with craniosynostosis due to the variable risk for increased intracranial pressure (ICP), localized cerebral compression, and developmental delay. Traditional treatment techniques such as fronto-orbital advancement (FOA) and total cranial vault remodeling are still widely used, but minimally invasive options such as endoscopic suturectomy and postoperative helmet therapy (ES + HT), spring-mediated distraction, and conventional distraction have become more commonplace. While each technique has its ardent supporters, there is a growing number of studies that compare the clinical outcomes of each technique. ES + HT is most effective when performed under 4 months of age because the correction depends solely on cranial expansion, while spring-mediated distraction is typically done in older infants (4 to 8 months of age). Cranial remodeling has no strict age limit, but many surgeons defer treatment until 7 to 10 months to decrease the risk associated with anesthesia and recurrence of the malformation. Despite these concerns, there are some data that support early cranial expansion (<6 months of age) to optimize neurocognitive outcomes. Compared with FOA, endoscopic and spring-mediated distraction techniques are less costly, less morbid, and have similar revision.

The patient has left unilateral coronal craniosynostosis (UCS), which manifests as ipsilateral forehead and brow retrusion and shortening of the ipsilateral hemi-cranium, with orbital and facial asymmetry. Open cranial vault procedures do not directly correct the facial symmetry and at least two investigations show better facial asymmetry is achieved with early, minimally invasive approaches. The orbital asymmetry results in strabismus (contralateral head tilting termed ocular torticollis) and contralateral astigmatism in the majority of patients. Several studies confirm significantly better ophthalmologic outcomes following early endoscopic suturectomy for UCS versus FOA performed at an older age.

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124. One month after chondrolaryngoplasty for facial feminization, the patient reports that the pitch of her voice is lower than before surgery. She does not have hoarseness. Which of the following structures was most likely injured?

- A) Anterior commissure tendon
- B) Arytenoid cartilage
- C) Cricothyroid membrane
- D) Hyoepiglottic ligament
- E) Recurrent laryngeal nerve

The correct response is Option A.

Transgender women (assigned male at birth) who underwent puberty without hormone blockade often have enlarged thyroid cartilage as is seen in cis-males. Chondroplasty of the tracheal cartilage can decrease the prominence referred in lay terms as the "Adam's apple." A crease proximal or distal to the area of prominence is used for the approach. Perichondrium is often raised overlying the area of reduction and the excess prominence superior to the vocal cords and anterior commissure is reduced by burr or knife. Endoscopy may be used to verify the location of the anterior commissure to avoid injury to the vocal cords. Anterior commissure tendon injury leads to a deepened voice. Setback of the commissure is a treatment for high-pitched voices. A recurrent laryngeal nerve injury would result in hoarseness. The arytenoids are posterior and should not be encountered with the reduction procedure. The hyoepiglottic ligament connects the epiglottis to the hyoid bone; it assists with elevation of the epiglottis and is not involved with voice pitch. The cricothyroid membrane is the membrane that is entered for emergency airways. It is located inferior to the vocal cord structures and should not cause lowering of the voice.

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125. A 3-year-old girl with a history of congenital right trigeminal neuropathy is referred for recurrent corneal ulceration of the right eye. Physical examination discloses that she is completely insensate along the right V1 nerve/dermatome distribution. The right cornea is insensate with several areas of mild ulceration. Which of the following procedures is most likely to preserve vision in this child's right eye?

- A) Corneal neurotization with sural nerve graft from left supratrochlear nerve
- B) Corneal transplantation
- C) Ipsilateral supratrochlear nerve transfer to ophthalmic nerve
- D) Laser-assisted in situ keratomileusis (LASIK)
- E) Tarsorrhaphy

The correct response is Option A.

Neurotrophic keratitis is a rare vision-threatening condition caused by decreased corneal sensation due to trigeminal neuropathy. Subsequent inflammation and ulceration can lead to corneal opacification and, in young children, amblyopia. Preventing ulceration of affected corneas is critical to maintaining vision. In young children, however, tarsorrhaphy (surgical adhesion of eyelids) can result in deprivational amblyopia and permanent vision loss. Corneal transplantation has been attempted as well. However, without adequate sensation, most transplanted corneas become ulcerated and opacify as well. In the last decade, corneal neurotization has emerged as a means of restoring sensation and preventing persistent ulceration. In this procedure, fibers from the contralateral supratrochlear nerve are redirected via a sural nerve graft (or other graft) to the affected cornea, where they serve to reinnervate the affected eye. In cases with mild corneal ulceration, neurotization can reverse these neurotrophic changes and help restore normal corneal architecture.

Ipsilateral supratrochlear nerve transfer will not work in someone without functional sensation in that nerve. The ophthalmic nerve is upstream of the supratrochlear nerve and is also affected.

Laser-assisted in situ keratomileusis (LASIK) procedure involves reshaping the cornea in order to correct refractive errors. It does not affect sensation.

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126. A 50-year-old woman presents with a 1.5-cm white plaque on the left cheek that has been slowly growing for the past 3 years. A photograph is shown. Examination of the specimen obtained on biopsy shows perineural invasion and basaloid epithelioid cells displaying ductal lumina. Which of the following is the most likely diagnosis?

- A) Keratoacanthoma
- B) Malignant melanoma
- C) Microcystic adnexal carcinoma
- D) Squamous cell carcinoma

The correct response is Option C.

Microcystic adnexal carcinoma (MAC) is a slow-growing skin cancer that primarily affects the head and neck and usually presents as a fleshy, plaque-like lesion. MAC is commonly misdiagnosed as basal or squamous cell carcinomas amongst others. MAC commonly has perineural invasion (PNI) and, as its names implies, affects apocrine structures. Although PNI can occur with basal cell carcinoma, squamous cell carcinoma, and melanoma, the latter two are generally much faster growing and this finding is still much less common. For basal cell carcinoma, PNI is typically observed in patients with advanced disease. Keratoacanthoma is a form of well-differentiated squamous cell carcinoma and is generally fast growing. Treatment of MAC is typically carried out with complete circumferential, peripheral, and deep margin assessment, and most often with Mohs micrographic surgery.

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127. A 74-year-old man with type 2 diabetes mellitus develops squamous cell carcinoma (SCC) of the mandible. His history is significant for bilateral distal fibular fractures sustained 10 years ago from a motor vehicle collision, which were repaired with open reduction and internal fixation. He states that the ability to eat and chew will be important to him. Which of the following statements regarding mandibular reconstructive options is correct?
- A) The bone quality of the scapular flap is superior to the iliac crest flap
 - B) Dental rehabilitation with implants is more predictable in osteocutaneous radial forearm flap than the iliac crest flap
 - C) Free fibular flaps have a higher rate of donor site morbidity than iliac crest flaps
 - D) A history of distal fibular fractures is not an absolute contraindication to the use of a free fibular flap
 - E) Iliac crest bone flaps have lower failure rates than osteocutaneous radial forearm flaps

The correct response is Option D.

A history of fibular fracture is not an absolute contraindication to using a free fibular flap. According to a systematic review, iliac crest flaps have the highest rate of failure when compared to all the other methods combined (fibular, radial, scapular). While not contraindicated, dental implants are less frequently placed in patients reconstructed with radial forearm bone flaps. More donor site morbidities have been reported for fibular than iliac crest flaps. Scapular flaps provide inferior bone quality to fibular and iliac crest flaps.

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128. Elderly patients are more likely than younger patients to have which of the following facial fractures?

- A) Nonoperative Le Fort fracture from a bicycle accident
- B) Nonoperative mandible fracture from a motor vehicle collision
- C) Nonoperative maxillary fracture from a fall
- D) Operative nasal fracture from interpersonal violence
- E) Operative orbital fracture from a workplace injury

The correct response is Option C.

Elderly patients are more likely to sustain injury from falls than younger patients and are less likely to be in fights. Nonoperative maxillary fractures and nasal bone fractures are more common in elderly patients, and mandible fractures are more common in younger patients.

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129. A 20-year-old man has severe hypotension and bradycardia after sustaining multiple facial fractures in a motor vehicle collision. He has no other injuries. Repairing which of the following structures will most likely improve the patient's symptoms?

- A) Mandible
- B) Mental nerve
- C) Nasal bone
- D) Orbital floor
- E) Zygomatic arch

The correct response is Option D.

The oculocardiac reflex can precipitate marked bradycardia and hypotension in the setting of trauma with significant orbital and maxillofacial injury. Prompt identification and management with vagolytic agents or definitive surgical intervention may prevent morbidity or mortality. Patients who sustain maxillofacial trauma involving the orbit, most commonly the orbital floor, are at risk for developing the oculocardiac reflex. These patients tend to be young, and common symptoms include nausea and vomiting. The oculocardiac reflex is not static and may evolve during a patient's clinical course.

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130. A 7-year-old girl presents with a tender and erythematous right pretragal abscess. Upon inquiring about the pit inferior to it, her parents report only recent drainage, despite presence since birth. They deny hearing deficits but report a family history of a similar defect. Facial cellulitis and excess granulation tissue are also noted on physical examination. Photographs are shown. Malformation of which of the following embryological structures most likely accounts for these findings?

- A) Hillocks
- B) Meatal plug
- C) Otic capsule
- D) Otic vesicle
- E) Tubotympanic recess

The correct response is Option A.

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Auricular hillocks are ectodermal derivatives of the first pharyngeal groove and are responsible for the formation of external ear structures (e.g., auricle and external auditory canal [EAC]). Incomplete fusion of the auricular hillocks (defective closure of the dorsal 1st pharyngeal groove) results in preauricular sinus. This is the only answer choice that contributes to the development of the external ear.

The meatal plug is an ectodermal derivative of the first pharyngeal groove (extends from the medial end of the EAC), which largely degenerates/canalizes, but is responsible for formation of the surface layer of the tympanic membrane. Persistence of the meatal plug results in conductive congenital deafness.

The otic vesicle is an ectodermal derivative of the developing brain that is responsible for formation of inner ear structures (e.g., saccule, utricle, semicircular and cochlear ducts, and membranous cochlea including the spiral organ of Corti). Abnormal development of the membranous labyrinth results in sensorineural congenital deafness.

The otic capsule is derived from mesenchyme of the first and second pharyngeal arches, surrounds/is induced by the otic vesicle, and is responsible for formation of inner ear structures (e.g., bony labyrinth). Abnormal development of the bony labyrinth results in sensorineural congenital deafness.

The tubotympanic recess is an endodermal derivative of the first pharyngeal pouch, responsible for the formation of middle ear structures (e.g., auditory tube, tympanic cavity, etc.). Abnormal/under-development of the middle ear structures increases the risk for chronic otitis media and can have an effect on conductive hearing.

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131. A 23-year-old woman with vertical maxillary excess is scheduled to undergo a LeFort I osteotomy with impaction. During this procedure, which of the following pairs of arteries is most likely to be disrupted?

- A) Ascending pharyngeal and ascending palatine
- B) Greater palatine and facial
- C) Maxillary and lesser palatine
- D) Nasopalatine and descending palatine
- E) Sphenopalatine and pterygopalatine

The correct response is Option D.

Understanding the vascular anatomy of the maxilla is critical to successfully performing a Le Fort I osteotomy. In addition to the periosteal blood supply from the mucosal attachments, there are several named vessels that supply the palate and alveolar processes, which are mobilized in a Le Fort I osteotomy. Of the answer choices listed, the nasomaxillary and descending palatine arteries are commonly disrupted during surgery. After downfracture, the ascending palatine and ascending pharyngeal arteries become the dominant blood supply to the segment.

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132. An 18-year-old man presents with right periorbital edema and ecchymosis after an all-terrain vehicle collision. Physical examination shows enophthalmos, diplopia, and pain with eye movements. When asked to look upward from forward gaze, there is upward gaze restriction. A photograph is shown. Which of the following locations is most likely fractured?
- A) Greater wing of sphenoid bone
 - B) Lamina papyracea of ethmoid bone
 - C) Orbital plate of frontal bone
 - D) Orbital process of maxillary bone
 - E) Posterior crest of lacrimal bone

The correct response is Option D.

Limitation with vertical gaze, as described in the vignette, is indicative of extraocular muscle (EOM) entrapment.

The lamina papyracea of the ethmoid bone contributes to the medial orbital wall. Fractures of the medial wall may result in medial rectus entrapment and restriction with lateral gaze. Such injuries can involve the ethmoidal/sphenoidal sinuses.

The greater wing of the sphenoid bone contributes to the lateral orbital wall. Fractures of the lateral wall are less common due to its increased strength, but at the wings of the sphenoid, bone can have serious effects on contents of the superior orbital fissure and may even involve the intraorbital portion of the optic (II) nerve.

The orbital plate of the frontal bone contributes to the superior orbital roof. Fractures of the superior roof may result in superior rectus and/or oblique entrapment. Such injuries can

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involve the frontal sinus, frontal lobe, supraorbital nerve, and/or supratrochlear nerve (resulting in loss of sensation of the forehead and upper eyelid).

The orbital process of the maxillary bone contributes to the inferior orbital floor. Fractures of the inferior floor may result in inferior rectus/oblique entrapment and restriction with upward gaze. Such injuries can involve the maxillary sinus and/or infraorbital nerve (resulting in malar and superior alveolar numbness).

The posterior crest of the lacrimal bone contributes to the medial orbital wall. Fractures of the medial wall may result in medial rectus entrapment and restriction with lateral gaze. Such injuries can involve the ethmoidal/sphenoidal sinuses.

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133. A 28-year-old woman comes to see the plastic surgeon because she is unhappy about her "square jaw" and desires a softer shape for her face without surgical intervention. Treatment of her masseter hypertrophy with botulinum toxin was recommended. The patient should be informed that the most likely effect from repeated injections is which of the following?
- A) She can be assured that the use of botulinum toxin injection for masseter hypertrophy is within FDA guidelines
 - B) She should take NSAIDs in anticipation of headaches after botulinum toxin injection
 - C) She will not have any functional issues with eating and chewing after botulinum toxin injection
 - D) The volume and bulk of the masseter muscle will be significantly decreased with botulinum toxin injections

The correct response is Option D.

A recent study (Shome et al.) demonstrated that after a series of botulinum toxin injections, masseter volume reduction lasted up to 4 years. Therefore, this treatment does not only have short-term effects.

In a review (Peng et al.), 30% of patients reported temporary decrease in mastication force after botulinum injection. Headaches are infrequently reported and happen immediately after injection; they resolve after 2 to 4 days. When patients' masseter volumes were measured before and after treatment, there was significant reduction in masseter volume (Chang et al.).

Currently, botulinum toxin injection is an off-label use in treatment of masseter hypertrophy.

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134. A 7-year-old girl presents to the clinic with poor school performance, speech difficulties, and hypernasality. The patient also has a history of immunodeficiency and hypocalcemia. Clinically, there is no evidence of overt or submucosal cleft palate. Which of the following is the most appropriate next step for her care?

- A) Formal speech evaluation
- B) MRI
- C) Palatoplasty
- D) Observation

The correct response is Option A.

Velopharyngeal dysfunction can be divided into insufficiency, incompetence, and mislearning. The term insufficiency is related to a structural defect that results in poor closure of the velopharyngeal port. Incompetence is usually associated with neurological or muscular causes to inefficient port closure. Mislearning is less frequent and related to normal anatomy and muscle function, but inadequate production of sounds.

The patient described has many of the medical abnormalities observed in 22q11.2 deletion syndrome. These include, but are not limited to, congenital heart defects, hypocalcemia, immune deficiencies, speech delay/disorders, palatal abnormalities, intellectual disabilities, and psychiatric disorders. Late speech disorder diagnosis is not uncommon and warrants a thorough evaluation in a cleft center; this patient would also benefit from a genetics consultation. Depending on the formal speech evaluation results, further measures of velopharyngeal closure, such as nasometry and pressure flow, as well as imaging with videofluoroscopy and nasopharyngoscopy, might be recommended.

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135. Early replacement of an avulsed tooth is critical to increasing its chance of long-term survival because it minimizes further damage to which of the following structures?

- A) Cementum
- B) Dentin
- C) Enamel
- D) Periodontal ligament
- E) Pulp

The correct response is Option D.

Avulsion of a permanent tooth is one of the most serious dental injuries that may be encountered by a plastic surgeon. Without prompt intervention, the tooth may be lost, committing the patient to a bone graft, an implant, or lifelong prosthodontic appliance. When a permanent tooth is fully avulsed, exposure of the periodontal ligament can lead to its desiccation and cell death within an hour of injury. The long-term viability of a tooth with a dry time of greater than 60 minutes is poor. If the tooth cannot be immediately replanted, it should be stored in a neutral medium such as milk, saliva (in the mouth), or Hanks balanced storage solution. Enamel and cementum make the hard outer layer of the tooth (enamel at the crown and cementum at the root) and are relatively resistant to damage with an avulsion. Dentin is the thick layer deep to the enamel/cementum, which makes up the bulk of the tooth and is not typically injured in a clean avulsion. The pulp contains the neurovascular supply of the tooth. In a complete avulsion, the pulp will become nonviable and will need to be removed with a root canal procedure after the tooth has become stable. However, with appropriate treatment, the tooth can survive after the pulp has been removed.

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136. A 4-month-old infant is evaluated because of a lesion near the lateral aspect of the left eyebrow. A photograph is shown. The mass is firm, well-circumscribed, and does not move with overlying skin movement. Which of the following preoperative imaging studies is most appropriate?
- A) CT scan
 - B) MRI
 - C) Ultrasonography
 - D) X-ray studies
 - E) Imaging studies are not necessary

The correct response is Option E.

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Dermoid cysts of the craniofacial region represent about 7% of all dermoid cysts and have an incidence of around 1 in 1000 live births. These masses can arise in multiple anatomic locations on the head, including the lateral eyebrow (sometimes referred to as an angular dermoid), midline nose, glabella, medial canthus, temporal or occipital scalp, frontal/anterior fontanel, and postauricular sulcus. Intracranial extension occurs in midline nasal dermoid cysts (13% below and 0% above the nasofrontal suture), frontal/fontanel (36.8%), temporal (16.2%), and occiput (16.3%), while this almost never occurs in the remaining locations (lateral brow, parietal, medial canthus, auricular). Cysts of the lateral brow represent almost two-thirds of all craniofacial dermoid cysts, and intracranially, extension or contact with the dura does not occur. Thus, the diagnosis is clinical, and further imaging in a child this young is not warranted. Overland et al. advocate imaging (CT or MRI) in older patients (>2 years of age) due to an increased risk for orbital extension with growth.

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137. A 7-year-old boy sustains a deep laceration over the right side of the face. A photograph is shown. Injury to the parotid (Stensen) duct is suspected. At the anterior edge of the parotid gland, the duct should lie immediately superficial to which of the following structures?

- A) Deep subcutaneous fat
- B) Masseteric fascia
- C) Submuscular aponeurotic system (SMAS)
- D) Superficial parotid fascia
- E) Temporoparietal fascia

The correct response is Option B.

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The parotid gland is the largest of the three paired salivary glands (parotid, submandibular, and sublingual). It has two lobes, the deep and superficial, each of which is enveloped in a fascial sheath (parotid sheath) and between which passes the facial vein and nerve. The superficial lobe lies lateral (superficial) to the masseter muscle, and the deep lobe lies between the mastoid process and the mandibular ramus. The parotid, or Stensen, duct arises from the deep lobe of the parotid gland and receives contributions from the superficial lobe as it travels anteriorly. After exiting the anterior edge of the superficial lobe, the duct passes directly over the masseter muscle, crosses over the anterior edge of the masseter, extends medially and anteriorly over and through the buccinator muscle, and enters into the mouth via the parotid papilla, typically located opposite the second maxillary molar. The course of the duct has classically been described as following a line connecting the tragus and the midportion of the upper lip, but there is significant variation, and some studies report that this line should end in the lower half of the upper lip. The laceration shown in the photograph is just at the anterior border of the parotid and, at this level, the duct should be passing over the masseter muscle and its fascia. The course of the duct is below the superficial lobe of the parotid and, therefore, well below the subcutaneous tissue and the submuscular aponeurotic system (SMAS), which is confluent with the platysma inferiorly and the temporoparietal fascial superiorly. Superficial parotid fascia defines the layer of fascia that invests the superficial lobe of the parotid gland.

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138. During recipient vessel dissection in preparation for a head and neck free flap reconstruction, a nerve that runs deep and roughly parallel to the posterior belly of the digastric muscle is accidentally divided. This patient is most likely to have which of the following dysfunctions as a result?

- A) Impaired shoulder elevation
- B) Loss of depressor anguli oris movement
- C) Paralysis of the hemidiaphragm
- D) Tongue deviation
- E) Vocal cord paralysis

The correct response is Option D.

The hypoglossal (XII) nerve emerges from the hypoglossal canal in the skull base and runs deep and roughly parallel to the posterior belly of the digastric in the upper neck, eventually innervating the intrinsic and extrinsic muscles of the tongue (except for the palatoglossus, which is innervated by the vagus [X] nerve). Division of the nerve results in ipsilateral tongue paralysis. The posterior belly of the digastric muscle is known as the "resident's friend" because it acts as a useful anatomic landmark for several critical structures in the neck. It lies directly superficial to the branches of the external carotid artery, the internal carotid artery, jugular vein, and hypoglossal (XII) nerve.

The marginal mandibular nerve, a branch of the facial (VII) nerve, innervates the depressor anguli oris and depressor labii inferioris, which are the facial mimetic muscles responsible for frowning. It runs superficial to the posterior belly of the digastric muscle but deep to the platysma muscle. It is often injured in surgery of the neck region.

The vagus (X) nerve exits the cranium via the jugular foramen and courses from superior to inferior within the carotid sheath between the internal jugular vein and common carotid artery. It has diverse functions including supplying the larynx, pharynx, heart, esophagus, stomach, and small and large intestines. Transection of the vagus (X) nerve in the neck can result in vocal cord paralysis, among other dysfunctions.

The spinal accessory (XI) nerve innervates the sternocleidomastoid and trapezius muscles. Therefore, its division results in impaired shoulder mobility. Although it lies deep to the posterior belly of the digastric muscle, it courses inferiorly and posteriorly, crossing the internal

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jugular vein, rather than parallel to the muscle, to enter the posterior triangle of the neck. The phrenic nerve originates from cervical spinal nerves (C3-C5) and is found in the floor of the posterior triangle of the neck and is not found deep to the posterior belly of the digastric.

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139. A 3-month-old male infant presents with left occipital flattening and associated external ear and facial asymmetry. Significant head tilt and limited range of motion with neck rotation are noted on physical examination. A photograph is shown. Which of the following muscles is most likely contributing to the patient's plagiocephaly?

- A) Digastric
- B) Platysma
- C) Splenius cervicis
- D) Sternocleidomastoid
- E) Trapezius

The correct response is Option D.

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Congenital muscular torticollis occurs as a result of sternocleidomastoid shortening, presenting as head tilt and limited range of motion with neck rotation. The inability to rotate the neck increases the time spent in the preferred position and contributes to deformational plagiocephaly. The digastric muscle acts to elevate the hyoid, while the platysma is involved in facial expression. The splenius cervicis extends the spinal column, and the trapezius functions to maintain posture and stabilize the scapula.

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140. Feminization of the forehead in a transgender woman most commonly addresses which of the following key skeletal features?

- A) Cortical thickness
- B) Frontal bone width
- C) Frontal bossing
- D) Low radix
- E) Metopic ridge

The correct response is Option C.

Facial feminization surgery addresses many aspects of the facial skeleton and soft tissues. The forehead surgery can include hairline reduction and brow lift for the soft tissue as well as frontal sinus setback and reduction for supraorbital rim. Male patients develop enlarged frontal sinus compared with female patients during puberty, as well as thicker lateral supraorbital rims. Men also have a raised radix and overall thicker bone. Although the thickness of the entire skull can be thicker in men, reduction and contour in feminization surgery focuses on the frontal bone and lateral supraorbital rim.

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141. A 46-year-old woman with no history of trauma has had 1 month of headaches and soft tissue swelling over the frontal sinus and lateral frontal bone. Today she has fever, mental status changes, and increased swelling and redness of the forehead. CT scan shows a frontal epidural abscess and opacified frontal sinuses. Which of the following is the most likely diagnosis?

- A) Exostosis
- B) Fibrous dysplasia
- C) Frontal osteoma
- D) Infected encephalocele
- E) Pott puffy tumor

The correct response is Option E.

Pott puffy tumor is currently rare due to availability of antibiotics. Pott puffy tumor is an osteomyelitis and abscess that results from chronic frontal sinusitis. The clinical presentation and CT scan findings are typical for the presentation of this tumor. Fibrous dysplasia is a bony overgrowth tumor that is not infectious in nature. Encephalocele is a congenital condition with a skull defect. Exostosis and frontal osteoma are benign overgrowths of the bone that occur slowly. They are not associated with mental status changes.

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142. During second-stage ear reconstruction with elevation of the costal cartilage framework, a temporoparietal flap is elevated to cover a cartilage block. The blood supply of this flap most commonly comes from which of the following arteries?

- A) Angular
- B) Maxillary
- C) Occipital
- D) Posterior auricular
- E) Superficial temporal

The correct response is Option E.

Elevation of the ear reconstruction framework can be covered by using a temporoparietal flap (TPF) if needed. The most common blood supply of the TPF is typically the superficial temporal artery but less frequently can be the posterior auricular artery or the occipital artery branches. The TPF flap can be safely raised on these less common pedicles as needed.

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143. A 17-year-old girl presents to the clinic to have the lesion in the photograph removed. She has had it since birth. She does not like its appearance and has noted it has changed in size and shape during the last two years. Histopathologic examination of the specimen is most likely to show which of the following?
- A) Amelanotic melanoma
 - B) Basal cell carcinoma
 - C) Nevus sebaceous
 - D) Squamous cell carcinoma
 - E) Trichoblastoma

The correct response is Option C.

The photograph shows a sebaceous nevus of Jadassohn, and on pathology, a benign organoid nevus is the most likely finding. Given the patient's age, malignant transformation is very rare (around 2.5%). Until recently, the most common transformation has been thought to be basal cell carcinoma (1.1%). However, it is now thought that many of these were trichoblastomas. A melanoma present since childhood does not fit the presentation of this patient.

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144. A 58-year-old man with a history of base-of-tongue cancer treated with radiation therapy and chemotherapy 3 years ago presents with right jaw pain, severe malocclusion (crossbite), and drainage from a wound in the right cheek. A photograph is shown. CT scan shows a pathologic fracture and bony destruction consistent with osteoradionecrosis of the mandible. A biopsy is negative for recurrent cancer. Which of the following is the most appropriate treatment?

- A) Hyperbaric oxygen
- B) Open reduction and internal fixation
- C) Pentoxifylline and tocopherol
- D) Segmental mandibulectomy and osteocutaneous free flap reconstruction
- E) Sequestrectomy and treatment with antibiotic oral rinses

The correct response is Option D.

Osteoradionecrosis (ORN) is a complication caused by high-dose radiation therapy to the head and neck, most commonly affecting the mandible. ORN may be painful and can be associated with pathologic fracture, purulent infection, osteomyelitis, and fistula formation. Marx classified ORN into three stages: Stage I, exposed alveolar bone without pathologic fracture that is responsive to hyperbaric oxygen (HBO)

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therapy; Stage II, disease that does not respond to HBO and requires sequestrectomy and saucerization; and Stage III, full-thickness bone damage or pathologic fracture that usually requires complete resection and reconstruction. In this case, the patient has a pathologic fracture (Stage III) as well as a fistula, and segmental mandibulectomy and osteocutaneous free flap reconstruction are indicated. There is no role for open reduction and internal fixation in most cases of ORN because healing is not likely to occur. Pentoxifylline and tocopherol (vitamin E) are more recently described treatments that have been shown to be effective in the treatment of early stage ORN.

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145. A patient presents for consultation for reconstruction of a saddle deformity following nasal trauma. Structural support for dorsal augmentation and lengthening of the nose is required. Which of the following is most likely to result in secondary development of nasal asymmetry during the early postoperative period?

- A) Alloplastic implant
- B) Cantilevered costal bone graft
- C) Cantilevered cranial bone graft
- D) Carved costal cartilage graft
- E) Diced cartilage graft

The correct response is Option D.

Multiple techniques have been described for dorsal augmentation in rhinoplasty. Carved costal cartilage offers structural support for both dorsal augmentation and lengthening of the nose. There is a large amount of donor material available, but carved rib cartilage is prone to warping and may result in the development of secondary deformity. Techniques, such as concentric carving and insertion of a k-wire into the graft, have been used to mitigate this, but success is very technique-dependent. Dorsal augmentation with bone grafts, such as cranial bone graft and rib, are more subject to bone resorption than warping. Diced cartilage grafts offer dorsal augmentation but do not offer structural support to lengthen the nose. These grafts are malleable in the postoperative period and potentially allow correction of minor asymmetries.

Nasal augmentation with alloplastic implants is common in Asian countries. These implants carry a risk for infection, extrusion, capsule contracture, and malposition. While rare, these complications can be severe and result in secondary deformity.

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146. A 48-year-old woman presents to the clinic after Mohs micrographic surgery for a mid-cheek basal cell carcinoma. The defect is 4 cm and abuts the left eyelid-cheek junction. Which of the following is the most appropriate method to close the defect?

- A) Cheek neck rotation flap
- B) Lateral thigh flap
- C) Radial forearm free flap
- D) Split-thickness skin grafting
- E) Xenografting

The correct response is Option A.

Mohs micrographic surgery is more often performed by the dermatologist, who then refers the patient to the plastic surgeon for closure. It allows for closure of margin-free carcinomas, typically either basal or squamous cell cancers. Defects of the cheek below the orbit can be challenging because ectropion of the lower lid can be a complication of surgery. For that reason, split-thickness skin grafts that can contract are not the first line choice of a large cheek defect below the orbit. An incision that extends upward toward the lateral canthus and then into the preauricular skin and down into the neck allows wide mobilization of the soft tissue to close relatively large defects. Free flap reconstruction is used in head and neck reconstruction, but it may provide soft-tissue reconstruction that is too bulky and a color match that is less than optimal. For those reasons, radial forearm and lateral thigh free flaps are not the optimal choice. There are autologous options, but xenografts are not used because the issues of cicatricial ectropion and graft rejection are overwhelming.

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147. A 5-year-old boy has an interrupted aortic arch, low-set ears, broad nasal bridge, velopharyngeal insufficiency, and hypoparathyroidism. A photograph is shown. Which of the following additional findings are most likely in this patient?

- A) Facial asymmetry, microtia
- B) High myopia, retinal detachment
- C) Lower eyelid coloboma, downward-slanting palpebral fissures
- D) Lower lip pits, salivary mucous drainage
- E) T-cell immunodeficiency, chronic otitis media

The correct response is Option E.

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22q11.2 Deletion syndrome (also known as DiGeorge, velocardiofacial, and conotruncal anomaly face syndromes) is often identified with help of the "CATCH 22" mnemonic, which refers to its characteristics of cleft palate, abnormal facies, thymic hypoplasia, cardiac malformations, and hypoparathyroidism. T-cell immunodeficiency and recurrent otitis media infections occur secondary to thymic hypoplasia and cleft-related ear anomalies.

Van der Woude syndrome is characterized by cleft palate and/or cleft lip, and lower lip pits/fistulae. Abnormal salivary gland morphology and hypodontia may also occur.

Treacher Collins syndrome (mandibulofacial dysostosis) is characterized by malar and mandibular hypoplasia, down-slanting palpebral fissures, lower eyelid coloboma, and ear anomalies.

Stickler syndrome type 1 is characterized by cleft palate, facies such as mid-face hypoplasia/retrusion, myopia with increased risk for retinal detachment, sensorineural hearing loss, and joint abnormalities including hypermobility and early-onset osteoarthritis.

Hemifacial microsomia is characterized by small and/or flattened maxillary, temporal, and zygomatic bones. Facial asymmetry is further apparent upon animation when soft tissue and nerve hypoplasia occur. Oral clefts and ear anomalies are commonly involved, as well as underdevelopment of the orbits.

Van der Woude syndrome, Treacher Collins syndrome, Stickler syndrome, and hemifacial microsomia are all unrelated to hypoparathyroidism.

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148. A 21-year-old man undergoes discectomy for the treatment of temporomandibular joint internal derangement. Which of the following long-term complications is most likely for this patient?

- A) Ankylosis
- B) Condylar remodeling
- C) Facial (VII) nerve injury
- D) Frey syndrome

The correct response is Option B.

The temporomandibular joint (TMJ) is described as a ginglymoarthrodial joint since it is both a ginglymus (hinging joint) and an arthrodial (sliding) joint. A superior joint space is separated from an inferior joint space by a disc. The arterial supply to the TMJ is provided by the branches of the superficial temporal branch of the external carotid, in addition to the deep auricular, ascending pharyngeal, and maxillary arteries. Nervous innervation is provided by the auriculotemporal and masseteric branches of the mandibular nerve (cranial nerve V₃). Resection of the disc is a treatment for internal derangement that is not responsive to conservative measures. The most common long-term complication of discectomy is remodeling of the mandibular condyle. While Frey syndrome, facial (VII) nerve injury, and ankylosis are possible, they are less common than remodeling.

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149. A 12-week-old infant undergoes repair of a complete bilateral cleft lip. Which of the following is a principle of both bilateral and unilateral cleft lip repair?

- A) Centralizing the columella
- B) Creating a rotation advancement flap
- C) Discarding the prolabial vermillion
- D) Establishing muscular continuity
- E) Preparing the projecting premaxilla

The correct response is Option D.

Establishing orbicularis oris continuity is a goal in both unilateral and bilateral cleft lip repair. Centralizing the columella is performed only in unilateral cleft lip repair. The prolabium is only apparent in bilateral cleft lips. Preparing the projecting premaxilla is done only in bilateral cleft lip repairs. Creating a rotation advancement flap is performed only in unilateral cleft lip repair.

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150. The ear anomaly depicted in the photograph shown is most commonly found in patients with which of the following syndromes?

- A) Apert
- B) Klippel-Trenaunay
- C) Stickler
- D) Treacher Collins
- E) Van der Woude

The correct response is Option D.

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The photograph depicts a patient with lobular type microtia and represents failure of formation of the pinna of the ear. Patients commonly have stenosis or absence of the external auditory canal, and in cases of lobular type microtia, exhibit a microtic remnant composed of malformed cartilage and fibrofatty tissue that is reminiscent of the ear lobule. This condition may be seen in isolation but is commonly seen in cases of hemifacial microsomia and Treacher Collins syndrome. Treacher Collins syndrome, or mandibulofacial dysostosis, exhibits a broad phenotypic spectrum and is commonly seen with hypoplasia or absence of the zygoma, coloboma of the lower eyelid, lateral canthal dystopia, absence of the medial lower eyelid lashes, mandibular hypoplasia with a steep occlusal plane, and abnormalities of the external ear, including microtia.

Apert syndrome results from *FGFR2* mutations *Ser252Trp* or *Pro253Arg* and results in multisuture craniosynostosis, mid-face hypoplasia, complex syndactyly, cystic acne, and other less common findings. It is transmitted as an autosomal dominant condition.

Stickler syndrome is inherited in autosomal dominant and recessive patterns. It results from mutations in collagen genes *COL2A1*, *COL11A1*, and *COL11A2*. This may manifest with ocular abnormalities including early-onset cataracts, vitreous anomalies, retinal detachments, and severe myopia. Patients may have sensorineural hearing loss. Mandibular hypoplasia and Pierre Robin sequence is common in these patients.

Van der Woude syndrome results from a mutation of the *IRF6* gene and is a common autosomal dominant condition associated with cleft lip and palate. Patients characteristically exhibit lower lip pits.

Finally, Klippel-Trenaunay syndrome is a congenital capillary-lymphatic-venous malformation of the lower extremity with associated soft tissue and bony overgrowth. This condition is caused by a somatic mutation in the *PIK3CA* gene and is therefore on the phenotypic spectrum with CLOVES syndrome and other *PIK3CA*-related overgrowth syndromes (PROS).

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Section 4: Breast and Cosmetic

151. A 47-year-old woman presents with concerns about a tired appearance of her upper eyelids. She notes that the lax quality of the skin makes it difficult to put her makeup on. Physical examination shows dermatochalasis with skin resting on the eyelashes and prominence of the medial fat pad. Margin reflex distance 1 is 4 mm. The patient has evidence of 13 mm of levator function. Which of the following is the most appropriate procedure for this patient?
- A) Fasanella-Servat procedure
 - B) Hyaluronic acid injection into the upper eyelid
 - C) Lateral temporal brow lift surgery
 - D) Levator advancement
 - E) Upper eyelid blepharoplasty

The correct response is Option E.

The examination of the patient notes that there is no ptosis of the upper eyelid based on a normal margin reflex distance 1 of 4 mm. This measurement describes the lid margin to be 2 mm above the upper border of a 4-mm pupil. Additionally, the patient is noted to have normal levator muscle excursion. Thus, the Fasanella-Servat procedure (resection of a portion of the tarsus, conjunctiva, and Müller muscle) and the levator advancement procedures are not indicated in this patient.

Hyaluronic acid filler can be used to fill in for volume lost from the upper eyelids. However, this will not address the quality of the eyelid skin and the excess skin resting on the eyelashes.

The patient is noted to have lateral brow hooding, which can be addressed by lateral temporal brow lift surgery. This procedure will return brow skin to its appropriate position, but it will not address the patient's main concerns and findings, which are limited to the skin of the upper eyelid (lax redundant skin of the upper eyelid which abuts the eyelashes). These concerns of dermatochalasis are best addressed by the skin-only upper eyelid blepharoplasty.

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152. A 39-year-old man undergoes rhinoplasty at the practice. Six months after the procedure, he is displeased with the outcome and notes mild persistent tip deviation. After seeking three opinions from plastic surgeons in the community who all agree to care for him, he returns to the practice and insists that the original surgeon fix his nose because he knows that surgeon is "the best." This patient most likely has which of the following psychological disorders?

- A) Bipolar disorder
- B) Body dysmorphic disorder
- C) Histrionic personality disorder
- D) Narcissistic personality disorder

The correct response is Option D.

Identification of various personality or psychiatric disorders prior to administering aesthetic care for patients can minimize social issues that can arise with the physician-patient relationship. Body dysmorphic disorder is hallmarked by pervasive and intrusive thoughts about a physical element (arm contour, for example) and may occupy several hours a day, causing severe distress and impairing one's otherwise normal activities. The diagnosed individual is often the only person who can see the affliction. Histrionic personality disorder (HPD) is characterized by a pattern of excessive attention-seeking behaviors. This includes inappropriate seduction and an excessive desire for approval. People diagnosed with HPD are often lively, dramatic, vivacious, enthusiastic, and flirtatious. Narcissistic personality disorder (NPD) patients have a grandiose sense of self-importance and are preoccupied with fantasies of unlimited success, power, brilliance, beauty, or ideal love. These patients have a sense of entitlement (i.e., unreasonable expectations of especially favorable treatment or automatic compliance with their expectations). The ironic hallmark of the patient with NPD is that they often return for cosmetic surgery even if they are dissatisfied with the initial results. Bipolar disorder patients have extremes in mood/behavior: mania and depression. This mental illness is hallmarked by severe high and low moods and changes in sleep, energy, thinking, and behavior. These patients have periods of feeling overly happy and energized and other periods of feeling very sad, hopeless, and sluggish.

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153. A 35-year-old woman is interested in a tummy tuck and liposuction of the flanks and mid back. She does not smoke cigarettes, can climb two flights of stairs without shortness of breath or chest pain, and takes medication for hypothyroidism, which is well-controlled. Height is 5 ft 6 in (167 cm) and weight is 260 lbs (118 kg). BMI is 42 kg/m². She is otherwise healthy. On the basis of this patient's history, which of the following is the most appropriate American Society of Anesthesiologists (ASA) physical status classification?

- A) ASA I
- B) ASA II
- C) ASA III
- D) ASA IV
- E) ASA V

The correct response is Option C.

This patient is classified as ASA III, on the basis of a BMI greater than 40 kg/m². Thus, she may not be a candidate for surgical facilities that are restricted to ASA I or II cases, like many office-based surgical facilities. Other examples of health factors that potentially classify a patient as ASA III (or higher) include: history of transient ischemic attack, stroke, poorly controlled diabetes mellitus or hypertension, chronic obstructive pulmonary disease, active hepatitis, alcohol dependence or abuse, implanted pacemaker, moderate decrease of ejection fraction, end-stage kidney disease undergoing regularly scheduled dialysis, percutaneous coronary angioplasty within 60 weeks, and history of myocardial infarction or stents for coronary artery disease more than 3 months ago.

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154. A 57-year-old woman undergoes rhytidectomy. During the dissection of the posterior border of the platysma, a divided nerve is seen over the midportion of the sternocleidomastoid muscle. If this nerve is not repaired, the patient will most likely have numbness of which of the following structures of the ear?

- A) Antihelix
- B) Concha cymba
- C) Crus of the helix
- D) Earlobe
- E) Tragus

The correct response is Option D.

The injured nerve in this case is the great auricular nerve, which crosses over the sternocleidomastoid muscle belly approximately 6.5 cm inferior to the external auditory canal. This is the most common nerve injury during rhytidectomy. The sensory innervation of the external ear arises primarily from four nerves: the auriculotemporal, the auricular branch of the vagus nerve, the great auricular nerve, and the lesser occipital nerve. The auriculotemporal nerve predominantly supplies the anterior and superior surface of the ear. Of the structures listed, only the earlobe or lobule is reliably innervated by only the great auricular nerve. The innervation of the antihelix, tragus, concha cymba, and crus of the helix is more variable. These regions have been described as being innervated by the the auriculotemporal nerve, auricular branch of the vagus nerve, or greater auricular nerve to varying degrees.

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155. During puberty, which of the following hormones is responsible for the development of the glandular buds of the breasts?

- A) Estrogen
- B) Follicle-stimulating hormone
- C) Oxytocin
- D) Progesterone
- E) Prolactin

The correct response is Option D.

During puberty, estrogen controls the growth of the breast ducts. Progesterone controls the growth of the glandular buds. Follicle-stimulating hormone, luteinizing hormone, prolactin, and oxytocin are responsible for milk production.

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156. A 22-year-old woman who is dissatisfied with the appearance of her breast seeks surgical correction. Examination shows a constricted base width, widened areola, and areola herniation. Which of the following is the most likely diagnosis?

- A) Athelia
- B) Hypomastia
- C) Poland syndrome
- D) Pubertal arrest
- E) Tuberous breast

The correct response is Option E.

The examination findings are consistent with the diagnosis of tuberous breast. Athelia is defined as absence of the nipple. Hypomastia would include a component of small breast volume, not described in this scenario. Poland syndrome often presents with an underdeveloped chest wall, including potential absence of the pectoralis major muscle. Pubertal arrest might allow for a disproportionately widened areola and apparent herniation if the breast bud had not fully developed, but it would not likely be associated with a constricted breast base width, which demonstrates breast development past the early stages of sexual development (known as Tanner stages).

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157. A 21-year-old woman with Fitzpatrick Type V skin presents for evaluation of acne scarring. Treatment with a fractional nonablative laser is planned. Which of the following lasers is most appropriate to treat acne in this patient?

- A) Carbon dioxide (10,600 nm)
- B) Erbium-doped fiber (1550 nm)
- C) Erbium:YAG (2940 nm)
- D) Erbium:YSGG (2790 nm)

The correct response is Option B.

Nonablative fractional lasers are commonly used for acne scar resurfacing in darker skin types. Nonablative lasers work by denaturation of dermal collagen with subsequent remodeling, without any vaporization or damage to the epidermis.

Erbium-doped fiber laser (1550 nm) is a nonablative laser while Erbium:YAG (2940 nm), carbon dioxide (10,600 nm), and Erbium:YSGG (2790 nm) are ablative lasers.

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158. A 42-year-old woman is scheduled for abdominoplasty, repair of diastasis recti abdominis, and incisional herniorrhaphy. At the start of the operation, 20 mL of 1% lidocaine with epinephrine 1:100,000 is injected into the lower abdominal incision. After incisional herniorrhaphy is completed, the general surgeon plans to inject liposomal bupivacaine into the lower abdominal hernia repair. Which of the following is the most appropriate recommendation regarding the injection of liposomal bupivacaine after lidocaine injection?

- A) Do not use liposomal bupivacaine after lidocaine is used
- B) Wait at least 20 minutes before injecting liposomal bupivacaine
- C) Wait at least 60 minutes before injecting liposomal bupivacaine
- D) Wait at least 90 minutes before injecting liposomal bupivacaine
- E) There are no restrictions

The correct response is Option B.

Wait at least 20 minutes before injecting liposomal bupivacaine. Liposomal bupivacaine (Exparel), is a long-acting (approximately 72 hours) local anesthetic that is an extended-release multivesicular liposomal version of bupivacaine. It has been shown that this drug can decrease the need for opiates in the postoperative period.

Nonbupivacaine anesthetics, including lidocaine, when mixed with liposomal bupivacaine may cause an immediate release of bupivacaine, potentially causing an overdose. For this reason, lidocaine and liposomal bupivacaine should not be mixed together. Administration of liposomal bupivacaine may follow the administration of lidocaine after a delay of 20 minutes or more. Administration of liposomal bupivacaine results in systemic plasma concentrations that can persist for 96 hours after local infiltration. That said, it is recommended that the use of local anesthetics be avoided within 96 hours following administration of liposomal bupivacaine. The other choices are incorrect because they do not conform to the recommendations and pharmacology of the involved medication.

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159. A 30-year-old woman presents to the clinic with difficulty breathing. Clinical examination shows a septal deviation with contralateral inferior turbinate hypertrophy. On application of topical nasal decongestant, there is no resolution of the inferior turbinate hypertrophy. In addition to surgical correction of the deviated septum, which of the following is the most appropriate treatment for the contralateral inferior turbinate hypertrophy?
- A) Complete inferior turbinectomy
 - B) Inferior turbinate outfracture
 - C) Submucosal resection
 - D) No additional correction is needed

The correct response is Option C.

Nasal septal deviations are commonly associated with nasal obstruction. Septal deviations can lead to compensatory hypertrophy of the contralateral inferior turbinate. It is important to differentiate between mucosal and bony hypertrophy. Mucosal hypertrophy typically responds well to topical nasal decongestant. This patient had no response with topical decongestant, signifying a primarily bony hypertrophy of the inferior turbinate.

While treating airway obstruction related to nasal septal deviations, it is important to address both the nasal septal deviation and the contralateral inferior turbinate hypertrophy, because straightening of the nasal septum will lead to narrowing of the airway if the contralateral inferior turbinate hypertrophy is not addressed.

The inferior turbinate has an important role in normal nasal physiology, and complete inferior turbinectomy is not advised since it leads to dryness, bleeding, mucosal crusting, ciliary dysfunction, chronic infection, malodorous nasal drainage, or atrophic rhinitis.

In patients with nasal airway obstruction secondary to bony hypertrophy of the inferior turbinate, submucosal resection is the more appropriate treatment.

In patients with primarily mucosal hypertrophy of the inferior turbinate, inferior turbinate outfracture is usually adequate.

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160. A 58-year-old woman plans to undergo Er:YAG laser resurfacing (2940 nm) to improve the appearance of perioral rhytides. The procedure targets which of the following?

- A) Collagen
- B) Elastin
- C) Hemoglobin
- D) Melanin
- E) Water

The correct response is Option E.

Use of nonsurgical skin rejuvenation has increased exponentially over the past 20 years, with over 4.6 million cases performed annually. This increase has led to expansion of different types of devices for resurfacing. The use of lasers for facial resurfacing has been discussed since the 1980s, initially with carbon dioxide lasers and then with erbium-doped yttrium aluminium garnet (Er:YAG) lasers in the late 1990s. Ablative laser treatments have been used to target actinic skin damage and moderate to heavy rhytides.

Lasers work by means of a wavelength of light being absorbed by specific targets (chromophores) in the tissue, causing thermal damage. The targeted chromophore absorbs energy, which is converted to heat. The Er:YAG laser has a wavelength of 2940 nm. The peak absorption of water is nearly 2900 nm, which means that an Er:YAG laser has an absorption 12- to 16-fold greater than carbon dioxide laser. Targeting hemoglobin would not be appropriate since this will not lead to rejuvenation of perioral rhytides. The treatment of melanin is not the correct target since this would only lead to hypopigmentation or absorb the laser wavelength and lead to a possible burn. Collagen and elastin are essential elements of maintaining a youthful dermis; these dermal proteins are not the target of lasers, but rather induced by the trauma occurring from the laser itself.

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161. A 45-year-old man presents 1 year after a "nose surgery" for a crooked nose and reports subjective nasal obstruction. He is diagnosed with empty nose syndrome. Overresection of which of the following structures is the most likely cause of this patient's condition?

- A) Inferior turbinates
- B) Lower lateral cartilage
- C) Middle turbinates
- D) Septal cartilage
- E) Upper lateral cartilage

The correct response is Option A.

Empty nose syndrome is characterized by a subjective sensation of nasal obstruction in the context of adequate nasal space. The differential diagnosis includes chronic rhinosinusitis, atrophic rhinitis, and autoimmune processes, and it can be diagnosed, in part, by alleviation of symptoms after the placement of a moist piece of cotton in the nose. Empty nose syndrome occurs in patients who have had turbinate surgery, and overresection of the inferior turbinates is the most common cause; some authors describe inferior turbinate resection as the "classic" cause. While middle turbinate resection can also be associated with empty nose syndrome, the middle turbinates are rarely resected during rhinoplasty. Instead, they are resected during endoscopic sinus surgery.

Resection of the upper lateral cartilage can be performed to correct middle vault deviation, and the upper lateral cartilage can be affected during dorsal hump reduction. The internal nasal valve is comprised of the nasal septum and the upper lateral cartilage; it does not contribute to empty nose syndrome. Resection of septal cartilage—both for septal cartilage graft harvest and to correct underlying septal pathology—can lead to complication, including hematoma, adhesions, structural deformity, and septal perforation, among others. It is not, however, associated with empty nose syndrome. Overresection of the lower lateral cartilage can lead to structural problems, such as inadequate tip support or alar ptosis. The lower lateral cartilage is not involved in empty nose syndrome.

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162. A 56-year-old woman presents with right breast swelling 10 years after undergoing bilateral mastectomy and reconstruction with bilateral submuscular textured implants with an acellular dermal matrix sling. Examination shows right-sided periprosthetic fluid collection. Breast implant-associated anaplastic large cell lymphoma is suspected. Analysis of the fluid will most likely show which of the following tumor markers?
- A) Anaplastic lymphoma kinase
 - B) CD3
 - C) CD5
 - D) CD30
 - E) Human germinal center-associated lymphoma (HGAL)

The correct response is Option D.

Breast implant-associated anaplastic large cell lymphoma (BIA-ALCL) has been associated primarily with textured implants. Thought to be related to chronic inflammation from subclinical infection, the presentation is typically with a late-onset seroma. Workup of a late-onset seroma includes aspiration of the seroma and cytological/immunohistochemical analysis. The predictive value is most significant on the initial aspiration because of the presumed larger concentration of malignant cells; as the seroma reforms, there is a hypothesized dilutional aspect.

BIA-ALCL neoplastic cells are strongly CD30-positive, but CD30 is a necessary but insufficient criterion to make the diagnosis since it can be displayed in nonmalignant situations as well (such as in viral infection).

While anaplastic lymphoma kinase (ALK) is associated with systemic ALCL in 60% of cases, it has not been associated with BIA-ALCL. Thus, while ALK assessment is considered necessary to the analysis, it is expected to be negative. BIA-ALCL neoplastic cells variably lose expression of CD3 and CD5. Compared with other forms of ALCL, BIA-ALCL is associated with a more indolent course, although a subset of patients do have an aggressive course. Human germinal center-associated lymphoma (HGAL) is associated with B-cell lymphoma.

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163. A 25-year-old man is concerned about the drooping tip of his nose. On physical examination, he has a dorsal hump, poor tip support, a drooping tip, excessive columella show, and a long caudal septum. Which of the following surgical maneuvers is best to correct this patient's nasal deformity?

- A) Caudal septal tongue-in-groove technique
- B) Columellar strut graft
- C) Lateral crura spanning sutures
- D) Medial foot plate excision
- E) Transdomal suture

The correct response is Option A.

To correct this patient's deformity, control of tip support, projection, and rotation is essential. A septal tongue-in-groove technique will provide more reliable control of the tip. This is similar to a tongue-in-groove septal extension graft; however, because this patient has adequate caudal septal length, the medial crura can be elevated and rotated onto the native caudal septum. If the septum has too much length, which is rare, the caudal septum can be shortened. The tradeoff in this technique is stiffness of the tip.

Columella strut is much less reliable and unnecessary because there is adequate septal length. Medial foot plate excision (removes prominent foot plates) will not correct a drooping tip. Transdomal sutures (narrow nasal tip) and lateral crura spanning sutures (straighten convex/concave lower lateral cartilages) will not correct this deformity.

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164. A 64-year-old woman undergoes a face and neck lift with SMAS plication and liposuction. Approximately 3 weeks after surgery, she continues to have decreased skin sensation at the angle of the mandible. Which of the following nerves was most likely injured during the procedure?

- A) Auriculotemporal nerve
- B) Buccal nerve
- C) Great auricular nerve
- D) Lesser petrosal nerve
- E) Marginal mandibular nerve

The correct response is Option C.

The great auricular nerve is a branch of the cervical plexus that provides cutaneous innervation to the skin of the ear and skin below the ear, including the angle of the mandible. The auriculotemporal nerve is a branch of the mandibular division of the trigeminal (V₃) nerve and provides sensory innervation to the skin of anterosuperior ear, part of the external auditory meatus, and the temporomandibular joint. The lesser petrosal nerve is not a sensory nerve; it is a branch of the glossopharyngeal (IX) nerve that carries preganglionic fibers to the otic ganglia. Finally, the buccal branches and marginal mandibular branches originate from the facial (VII) nerve and are also motor nerves only. The buccal branches of the facial (VII) nerve innervate the buccinator and the other muscles of facial expression above the lip. The marginal mandibular branch innervates the muscles of facial expression of the lower lip and chin.

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165. An 18-year-old woman with Fitzpatrick type IV skin presents for carbon dioxide laser treatment for hypertrophic scarring 1 year after sustaining facial burns. Two weeks after the first session, hypopigmentation is noted in the laser-treated areas. Which of the following adjustments to the laser setting is most likely to prevent further hypopigmentation from occurring after the next session?

- A) Decreasing the dwell time
- B) Decreasing the spot size
- C) Increasing the dwell time
- D) Increasing the energy
- E) Increasing the spot size

The correct response is Option A.

Patients classified as higher Fitzpatrick types have a higher risk for hypopigmentation after carbon dioxide laser therapy. For example, punctate hypopigmentation has been found in up to 35% of facial burn patients presenting 2 months after being treated with fractionated carbon dioxide laser therapy. To decrease the risk for further hypopigmentation, the dwell time needs to be decreased. Increasing the dwell time prolongs the time of exposure, increasing the risk for hypopigmentation. Increasing or decreasing the spot size only increases or decreases the surface area treated. Increasing the energy would also increase the risk for hypopigmentation.

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166. A 62-year-old married man presents for rhinoplasty with concerns for airway obstruction. He reports that he is generally unhappy with his nasal tip and that the appearance interferes with his work relationships. Which of the following patient characteristics is the strongest indicator for body dysmorphic disorder?

- A) Age
- B) Concerns of airway obstruction
- C) Marital status
- D) Report that nose affects his work relationships
- E) Unhappiness with nasal tip

The correct response is Option D.

Surgeons should avoid patients who are described as "SIMON," single, immature, male, overly expectant, and narcissistic. Male patients can have more difficulty describing their specific concerns with the aesthetic appearance of their noses, and it can be very challenging to meet expectations. They may also disguise their true motives involving rhinoplasty.

The correct answer is the patient's report that his nose affects his work relationships. People with body dysmorphic disorder (BDD) will place a very large emphasis on the physical area that they are focused on and believe that changing the area will improve their relationships.

Concerns of airway obstruction are incorrect because male patients may disguise their true motives for seeking a rhinoplasty; this is a valid concern and can be investigated during the clinical examination.

This patient is married, which is not known to be risk factor for male rhinoplasty patients and BDD.

His age is not a known risk factor for male rhinoplasty patients and BDD.

Having a complaint about a specific part of the nose is not a known risk factor for BDD.

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167. A patient reports diplopia 6 weeks after transconjunctival lower blepharoplasty. The best way to isolate the function of the muscle that is most likely injured is to have the patient move the eye in which of the following directions?

- A) Inferior only
- B) Lateral and inferior
- C) Lateral and superior
- D) Medial and inferior
- E) Medial and superior

The correct response is Option E.

The inferior oblique muscle is the most commonly injured muscle during lower blepharoplasty.

The extraocular muscles include the lateral rectus, medial rectus, superior rectus, inferior rectus, superior oblique, and inferior oblique. Vertical movements require coordination between the superior and inferior rectus muscles as well as the oblique muscles. The contribution of each muscle group depends on the horizontal position of the eye.

When the eye is adducted, the oblique muscles are the primary vertical movers. The inferior oblique muscle causes elevation, and the superior oblique muscle causes depression.

When the eye is abducted, the rectus muscles are the primary vertical movers. Elevation is due to the superior rectus, and depression is due to the inferior rectus.

When the eye is looking straight, both of these groups contribute to the vertical movements.

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168. A healthy 34-year-old woman presents to the emergency department for evaluation of a small, open wound of the right breast after an augmentation mastopexy that was performed 4 weeks ago in the Dominican Republic. The wound has not improved with local wound care and empiric treatment with oral antibiotics. She reports no fevers, chills, or malaise. Physical examination shows a 1-cm opening along the vertical incision below the nipple-areola complex with scant serous drainage noted. Which of the following is the most appropriate next step in treatment to address this patient's findings?
- A) Change the local wound care and oral antibiotic regimen
 - B) Debride the wound and remove the implant in the operating room
 - C) Excise and close the wound at bedside
 - D) Order an ultrasound-guided percutaneous drain placement
 - E) Start a course of intravenous antibiotics

The correct response is Option B.

Given this patient's history of travel to Latin America for surgery, the diagnosis of an atypical mycobacterial infection, such as *Mycobacterium abscessus*, should be strongly considered. As such, the most appropriate treatment should include operative washout and debridement with removal of the infected prosthesis. Tissue should be sent for acid-fast staining, mycobacterial culture, and pathology.

More conservative treatment of this wound with continued local wound care or attempt at bedside closure will likely delay definitive diagnosis and treatment and lead to treatment failure. Intravenous antibiotics alone are not sufficient to treat an open wound with underlying implant involvement due to an atypical mycobacterial infection. Fluid collection is not suspected so ultrasound-guided drain placement is unnecessary.

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169. The decrease in fine wrinkling during the first 6 months of retinoid use is most likely a result of which of the following mechanisms of action?

- A) Decreased compaction of the epidermal stratum corneum
- B) Decreased glycosaminoglycans on both the epidermis and dermis
- C) Increased collagen deposition in the dermis
- D) Thickening of the epidermal granular layer

Upon further review, this item was not scored as part of the examination.

The correct response is Option D.

Topical retinoids have been shown to have positive effects both in the epidermis and the dermis. Early effects include compaction of stratum corneum and thickening of the granular layer, which decreases the appearance of fine wrinkling. This compaction of the stratum corneum and thickening of the granular layer has been shown to improve the effectiveness with more uniform frosting as well as helping to prevent scarring in procedures like dermabrasion. Continued use of retinoids initiates increased collagen deposition in the dermis and increased glycosaminoglycans in both the epidermis and dermis.

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170. A 68-year-old woman with a history of breast cancer and cataracts who underwent lumpectomy and radiation 9 months ago presents with a nonhealing breast incision requiring drain placement. Results of a recent skin and breast biopsy were benign. She is currently treated with tamoxifen and doxorubicin. Which of the following is a CONTRAINDICATION for hyperbaric oxygen treatment in this patient?
- A) Cataracts
 - B) Doxorubicin
 - C) Surgical site drain
 - D) Tamoxifen
 - E) Tympanostomy tubes

The correct response is Option B.

The patient presents with delayed wound healing complicated by a history of radiation therapy. Radiation soft-tissue necrosis and osteoradionecrosis can develop 6 months after radiation treatment or later. Radiated tissue is noted for being hypocellular, hypovascular, and hypoxic. Progressive fibrosis and capillary loss are almost linear over time. Normally, the O₂ gradient across a wound is large across a short distance. However, radiated tissue often has a PO₂ of 5 to 10 mmHg. In addition, a PO₂ of less than 40 mmHg inhibits collagen synthesis.

Doxorubicin is a contraindication to hyperbaric oxygen treatment (HBOT) because it can increase the risk for doxorubicin-mediated cardiotoxicity, and it should be stopped at least 24 hours prior to treatment.

Tamoxifen is not a contraindication since it does not increase the risks of HBOT

Tympanostomy tubes are a treatment for eustachian tube dysfunction, which can occur during HBOT, and therefore they are not a contraindication.

Cataracts will increase during HBOT but are not a contraindication.

Surgical site drains would need to be left open during treatment but are not a contraindication.

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171. According to the Malignant Hyperthermia Association of the United States guidelines, which of the following intravenous agents should be avoided during the acute resuscitation phase of malignant hyperthermia, following dantrolene administration, when treating subsequent cardiac dysrhythmias?

- A) Dextrose 50% solution
- B) Epinephrine
- C) Lidocaine
- D) Metoprolol
- E) Verapamil

The correct response is Option E.

Malignant hyperthermia (MH) is a disturbance of calcium channel homeostasis, causing unregulated calcium release from sarcoplasmic reticulum. The coadministration of dantrolene used during resuscitation and an intravenous calcium channel blocker is contraindicated, since both verapamil and diltiazem have been associated with life-threatening hyperkalemia in this setting. The other agents listed (metoprolol, lidocaine, epinephrine, and dextrose 50%) may be used as needed during advanced cardiovascular life support protocols or for the treatment of hyperkalemia. MH is a pharmacogenetic disorder triggered in genetically susceptible individuals by volatile anesthetic gases and succinylcholine. It has autosomal dominant inheritance. Dantrolene is the only treatment for a MH crisis, and a newer formulation has faster administration than traditional preparations. The resuscitation poster for MH should be in every operating room facility and is mandated by the American Association for Accreditation of Ambulatory Surgical Facilities (AAAASF) standards. Their phone number is 1-800-MH-HYPER.

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172. A 65-year-old man presents for initial consultation for rhytidectomy. BMI is 32 kg/m². Blood pressure is 145/85 mmHg, and hemoglobin A_{1c} concentration is 6.4%. Rhytidectomy with neck lift under local anesthesia and sedation is planned. Which of the following treatments would most likely minimize the risk for hematoma?

- A) Clonidine
- B) Hypotensive anesthesia
- C) Lidocaine with epinephrine
- D) Metformin
- E) Self-suction drain

The correct response is Option A.

Perioperative hypertension is the single most important modifiable risk factor for preventing postoperative hematoma in rhytidectomy. Postoperative systolic blood pressure greater than 140 mmHg is strongly correlated with increased risk for hematoma. Clonidine is a long-acting α_2 -adrenergic agonist used to decrease postoperative hypertension. This strategy has been shown to decrease hematoma rates. The usual dose is clonidine 0.1 to 0.3 mg orally 1 hour before surgery or a transdermal patch with 0.1 to 0.2 mg. The lower doses are usually given to women.

Metformin is used for diabetic control and not associated with hematoma risk. Self-suction drains can minimize the seroma rate but not the hematoma rate. Lidocaine with epinephrine and hypotensive anesthesia can both decrease intraoperative bleeding; however, they may add to the risks for hematoma after their effects have worn off.

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173. A 52-year-old woman with a 15-year history of subglandular breast implants presents with concerns about obtaining her first mammogram. She states that she has avoided mammography because she is concerned about implant rupture from the procedure. Which of the following is the most appropriate next step?

- A) Diagnostic mammography with Eklund views
- B) Diagnostic mammography with Waters views
- C) MRI with contrast
- D) Screening mammography with Eklund views
- E) Screening mammography with Waters views

The correct response is Option D.

The correct answer is screening mammography with Eklund views. Some women report that they are hesitant to undergo screening mammography because they are afraid of an implant rupture. A study of breast implant complications reported to the Food and Drug Administration (FDA) demonstrated that of 714 breast implant adverse events reported, 66 described rupture or problems directly associated with mammography. In addition to implant rupture, an oncologic concern is inadequate x-ray views for assessment of the breast tissue.

Eklund described a modified position for mammography in which the breast tissue is displaced in front of the implant. This allows for adequate assessment of the breast tissue. Screening mammography is appropriate for routine mammography; diagnostic mammography is used to further characterize mammographic concerns or in the case of known pathology.

While MRI is used to detect silicone implant rupture and as an adjunct in oncological screening, it is not currently recommended as a routine primary screening tool.

It should be noted that the presence of breast implants should not be used to justify deferral of recommended oncologic screening, and the true incidence of breast implant rupture caused by mammography is difficult to assess given the different generations of implants and the possible presence of capsular contracture.

Waters views are used to assess the maxillary sinuses.

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174. Which of the following surgical site preparation products is most likely to cause significant eye injury and should be avoided for use in or around the eye?

- A) 3% Chloroxylonol
- B) 4% Chlorhexidine
- C) 5% Povidone-iodine
- D) Unscented baby shampoo with sterile water rinse

The correct response is Option B.

Chlorhexidine is a known ocular irritant at 4% strength and can cause severe corneal damage and corneal toxicity, especially if inadvertently left to dwell in the eye during a procedure. Thus, products like hexachlorophene and chlorhexidine gluconate should be avoided in and around the eye. Dilute chlorhexidine at 0.04% can be safely used as an eye treatment and is clinically prescribed for *acanthamoeba* keratitis, associated with contact lens use.

5% Povidone-iodine is available in a sterile ophthalmic variety and is used for ophthalmic procedures. 10% Povidone-iodine may also be used around the cheeks, brows, and eyelids. Unscented baby shampoo with a sterile rinse can be used for those with povidone-iodine allergies. While chloroxylonol is a mild eye irritant, it can be used with care around the eye.

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175. According to the World Professional Association for Transgender Health Standards of Care guidelines, which of the following gender confirmation procedures requires two formal referral letters from mental health professionals before planning the surgical procedure?

- A) Mastectomy
- B) Pectoral implant surgery
- C) Rhinoplasty
- D) Testicular prosthesis implantation
- E) Thyroid cartilage grafting

The correct response is Option D.

Transgender is a term used to describe a person whose gender identity differs from the sex that they were assigned at birth. For those with gender dysphoria, they may transition to their identified gender through a variety of medical and surgical approaches. To alleviate gender dysphoria, a multidisciplinary treatment plan is necessary. This includes social, psychological, medical, and surgical approaches. The mental health professional is critical in the evaluation and treatment of individuals with gender dysphoria. The World Professional Association for Transgender Health Standards of Care guidelines recommend two formal referral letters from mental health professionals before genital surgical treatment. Chest surgery requires one formal referral letter. However, facial surgeries do not require referral letters.

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176. A 38-year-old man has the ear deformity shown in the photograph. He would like to know if there is a name for the appearance of his ear. On the basis of the image, which of the following is the most likely diagnosis?

- A) Constricted ear
- B) Cryptotia
- C) Microtia
- D) Prominent ear
- E) Stahl ear

The correct response is Option A.

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Constricted ear deformities have a varying degree of hypoplasia of the superior third of the auricle. This patient has a mild form of a constricted ear deformity with presentation of a lop ear. Emblematic for a lop ear is the "folding" of the helical rim. In more severe cases, the antihelical fold can efface and the patient can present with a cup ear deformity. In an infant, ear molding is the treatment of choice. If the patient presents later in life, and in instances where the vertical height is near normal, excision of the folded aspect of the helix may suffice. If there is considerable lack of vertical height, the folded cartilage can be used as a flap to increase the auricular height. A variety of cartilaginous and loco-regional flap combinations have been described for this indication. The most well-known is the Banner flap.

A Stahl ear is characterized by an additional prominent fold in the scaphoid fossa, which results in an everted helical fold and pointed appearance of the ear. Like a constricted ear, this can be addressed with ear molding or with surgical correction later in life.

Prominent ears are defined as having an increased auriculocephalic angle (>25 degrees) and distance (>2 cm). This is measured between the mastoid and the posterior concha. Contributing factors can be an increased conchoscaphal angle (usually <90 degrees) due to inadequate development of the antihelical fold or an increased conchal depth (>1.5 cm). Surgery addresses one or both of those issues by excision of conchal cartilage and/or conchoscaphal sutures (Mustardé sutures).

Cryptotia is defined by the superior helical cartilage being buried underneath the temporal skin. On clinical examination, the ability to recreate a normal ear appearance with digital manipulation is the defining feature. In patients who did not have access to ear molding, a variety of techniques using locoregional flaps have been described to externalize the buried segment.

Microtia exists on a spectrum and involves absence of some or all structures of the ear (anotia). Molding is therefore not an option, and reconstructive procedures including use of autologous and synthetic material are indicated. This patient is suffering from a deformity and not an absence of auricular tissue.

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177. A patient who underwent cryolipolysis develops paradoxical adipose hyperplasia (PAH). Which of the following is the minimum amount of time that should pass after the procedure before surgically treating the PAH?

- A) 1 Month
- B) 3 Months
- C) 6 Months
- D) 1 Year
- E) 2 Years

The correct response is Option C.

Paradoxical adipose hyperplasia is a rare complication of cryolipolysis that may occur more frequently than in the manufacturer's reported data. Treatment is best delayed until the affected area has softened, which normally occurs in 6 to 9 months after the initial cryolipolysis procedure. Power-assisted liposuction is the preferred method of treatment, but in some cases, abdominoplasty may be necessary. Secondary treatments might be needed for recurrence or persistent bulge.

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178. A 67-year-old woman presents 6 months after right lower eyelid basal cell carcinoma excision reconstruction with wedge excision and closure. She reports epiphora. On examination, her scar is immature but healed, and she has an ectropion of the right lower eyelid. Displacement of the punctum in which of the following directions is the most likely cause of epiphora in this patient?

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

The correct response is Option A.

The correct answer is anterior displacement of the punctum. The lacrimal drainage system is divided into proximal and distal segments; the proximal segment consists of the punctum, canaliculus, and common canaliculus. The lower external punctum is 6.5 mm from the medial canthus, 0.3 mm in size, and dorsally directed. This dorsal positioning allows it to drain tears effectively. The upper punctum is 6 mm from the medial canthus, so the puncta are not in apposition when the eyelids are closed. When the eyelids are open, the ampulla is dilated, and when the eyelids close, tears are pushed through to the common canaliculus.

A postoperative ectropion, common after lower lid surgery, will cause the punctum to be anteriorly displaced, thus limiting its ability to drain tears effectively. Medial or lateral displacement do not, in general, cause epiphora. While excessive posterior displacement could theoretically also cause dysfunction of drainage, the ectropion makes this unlikely.

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179. Which of the following is a CONTRAINDICATION to the use of finasteride as a treatment for premenopausal women with hair loss?

- A) Amenorrhea
- B) Galactorrhea
- C) Hirsutism
- D) Masculinization of facial features
- E) Pregnancy

The correct response is Option E.

Although FDA-approved for male-pattern hair loss, finasteride is not approved by the FDA for use in women. It is classified as Pregnancy Category X (highest risk) and should not be taken or handled by pregnant women, women who may become pregnant, or those who are breast-feeding. Finasteride has been linked to abnormalities of the external genitalia of a male fetus of a pregnant woman who receives finasteride.

The other choices are not common problems with finasteride, although breast tenderness has been reported.

European studies have selectively used the drug in women for cases of hair loss associated with hyperandrogenism.

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180. An 18-year-old fair-skinned woman presents with a pigmented lesion on her abdominal wall. She reports no symptoms. On examination, a 2-mm lesion appears as a brown-colored protuberance along the milk lines. Which of the following is the embryologic basis for this condition?

- A) Anhidrotic ectodermal dysplasia
- B) Arrested mammary ridge development
- C) Failure of regression of mammary ridges
- D) Hypertrophy of glandular tissue
- E) Hypoplasia of ectodermal ductal system

The correct response is Option C.

Supernumerary nipples (polythelia) occur in 2 to 5% of humans in a position from the groin to the axilla. During the fourth week of embryo development, normally a pair of epidermal thickenings called the mammary ridges develop along the milk lines on either side of the body. These supernumerary nipples can appear similar to pigmented macules or fully developed nipple-areola complexes. These are rarely functioning but can occasionally be a cosmetic issue. Hypertrophy of glandular tissue is macromastia. Arrested mammary ridge development is found during polymastia. Anhidrotic ectodermal dysplasia can be seen in amastia. There is no hypoplasia of ectodermal ductal system in breast development.

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181. A 32-year-old man wants both cosmetic and functional improvement of his nose. He is scheduled for open rhinoplasty, submucous resection of the septum, spreader grafts, and submucous reduction of the inferior turbinates. Which of the following can be mixed with the local anesthesia to best decrease intraoperative bleeding during the rhinoplasty?

- A) Aprotinin
- B) Hyaluronic acid
- C) Ketorolac
- D) Tissue plasminogen activator
- E) Tranexamic acid

The correct response is Option E.

Tranexamic acid inhibits fibrinolysis, which strengthens clots and decreases bleeding. Tranexamic acid has been shown to decrease bleeding in many plastic surgical procedures including rhinoplasty, rhytidectomy, liposuction, reduction mammoplasty, and abdominoplasty, as well as others. The method of giving tranexamic acid includes intravenous, oral, topical, and local infiltration. Studies have failed to show an increased risk for thromboembolic events. The therapeutic results last for at least 17 hours. When mixed with local anesthesia, the most common doses are 1 to 2 mg/mL. Use of tranexamic acid in plastic surgery is increasingly popular but is presently off-label.

Aprotinin also prohibits fibrinolysis; however, this drug was removed from the market in the United States because of increased mortality associated with its use. Tissue plasminogen activator activates the conversion of plasminogen to plasmin, which dissolves clots and can increase bleeding. Ketorolac is a nonsteroidal anti-inflammatory drug and inhibits platelet function. Hyaluronic acid has not been shown to decrease bleeding.

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182. A patient who is immediately postoperative forehead feminization as well as transconjunctival lower blepharoplasty complains of pain in the right eye and photophobia. On examination, she has marked swelling of both upper eyelids and increased epiphora and chemosis on the right. Which of the following is the most appropriate next step in management?

- A) Administer topical anesthetic eye drops
- B) Increase intravenous pain medication and serial examinations
- C) Perform emergent bedside canthotomy and cantholysis
- D) Perform emergent bedside canthotomy only
- E) Return to the operating room for examination under anesthesia

The correct response is Option A.

The most likely diagnosis in this patient is a corneal abrasion. The cornea is highly innervated (300 to 400 times greater than skin) and any abrasion is associated with marked pain and epiphora. Topical anesthetic eye drops, such as proparacaine hydrochloride or tetracaine hydrochloride, can both treat the pain and be diagnostic. In the setting of a corneal abrasion, the patient would get relief within minutes after application and a formal ocular examination would then be possible. Treatment for a corneal abrasion would include symptom control with topical anesthetics as needed and prophylactic topical antibiotics. Eye patches should be avoided since they can decrease oxygenation of the cornea. Similarly, contact lenses should be omitted until the cornea is fully healed. The cause of corneal abrasions is any mechanical injury during induction, preparation, surgery, and emergence. Particular care should be taken by all team members during the entire surgery and up until the moment when the patient is coordinated enough to touch their face. A time that is particularly dangerous is the cleaning of the face at the end of surgery.

Camouflaging an acute pain episode with narcotics, without establishing and treating the root cause, is not sound medical care and can lead to a missed diagnosis with associated harm.

A return to the operating room, as a first step in management, is not indicated in this clinical scenario. If possible, an ophthalmological examination is best performed with an awake patient.

Both forehead feminization and lower blepharoplasty can lead to a retrobulbar hematoma, which may present similar to a corneal abrasion. Physical examination can distinguish between the two entities since a retrobulbar hematoma would present with proptosis. However, a canthotomy involves only the release of the lateral canthus without severance of the lateral canthal tendon that is found more posterior. This incision would inadequately treat a retrobulbar hematoma.

If topical anesthetic eye drops do not have an effect, then further escalation of care is warranted. If an acute retrobulbar hematoma is suspected, a canthotomy and cantholysis can be indicated. This is a procedure that can be done at bedside should the patient be unable to immediately return to the operating room. It is important that this is done properly and that the lateral canthal tendon is entirely released so that the retrobulbar pressure is released.

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183. A 25-year-old woman who is planning dual-plane breast augmentation with 325-mL smooth round silicone gel implants for aesthetic improvement of micromastia seeks guidance on implant surveillance. She expects to pay out-of-pocket for follow-up. Based on FDA guidelines, which of the following is the most appropriate recommendation for asymptomatic postoperative screening for this patient?

- A) High-resolution ultrasonography at 3 years
- B) High-resolution ultrasonography at 5 years
- C) Noncontrast MRI at 3 years
- D) Noncontrast MRI at 5 years
- E) Yearly clinical examination only

Upon further review, this item was not scored as part of the examination.

The correct response is Option B.

The most recent FDA recommendations for silicone implant surveillance include screening for asymptomatic leak with high-resolution ultrasonography or MRI, beginning at 5 years postoperatively. Given the patient's personal financial commitment, ultrasonography would likely be less expensive. Clinical examination alone would be unlikely to detect asymptomatic leak, or "silent rupture." Ultrasonography at 3 years is earlier than current FDA recommendations. Previous FDA recommendations included the use of noncontrast MRI to begin 3 years postoperatively, but the FDA has changed those recommendations as specified above.

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184. A 32-year-old woman presents with symptomatic macromastia. Family history includes premenopausal breast cancer in her aunt. The patient is scheduled for bilateral reduction mammoplasty (using an inferior pedicle with wise pattern skin incision), and consent is obtained. During the procedure, a 3 × 3-cm area of suspicious tissue on the left upper outer quadrant is noted. Frozen section study confirms a 5-mm ductal carcinoma with free margins. Which of the following is the most appropriate next step in management of this patient?
- A) Completion of reduction mammoplasty bilaterally, along with immediate left axillary sentinel node study
 - B) Completion of reduction mammoplasty bilaterally, along with routine orientation of the specimens, marking the cancer site with sutures and surgical metal clips
 - C) Completion of reduction mammoplasty bilaterally, followed by scheduling the patient for immediate adjuvant chemoradiotherapy
 - D) Completion of reduction mammoplasty bilaterally with excision of 3-cm extra margins of the cancer site
 - E) Completion of reduction mammoplasty on the right side, followed by left-sided mastectomy

The correct response is Option B.

The incidence of occult breast cancer detected by reduction mammoplasty is 0.06 to 5.45%. Management of the occult breast cancer depends on the history of breast cancer, surgical margin, and family history. Preoperative thorough history, clinical examination, and counseling regarding the risk for and implications of finding occult breast cancer are necessary. All women aged 35 years and older with positive family history or personal history of breast cancer should have a screening mammogram before surgery; if there is no family history, women aged 40 years and older should have a screening mammogram before surgery. Routine orientation of the specimens for pathologic analysis and en bloc resection should be performed in patients aged 30 years and older and in any patients with a personal or family history of breast cancer. Although mastectomy is the most common procedure performed after an incidental finding of occult breast cancer during reduction mammoplasty, multidisciplinary evaluation and tests are necessary before performing any surgical procedures (mastectomy, sentinel node study) or any plan for chemotherapy, hormone therapy, or radiation therapy. Also, lack of consent for other surgical procedures would prohibit the surgeon from adding another procedure at the time of breast reconstruction. Excision of the 3-cm extra margins is not the standard of care for 5-mm invasive breast cancer.

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185. A 48-year-old woman interested in mastopexy presents with C-cup breasts, grade 3 ptosis, striae of the breast skin bilaterally, 5-mm upper pole pinch thickness, and 7-cm diameter areolae. Which of the following is the strongest CONTRAINDICATION to a circumareolar-only approach to mastopexy?

- A) Breast skin striae
- B) C-cup breast size
- C) Grade 3 ptosis
- D) 5-mm upper pole pinch
- E) 7-cm diameter areolae

The correct response is Option C.

Circumareolar-only approaches to mastopexy are unlikely to be successful with severe ptosis (such as in this patient with grade 3 ptosis) and are usually recommended for patients with only mild-to-moderate ptosis. Moderate breast size (C cup) would not likely impact the success of this surgical approach. The striae are also unlikely to specifically impact a circumareolar approach but may indicate poor skin quality predisposed to recurrence of ptosis corrected with a variety of surgical techniques. The thin upper pole pinch (5 mm) would more likely impact implant-based decision-making. Wide areolae (7 cm) are suitable for circumareolar surgical techniques.

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186. A 49-year-old woman who underwent first-stage left breast reconstruction with a tissue expander presents for follow-up to discuss expander to implant exchange. The reconstructed side has more volume and superior fullness compared with the native breast, and the patient prefers the reconstructed side. A photograph is shown. In addition to implant exchange, which of the following would most likely give the patient the greatest satisfaction regarding the appearance of her breasts?

- A) Left breast fat grafting
- B) Left breast flap reconstruction
- C) Right breast implant augmentation
- D) Right breast mastopexy
- E) No additional procedures



The correct response is Option C.

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The patient shown in the initial photograph complains of lack of symmetry between the reconstructed breast and the native, contralateral side. The volume and superior fullness in the reconstructed breast are a result of an implant-based reconstruction. Studies have shown improved patient satisfaction with breast reconstruction when contralateral augmentation is performed for symmetry. For this patient who was happy with an implant-based reconstruction, symmetry was best achieved with a contralateral breast augmentation. In the additional image shown, she is pictured after tissue expander to implant exchange, nipple-areola complex reconstruction, and right breast augmentation. The other choices are less ideal and would not necessarily give the patient the symmetry or satisfaction she desires.

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187. A 26-year-old man with history of lipodystrophy of the abdomen and flanks undergoes suction-assisted lipectomy under general anesthesia. The surgeon anticipates 3 L of lipoaspirate. In the superwet technique, which of the following is the most appropriate amount of fluid for the patient to receive in the form of subcutaneous tissue infiltration?

- A) 0 mL
- B) 900 mL
- C) 1500 mL
- D) 3000 mL
- E) 6000 mL

The correct response is Option D.

Originally, liposuction was performed without wetting solutions. However, this technique was associated with reported estimated blood loss of up to 45% of aspirate. Infiltrating wetting solutions with a base of normal saline or Ringer's lactate with additives (epinephrine and lidocaine) prior to suctioning improves hemostasis and pain control. The current options for wetting solutions are dry, wet, superwet, and tumescent. The dry technique is rarely employed, and no wetting solution is infused. The wet technique employs injecting a standard 200 to 300 mL per anatomic area to be treated, irrespective of the anticipated lipoaspirate. The superwet technique is predicated on a 1:1 ratio of instilling 1 mL of solution per 1 mL of aspirate. True tumescent infiltration involves infiltration at a ratio of 2:1 to 3:1 of wetting solution per mL of expected lipoaspirate.

0 mL is used for a dry technique. 900 mL is used for a wet technique. 1500 mL does not fall into any category. 6000 mL is used in a tumescent technique.

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188. A 33-year-old woman presents to the office for a consultation for liposuction and is interested in the laser-assisted technique. Compared with suction-assisted lipectomy, which of the following is more likely to occur with laser-assisted suction lipectomy?

- A) Better aesthetic result
- B) Greater number of intact adipocytes
- C) Higher blood loss
- D) Higher complication rate
- E) Improved abdominal skin retraction

Upon further review, this item was not scored as part of the examination.

The correct response is Option D.

The challenges with assessing the benefits and risks of laser-assisted liposuction (LAL) are the poor study design and bias of most of the peer-reviewed literature. Some studies have suggested that LAL is associated with lower levels of hemoglobin in the aspirate. Studies suggested improved skin retraction, though again, in general the designs of the studies have been poor or included limited numbers of patients. An analysis by Prado demonstrated that 90% of adipocytes were destroyed by LAL as opposed to 90% intact following traditional liposuction. For the most part, reviews of the literature suggest LAL offers no benefit over traditional suction-assisted liposuction.

Of the choices listed, the most consistent theme in the published literature is the increased complication rates associated with LAL.

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189. Breast cancer cells can spread directly to the cranial cavity and brain via the vertebral venous plexus (Batson plexus). Through which of the following veins is it possible for these cells to reach this plexus?

- A) Axillary
- B) Azygos
- C) Brachiocephalic
- D) Intercostal
- E) Internal thoracic

The correct response is Option D.

Hematogenous spread through the intercostal veins is the most likely way for breast cancer to reach the internal vertebral venous plexus. Although 75% of the lymph from the breast drains to the axillary nodes with most of the remaining lymph draining to the parasternal nodes, these lymphatic channels are not the most likely way to transmit cancer to the internal vertebral venous plexus. This plexus of veins would be most likely to receive cancer cells transmitted through the blood. The internal thoracic vein drains blood from the breast in the opposite direction of the vertebral column. The thoracoacromial artery supplies blood to the breast, as opposed to draining the breast, and therefore would not provide a route for spreading cancer.

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190. A 51-year-old woman presents for breast reconstruction. She was recently diagnosed with left-sided breast implant-associated anaplastic large cell lymphoma (BIA-ALCL). She has bilateral submuscular textured implants that were placed 8 years ago. The patient would also like to have the contralateral implant removed during the left-sided surgery. Which of the following best describes the chance of finding BIA-ALCL pathology in this patient's contralateral breast?
- A) 1.6%
 - B) 4.6%
 - C) 7.6%
 - D) 10.6%
 - E) 13.6%

The correct response is Option B.

The risk for breast implant-associated anaplastic large cell lymphoma (BIA-ALCL) has been estimated to be between 1:1000 and 1:30,000 women with textured breast implants. Management consists of removal of the implant, complete surgical excision of the surrounding implant capsule, and excision of any suspicious lymph nodes. According to National Comprehensive Cancer Network guidelines, removal of the contralateral implant can be considered because in 4.6% of reported cases, the pathology disclosed BIA-ALCL in the contralateral breast.

Once full diagnostic workup and staging are performed, the options for reconstruction need to be discussed with the patient. A patient with resectable disease, stage IA to stage IC, can be offered resection and immediate reconstruction with either a smooth implant or autologous reconstruction, or the patient can choose to have resection followed by repeat imaging in 3 to 6 months and delayed reconstruction.

Stage IA is T1 N0 M0 disease confined to effusion or a layer on the luminal side of the capsule with no lymph node involvement and no distant spread.

Stage IC is T3 N0 M0 cell aggregates or sheets infiltrating the capsule, no lymph node involvement, and no distant spread.

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In advanced disease, stages IIA to IV, surgical resection and chemotherapy followed by repeat positron emission tomography CT scan in 6 to 12 months is recommended. If the patient has no signs of metastatic activity, then delayed reconstruction with either a smooth implant or autologous reconstruction are both options.

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191. A healthy 14-year-old girl presents to the office for evaluation of her breasts. Physical examination shows a superiorly positioned nipple-areola complex with absent breast tissue on the right side and otherwise normal breast development on the left. She wears a B-cup brassiere but uses a brassiere insert on the right. Her mother states that this asymmetry causes the patient significant emotional distress, and they would like to discuss surgical options. Which of the following mammoplasty techniques is most appropriate to address this patient's right breast findings?
- A) Deep inferior epigastric perforator flap
 - B) Latissimus dorsi myocutaneous flap
 - C) Saline implant augmentation
 - D) Structural fat grafting
 - E) Tissue expander placement

The correct response is Option E.

This young, healthy, adolescent girl has amastia of the right breast. Absence of breast tissue along with a superiorly malpositioned nipple-areola complex strongly indicates that tissue expansion may be required prior to formal reconstruction with either an implant or autologous tissue. Since the left breast tissue is still developing, a first-stage right breast tissue expander allows for expansion of the breast pocket, adjustment of breast size as the patient grows, and eventual implant or autologous tissue reconstruction tailored to her body habitus and desires once she reaches maturity.

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192. A 52-year-old woman presents with deepening of the nasolabial and nasojugal folds along with loss of volume of the midface. She is interested in facial fillers to enhance volume in these areas. A hyaluronic acid filler with a higher elastic modulus (G') value is most appropriate for this patient because which of the following is increased?

- A) Injection viscosity
- B) Longevity value
- C) Product stiffness
- D) Swelling factor
- E) Tissue dispersion

The correct response is Option C.

G' (elastic modulus) represents the ability of a hyaluronic acid filler to resist forces of deformation and return to its original shape. The higher the G' value, the stiffer the product and the greater the tissue support that the product is intended to provide. A gel's ability to expand as it binds water is its swelling factor and is a measure of its hydration.

Swelling factor is usually inversely related to G' , so swelling factor is incorrect. Tissue dispersion is incorrect since a more elastic or stiffer gel (higher G') will be less likely to spread throughout the tissue when injected. Viscosity, or viscous modulus (G''), is a measure of a gel's ability to dissipate energy when shear force is applied to it. Neither viscosity nor longevity are represented as G' , thus making these choices also incorrect.

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193. A 28-year-old woman undergoes a septorhinoplasty. Fracture of the septal L-strut will most likely result in which of the following complications?

- A) Bossa formation
- B) Open roof deformity
- C) Pollybeak deformity
- D) Rocker deformity
- E) Saddle-nose deformity

The correct response is Option E.

The keystone area of the nose is the junction of the cartilaginous and bony dorsum where the paired upper lateral cartilages, septal cartilage, bony septum, and paired nasal bones meet. Much like the keystone in an archway, if this area is damaged, the archway collapses. In the case of the nose, a fracture of the septal cartilage and the bony cartilage can result in instability and collapse of the septal cartilage and middle third of the nose into the pyriform, resulting in the saddle-nose deformity. When performing a septoplasty, preservation of a 1-cm caudal × 1-cm dorsal L-strut is recommended to preserve structural integrity. Regardless of the size of the L-strut, an unrecognized intraoperative fracture can result in a saddle-nose deformity.

Bossa are knob-like projections of alar cartilage irregularities through the skin. These can form as a result of overaggressive suturing, resulting in buckling or flexing of the cartilage, cutting of the cartilages, or scar tissue contraction of the cartilages.

An open roof deformity can be seen after a dorsal hump reduction. This is the result of seeing the separation between the sidewalls of the nose and the septum through the nasal skin as the skin falls unsupported into the grooves. This deformity can be corrected either by narrowing the separation by infracture of the nasal bones or by filling the defect with spreader grafts.

A pollybeak deformity is fullness in the supratip region of the nose. This can appear as a result of ptosis of the tip in relationship to distal dorsal septum, resection of the distal dorsal septum, or scar formation in the supratip region.

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A rocker deformity can occur after nasal osteotomies that go into the thicker bones above the level of the canthus and into the nasofrontal region. When the distal nasal bone is infractured medially, the superior portion of the segment moves (rocks out) laterally.

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194. A 31-year-old man who recently had a 100-lb (45.4-kg) weight loss presents with a 5-year history of bilateral gynecomastia. Results of endocrine workup are negative, and testicular ultrasonography shows no abnormalities. He does not take any hormones. Physical examination shows an estimated 300 g of primarily glandular tissue and marked skin redundancy. Which of the following is the best treatment for the degree of gynecomastia in this patient?

- A) Direct gland and skin excision with liposuction
- B) Direct gland and skin excision with nipple transposition
- C) Direct gland excision and cryolipolysis
- D) Liposuction and direct gland excision only
- E) Liposuction and nipple transposition

The correct response is Option B.

This patient has class IIAii gynecomastia per the McMaster classification of gynecomastia. To treat this degree of gynecomastia, in which there is 250 to 500 g of tissue that is primarily glandular and associated with marked skin redundancy, direct gland and skin excision with nipple transposition (with or without liposuction) is indicated. Skin excision patterns include a boomerang pattern to correct vertical and horizontal skin excess primarily in patients with massive weight loss. Transverse incisions are used to remove vertical excess.

Liposuction would not address the glandular tissue, and skin excision is needed to treat the skin redundancy. Liposuction combined with direct gland excision also does not correct the skin redundancy. Cryolipolysis is indicated for fat reduction, which would not treat the primarily glandular component. Direct gland and skin excision with liposuction does not correct the nipple position.

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195. A 31-year-old woman, gravida 2, para 2, presents for augmentation mammoplasty. She wants improved overall fullness with limited scarring. She currently wears a size 34A brassiere. Physical examination shows pseudoptosis. Submuscular augmentation with which of the following techniques is most appropriate to meet this patient's goals?

- A) Pectoralis muscle not released along inframammary fold
- B) Release of pectoralis muscle along inframammary fold and periareolar mastopexy
- C) Release of pectoralis muscle along inframammary fold and submammary dissection to inferior areola
- D) Release of pectoralis muscle along inframammary fold and vertical mastopexy
- E) Release of pectoralis muscle along inframammary fold only

The correct response is Option C.

The patient would benefit most from a type II dual-plane augmentation mammoplasty. Her breast parenchyma is moderately mobile over the pectoralis muscle, and she has moderate stretch of the lower pole skin. The goal of dual-plane augmentation is to maximize muscle coverage while allowing optimal lower pole expansion. It also allows redistribution of the breast tissue overlying a submuscular implant.

Soft tissue coverage of the implant is an important consideration regarding pocket location. If pinch thickness of the upper breast is 2 cm or greater, an implant can be placed above the pectoralis muscle. If pinch thickness is less than 2 cm, then the implant should be placed at least partially under the pectoralis muscle. If pinch thickness is less than 0.5 cm along the inframammary fold, then the pectoralis muscle should not be released along the inframammary fold.

There are three types of dual-plane augmentation. Type I releases the pectoralis muscle along the inframammary fold. This is used for most routine augmentation mammoplasties, with all the breast parenchyma above the inframammary fold, tight attachments of the parenchyma-muscle interface, and areola-to-inframammary fold stretch of 4 to 6 cm.

Type II dual-plane augmentation releases the pectoralis muscle along the inframammary fold and dissection is performed superficial to the pectoralis muscle to the inferior border of the areola. This is used for augmentation mammoplasties with most of the breast parenchyma above the

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inframammary fold, looser attachments of the parenchyma-muscle interface, and areola-to-inframammary fold stretch of 5.5 to 6.5 cm.

Type III dual-plane augmentation releases the pectoralis muscle along the inframammary fold, and dissection is performed superficial to the pectoralis muscle to the superior border of the areola. This is used for augmentation mammoplasties in patients with glandular ptosis or true ptosis, when a third of the breast parenchyma is below the inframammary fold, there are very loose attachments of the parenchyma-muscle interface, and areola-to-inframammary fold stretch is 7 to 8 cm. Type III can also be used in breasts with constricted lower poles.

Mastopexy increases scarring, which this patient wanted to limit, and is often not needed with the appropriate dual-plane approach.

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196. A 33-year-old woman seeks panniculectomy to address intertrigo following a 100-lb weight loss after undergoing bariatric surgery 18 months ago. Her weight has been stable for the past 3 months, and her current BMI is 30 kg/m². Which of the following aspects of this patient's history is most likely to interfere with insurance coverage?

- A) BMI of 30 kg/m²
- B) 3 Months of weight stability
- C) 18 Months status postbariatric surgery
- D) Primary symptom of intertrigo
- E) 100-lb weight loss

The correct response is Option B.

Many patient history factors are important when considering indications for body contouring after weight loss. Surgical indications include symptomatic rashes, large amounts of weight loss, adequate time between bariatric surgery and body contouring surgery, decreased BMI, and a substantial time period of weight stability, longer than 3 months. Additionally, insurance carriers have varying criteria to allow authorization of abdominal contouring procedures, specifically panniculectomy. Many insurance carriers require 6 months of weight stability. Severe intertrigo, 100-lb weight loss, 18 months status post bariatric surgery, and a relatively low BMI would be in keeping with frequently used clinical indications for surgery and insurance coverage criteria.

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197. A 36-year-old woman, gravida 3, para 3, presents to the office for consultation for abdominal contouring. Current BMI is 22.5 kg/m². She has lost 20 lb (9 kg) since the birth of her last child 2 years ago, and her weight has been stable for the past 6 months. Examination of the abdomen shows lipodystrophy in the lower abdomen with skin laxity both above and below the umbilicus, and a small overhanging panniculus below the umbilicus. She has mild diastasis recti with no hernias noted. Which of the following is the most appropriate treatment for this patient?
- A) Abdominoplasty with rectus plication
 - B) Fleur-de-lis abdominoplasty
 - C) Radiofrequency skin tightening
 - D) Reverse abdominoplasty
 - E) Suction-assisted liposuction

The correct response is Option A.

The best choice for this patient will address all of her concerns and physical examination findings. These findings include upper and lower abdominal skin laxity, lower abdominal lipodystrophy, and rectus diastasis.

Radiofrequency skin tightening is not reliable or predictable. It will not address the concerns with lipodystrophy or narrow the rectus diastasis. Additionally, of note, there is little higher-level evidence in peer-reviewed literature demonstrating the effects or benefits of radiofrequency for skin tightening in the abdomen.

Suction-assisted liposuction will address the lower abdominal lipodystrophy but will not address the supraumbilical skin laxity or the rectus diastasis. Reverse abdominoplasty will primarily address the skin laxity above the umbilicus but is not as helpful for laxity below the umbilicus.

The best choice for this patient among the options listed is an abdominoplasty with rectus plication. This will address all her areas of concern. A fleur-de-lis abdominoplasty is typically indicated in a patient who has sustained massive weight loss and has both horizontal and vertical truncal laxity. The trade-off of a noticeable vertical scar with clothing such as a bikini would not be worth the benefit of any additional skin tightening, and it is typically not indicated in the typical postpartum woman with a BMI in the normal range who does not have a history of massive weight loss.

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198. A healthy 18-year-old woman presents for evaluation for reduction mammoplasty. Physical examination of the breasts shows a palpable area of fibrocystic tissue in the left axilla. The patient states that this tissue has been present since menarche and often becomes swollen and slightly tender during menses. Which of the following is the most likely developmental origin of this tissue?

- A) Failure of mammary ridge involution
- B) Hypertrophy of lactiferous duct formation
- C) Incomplete mesodermal resorption
- D) Overdevelopment of apocrine and sebaceous glands

The correct response is Option A.

Accessory breast tissue, or polymastia, results from incomplete involution of the ectodermal ridge outside the main mammary buds. During embryologic development, the breast forms from paired ectodermal ridges. Fifteen to twenty of these buds initially appear but then undergo apoptosis, leaving a pair of main mammary buds at the level of the fourth to fifth intercostal space. These mammary buds will become breasts. However, accessory breast tissue, such as in this patient, develops when a portion of the ectodermal ridges fails to involute during the seventh week of gestation. The other choices do not accurately describe the developmental origin of accessory breast tissue.

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199. A 37-year-old man presents to the office for evaluation and treatment of an area of localized hair loss. Physical examination shows a 2 × 4-cm ovoid-shaped area of baldness on the temporal scalp. The rest of the scalp examination is normal. On the basis of the clinical findings, which of the following is the most appropriate treatment for hair restoration?

- A) Hair transplantation
- B) Rotational scalp flap
- C) Serial excision
- D) Topical ketoconazole
- E) Triamcinolone injection

The correct response is Option E.

The most likely diagnosis in this clinical scenario is alopecia areata (AA). AA is different from other forms of alopecia since it is a T-cell-mediated autoimmune disease affecting the regional hair follicles. The exact cause is not fully understood, but it is estimated to affect about 2% of the population. Severity can be limited to a singular lesion or extend to multiple confluent lesions with severe impact on a patient's mental health. While any given lesion can spontaneously resolve, the first-line treatment is injection of triamcinolone combined with minoxidil topical therapy. The injections usually have to be repeated. Systemic therapy with Janus kinase inhibitors is reserved for severe cases of AA. Clinical examination of a fungal infection with tinea capitis differs from the patient presentation in this case. Findings may include scaly skin, brittle hair, and broken hair shafts (black dots). Treatment includes oral and topical antifungal medication such as ketoconazole.

Hair transplantation is not a treatment for AA since the underlying pathology would also affect the transplanted hair follicles.

While a rotational scalp flap may be an option for a bald spot of this size, it would not be indicated in the setting of AA. The main reason is that hair can regrow spontaneously or in response to other therapy modalities. Further, the transferred flap can also become affected by AA in the future. A rotational flap would be indicated for closure of primary defects or other causes (e.g., burn scar, previous skin graft).

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Serial excision is useful for a variety of pathologies such as scars, melanocytic nevi, or skin grafts. It would not be advised in the setting of AA.

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200. A 45-year-old woman who underwent lipoabdominoplasty 6 weeks ago comes to the office. She is pleased with the contour and the low placement of the scar; however, she has persistent pain along the inferior portion of the incision with numbness in the thigh. On examination, pain is elicited with light pinching or pressure over the affected area along the lower portion of the incision, with a positive Tinel sign present along the anterior superior iliac spine. Nerve entrapment is suspected. Which of the following nerves is most likely involved?

- A) Anterior femoral cutaneous
- B) Genitofemoral
- C) Ilioinguinal
- D) Lateral femoral cutaneous
- E) Lateral thoracic

The correct response is Option D.

Meralgia paresthetica is the term for compression of a branch of the nerves that gives normal sensation to the lateral upper thigh. In a review of the literature by Ducic et al., the lateral femoral cutaneous nerve (LFCN) was the nerve most commonly injured after abdominoplasty, with the pooled risk calculated for injury to the LFCN being 1.36% (n = 28/2061 patients). The LFCN is best protected by understanding the relationship with the anterior superior iliac spine (ASIS) and by leaving a swath of undissected loose areolar tissue covering this region. Overly wide dissection, blind dissection between planes, and randomly placed "deep bites" of tissue (during muscle plication or near the ASIS) all have the potential to create direct nerve injury. The ilioinguinal, anterior femoral cutaneous, lateral thoracic, genitofemoral nerves can be injured during an abdominoplasty; however, none fit the anatomic location and nerve distribution described.

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Section 5: Core Surgical Principles

201. A 29-year-old man presents with deep second- and third-degree burns on 35% of total body surface area. Fluid resuscitation via the Parkland formula is performed. Which of the following parameters is most commonly used to assess for adequacy of resuscitation?

- A) Blood pressure
- B) Heart rate
- C) Pulmonary wedge pressure
- D) Pulse oximetry
- E) Urine output

The correct response is option E.

Patients who sustain greater than 20% total body surface area second- or third-degree burns will require aggressive resuscitation to prevent development of burn shock. While the Parkland formula and other such resuscitation protocols are useful for initiation of proper burn resuscitation, these measures should only be used as a starting point, with the resuscitation being guided by the physiologic response of the patient. The most important parameter to assess the adequacy of resuscitation is urine output. A goal for adequate resuscitation efforts should be above 0.5 mL/kg/hr for adults and closer to 1 mL/kg/hr for children. It is important to note that over-resuscitation can also result in what has been recently described as "fluid creep," and includes significant complications such as excessive edema, third spacing, and even abdominal compartment syndrome, so fluid infusions should also be lowered if urine output is significantly higher than these rates. While monitoring of other physiologic parameters such as blood pressure, heart rate, and pulse oximetry are important, and serial measurements of cardiac output are increasingly being used, they are not more commonly used than urine output to assess the adequacy of resuscitation or help to prevent over-resuscitation. Pulmonary wedge pressure is no longer a common modality for monitoring fluid resuscitation status.

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202. A 42-year-old man presents with partial degloving injury of the right leg and fracture of the pelvis sustained during a motorcycle collision 2 weeks ago. Medical history includes factor V Leiden. BMI is 31.1 kg/m². Skin graft reconstruction of the degloving injury of the leg is planned. According to the Caprini Risk Assessment Model (2005), which of the following conditions in this patient represents the greatest risk for perioperative venous thromboembolism?

- A) Age
- B) BMI greater than 25 kg/m²
- C) Major surgery (greater than 45 minutes in duration)
- D) Pelvic fracture
- E) Positive factor V Leiden

The correct response is Option D.

The ASPS Venous Thromboembolism Task Force Report includes recommendations for risk stratification based on the Caprini Risk Assessment Model (RAM), which has been widely validated in the scientific literature for evaluation of surgical patients. The 2005 model in particular is most applicable to plastic surgery. This model awards a score based on various weighted patient risk factors, with venous thromboembolism (VTE) risk increasing as the score increases. The literature suggests that patients with a Caprini RAM score less than 8, who were not provided chemoprophylaxis, experienced VTE at a rate of 11.3%.

The Caprini RAM score for this patient is 12. Age 41 to 60 years is 1 point. BMI greater than 25 kg/m² is 1 point. Major surgery (longer than 45 minutes) is 2 points. Positive factor V Leiden, an inheritable mutation in factor V protein, which is involved in the blood clotting cascade, is 3 points. Hip, pelvis, or leg fracture within the past month is 5 points. Based on this risk stratification tool, the surgeon "should strongly consider the option to use extended low molecular weight heparin postoperative prophylaxis" in this patient.

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203. A 55-year-old obese woman presents with sternal wound dehiscence 10 days after undergoing pectoralis major flap reconstruction. Medical history includes stable hypertension, coronary artery disease, and coronary artery bypass grafting complicated by mediastinitis. Which of the following factors is a predictor for recurrent sternal wound dehiscence in this patient?

- A) Age
- B) Coronary artery disease
- C) Female sex
- D) Hypertension
- E) Pectoralis major flap harvest

The correct response is Option C.

A retrospective chart review of 77 patients was conducted over a 7-year period, focusing on patients with sternum dehiscence who underwent pectoralis major transposition for sternal reconstruction. Female sex, smoking, detachment of the humeral insertion, and operation time are associated with postoperative wound complications.

Breast size in women was previously found to be a risk factor for the development of post-sternotomy mediastinitis. Jones et al. found that recurrent dehiscence after tissue-flap coverage of the sternum occurs more frequently in obese women with large pendulous breasts. An association between female sex and recurrent wound dehiscence was also found in the study. This might have been caused by traction of large breasts on the wound edges or devascularization of mammary tissue. Due to the retrospective nature of this study, breast size as a cofactor could not be included in the analysis.

Age, pectoralis major harvest, hypertension, and coronary artery disease are not independent risk factors for recurrent sternotomy dehiscence.

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204. An otherwise healthy 74-year-old man presents with traumatic brain injury from an open comminuted anterior and posterior table frontal sinus fracture sustained in a motor vehicle collision. Persistent clear fluid rhinorrhea is observed when the patient is upright. The patient is initially medically unstable, and surgical intervention is delayed by 5 days. Which of the following factors represents the greatest increase in risk for a central nervous system infection?
- A) Cerebrospinal fluid leak
 - B) More than 48 hours before operative repair
 - C) Open fracture injury
 - D) Patient age
 - E) Presence of traumatic brain injury

The correct response is Option B.

There are many algorithms for treating frontal sinus fractures. Unfortunately, many of these patients have other injuries that may limit their surgical options. Conservative management has been shown to be successful at managing comminuted, displaced fractures, pre-injury comorbidities, or those with cerebrospinal fluid (CSF) leak. Factors that are not associated with an increased risk for serious infection include: preoperative CSF leak, persistent CSF leak, surgical procedure performed, age, gender, and penetrating or open injury. Factors that do impact the risk for serious infection include: greater than 48 hours from injury to operating room intervention, use of CSF catheter diversion, and soft-tissue infection.

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205. A 45-year-old woman with a history of breast cancer presents for a discussion of breast reconstruction with silicone breast implants. She inquires about the current screening recommendations for implant rupture. Which of the following postoperative screening recommendations should the surgeon communicate to this patient?

- A) CT scan at 3 years followed by CT, MRI, or ultrasound every 2 years thereafter
- B) Mammogram every 5 years
- C) MRI at 2 years then every 3 years thereafter
- D) MRI at 3 years then every 2 years thereafter
- E) MRI or ultrasound at 5 to 6 years then every 2 to 3 years thereafter

The correct response is Option E.

As a critically important part of the informed consent process, practitioners should be very familiar with updated information from the FDA. The screening recommendations for implant rupture for women with silicone gel-filled implants were recently updated (September 2020). The current FDA recommendations are that asymptomatic patients should have the implants evaluated with either ultrasound or MRI 5 to 6 years after implantation and then every 2 to 3 years thereafter. This new recommendation replaces the old recommendation by adding ultrasound as an accepted modality and extending the time until the first evaluation. The older recommendation was MRI evaluation at 3 years, with follow-up evaluation being performed every 2 years. These recommendations apply to women who have cosmetic augmentation and breast reconstruction. CT scan is not an acceptable modality for implant evaluation. Since this patient has had mastectomies and breast reconstruction, mammography is not indicated.

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206. A 29-year-old man who is a laborer presents with significant pain of the nondominant left hand. Medical history includes a laceration of the ring and small fingers palmarly over the proximal phalanx 1 year ago. At the time of the injury, he underwent repair of the flexor digitorum profundus to the small finger and direct repair of the ulnar digital nerve to the ring finger. All other nerves were intact. On examination, the patient reports pain over the nerve repair site that interferes with work-related tasks. There is no sensation distal to the repair. Positive Tinel sign over the ulnar extent of the scar on the ring finger is noted. Which of the following surgical techniques is most appropriate in this patient?
- A) Excision of neuroma alone
 - B) Excision of neuroma and nerve implantation into bone
 - C) Excision of neuroma and nerve repair with allograft
 - D) External and internal neurolysis of the neuroma in continuity
 - E) Targeted muscle reinnervation or nerve transfer to nearby motor nerve

The correct response is Option C.

Injuries to the extremities are extremely common, and with the close proximity of the digital nerve to the palmar surface of the digits, these nerves are commonly lacerated. Initial treatment includes primary repair or grafting, depending on the extent of injury and the ability to perform direct repair with minimal tension. Despite repair, patients may develop neuroma in continuity and fail to recover meaningful sensation distal to the level of injury.

In this scenario, the patient has developed a neuroma in continuity at the site of digital nerve repair. Many treatment options exist for the treatment of neuroma in the extremities where the distal nerve target is present. These include: direct repair, the use of a nerve conduit, allograft, or autograft. Where the distal nerve target is absent, as with amputation, techniques to limit or treat neuroma include: excision alone, excision with amputation into muscle or bone, nerve graft to nowhere, nerve capping, centro-central coaptation, end to side neurorrhaphy, targeted muscle reinnervation (nerve transfer), or regenerative peripheral nerve interface (RPNI).

In the study by Moran et al., where authors retrospectively reviewed 127 patients following surgery for symptomatic neuroma, they found that patients who underwent neuroma excision followed by repair had significantly lower DASH scores, compared with implantation into muscle or bone or with simple excision alone ($p = 0.03$).

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Lans et al. demonstrated that patients who underwent neuroma excision followed by repair/reconstruction had lower numeric rating pain scores, lower PROMIS pain interference scores, and higher PROMIS upper extremity scores.

While targeted muscle reinnervation is a useful technique to prevent or treat neuroma pain, it is more commonly performed in the setting of amputation.

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207. A 139-lb (63-kg), 24-year-old woman undergoes abdominoplasty. Bupivacaine 0.25% with epinephrine is administered for postoperative pain management. Which of the following is the maximum quantity of bupivacaine 0.25% with epinephrine that can be administered safely to this patient?

- A) 45 mL
- B) 55 mL
- C) 65 mL
- D) 75 mL
- E) 85 mL

Upon further review, this item was not scored as part of the examination.

The correct response is Option D.

Bupivacaine with epinephrine can be given at the dose of 3.0 mg/kg, not exceeding 225 mg given in a single dose. In this patient, 3.0 mg/kg multiplied by 63 kg is 189 mg. A 0.25% concentration of bupivacaine means that there is 2.5 mg of bupivacaine in 1.0 mL. Thus, 75.6 mL of bupivacaine 0.25% will yield 189 mg of bupivacaine.

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208. A 35-year-old man presents with a laceration to the dorsum of his nondominant hand sustained with a kitchen knife. Examination shows a laceration to the metacarpophalangeal (MCP) joint of the long finger. There is no obvious joint involvement, but the patient has an extensor lag of 30 degrees at the MCP joint. Surgical repair of the Zone 5 extensor digitorum communis tendon is performed. Postoperatively, which of the following treatment plans is most likely to provide this patient with the most motion and best outcome?

- A) 1 week of immobilization followed by relative motion splint and short arc motion
- B) 2 weeks of immobilization followed by dynamic extension splint
- C) 3 weeks of immobilization followed by full motion
- D) 4 weeks of immobilization followed by protected motion
- E) No postoperative orthosis and released to full motion immediately

The correct response is Option A.

Traditionally, extensor tendon injuries were treated with 4 to 6 weeks of immobilization that would subsequently lead to decreased flexion and stiffness. More recently, short arc motion protocols with relative motion splints have been utilized and demonstrate improved outcomes. To do this, a thermoplastic yoke splint is constructed by placing the digits of the repaired extensor tendon in approximately 15 to 20 degrees more metacarpophalangeal extension than the adjacent digits for 6 weeks while allowing full interphalangeal joint motion. The wrist is typically placed into an extension splint for 3 weeks at approximately 20 degrees extension to decrease tension on the repair site. Dynamic splinting following extensor tendon repair still limits gliding of the tendon by keeping the digit in a relative static position.

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209. A 63-year-old woman with a history of ulcerative colitis presents after being diagnosed with invasive ductal carcinoma of the right breast. Her BMI is 23 kg/m². She undergoes unilateral mastectomy with immediate reconstruction with a free deep inferior epigastric perforator flap. Her initial postoperative course is uneventful. Five weeks after the procedure, the patient returns to the clinic. Examination shows erythema and skin ulcers surrounded by violaceous discoloration around the abdominal and breast incisions. No underlying fluid collections are appreciated. Punch biopsies of the ulcers are performed and show neutrophilic dermatosis. Which of the following is the most appropriate next step in management?
- A) Broad-spectrum antibiotic therapy
 - B) CT scan of the chest/abdomen/pelvis
 - C) High-dose steroid therapy
 - D) Surgical exploration with washout and debridement
 - E) Ultrasound of the breast and abdomen

The correct response is Option C.

Pyoderma gangrenosum (PG) is a rare skin disorder of unknown cause that is believed to be part of the spectrum of neutrophilic dermatoses. Specific characteristics of postoperative PG include dramatic deterioration of surgical wounds after a period of 4 days to 6 weeks, with predominant involvement of the breast and abdomen. Numerous reports of PG following reduction mammoplasty and breast reconstruction have been published. Additionally, patients with a history of inflammatory bowel disease are at an increased risk for developing PG.

Clinically, postoperative PG is characterized by fever, chills, cellulitis, and wound breakdown. The hallmark finding is a rapidly enlarging area of central skin ulceration surrounded by violaceous skin with irregular borders. Systemic signs of inflammation along with laboratory abnormalities (leukocytosis, hyponatremia, and hypoproteinemia) can accompany these findings. The diagnostic challenge of postoperative PG is related to its clinical resemblance to necrotizing infection and, hence, a high index of suspicion is required. However, the presence of neutrophilic dermatosis supports the diagnosis of PG. Treatment consists of immunosuppression and frequently consists of a combination of high-dose steroids and topical tacrolimus.

Additional imaging would not aid in management in this case. Broadening antibiotic coverage or surgical debridement would be indicated for treatment of infection. Local wound care does not address the underlying cause of the clinical condition and, hence, would not be the most appropriate next step.

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210. A 41-year-old woman is evaluated for abdominoplasty and liposuction in the outpatient setting. Surgery is expected to take 2 hours. Caprini score is 2. Which of the following is the approximate risk for venous thromboembolism in this patient?

- A) 1%
- B) 10%
- C) 15%
- D) 20%
- E) 25%

The correct response is Option A.

There have been many studies aimed at risk stratification for venous thromboembolism (VTE) in plastic surgery patients. Despite this, the topic remains controversial. There are no specific recommendations for patients undergoing abdominoplasty and liposuction; as such, management strategies are case-specific and vary widely between practitioners. It is, however, well-known that abdominoplasty has a higher risk for VTE events compared with other procedures. Though the specific rates of VTE vary per study, the average risk is about 1%. Interestingly, in one study using Internet Based Quality Assurance Program data, the rate was found to be 0.15%. This particular study did not find an increased incidence of VTE in those undergoing multiple procedures, and this has been corroborated by multiple authors. That being said, it is important to calculate a Caprini score and treat each patient on a case-by-case basis. At the least, sequential compression devices should be used for every patient undergoing abdominoplasty, and for those with higher Caprini scores, one should consider using low molecular weight heparin or unfractionated heparin for VTE prophylaxis. The risks of 10%, 15%, 20%, and 25% are too high, and thus they are incorrect.

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211. A 35-year-old woman undergoes bilateral reduction mammoplasty for treatment of symptomatic macromastia. Medical history includes chronic neck and back pain for 15 years. She wears a size 36H brassiere. The pathology specimen shows ductal carcinoma in situ completely excised with 2-mm margins. Postoperative MRI shows no additional abnormalities. Which of the following is the most appropriate next step to adequately treat this patient's breast cancer?

- A) Chemotherapy
- B) Formal lumpectomy for adequate margins
- C) Radiation therapy
- D) Sentinel lymph node dissection
- E) No additional treatment necessary

The correct response is Option C.

An incidental finding of breast cancer on breast reduction specimen final pathology can lead to significant anxiety for both the patient and the plastic surgeon. To mitigate this anxiety and provide the best care and support for the patient, plastic surgeons should be aware of the current guidelines for treatment of breast cancer. In this patient, there are two viable options for adequate treatment similar to most breast cancers after the diagnosis is confirmed by biopsy with equivalent 5-year survival rates: lumpectomy and adjuvant radiation versus completion mastectomy. Ductal carcinoma in situ (DCIS) requires excision with margin greater than or equal to 2 mm for adequate extirpation. Because this patient has adequate margins with the breast reduction specimen, she would only require adjuvant radiation therapy unless she elects to have completion mastectomy with or without reconstruction. Chemotherapy is reserved for invasive tumors with potential systemic spread. Sentinel lymph node dissection is not required with in situ cancers that are noninvasive.

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212. A 45-year-old woman presents for a discussion regarding breast augmentation. She is concerned about the high incidence of capsular contracture and asks for postoperative antibiotic therapy. Medical history includes no known drug allergies. Which of the following is the most appropriate postoperative antibiotic therapy in this patient?
- A) Cephalexin; 500 mg, four times daily for 7 days
 - B) Ciprofloxacin; 500 mg, twice daily for 7 days
 - C) Clindamycin; 300 mg, every 6 hours for 7 days
 - D) Sulfamethoxazole and trimethoprim; one double-strength tablet, twice daily for 7 days
 - E) Postoperative antibiotics are not indicated

The correct response is Option E.

For the patient in the scenario, postoperative (empiric/prophylactic) antibiotics are not indicated. Though capsular contracture is the most common long-term implant complication of breast augmentation, routine postoperative antibiotics have not been shown to decrease this complication. Capsular contracture can result in discomfort, pain, malposition, asymmetry, and the need for revision and reoperation. Though still the subject of hypotheses, the leading theory is that capsular contracture stems from a subacute infection leading to biofilm formation. In one study, the most common isolate was *Staphylococcus epidermidis*, implying contamination of the implant with insertion. Given this, several algorithms have been proposed to reduce the chance of contamination, including betadine irrigation, antibiotic irrigation, and utilization of a "no-touch." Postoperative antibiotic therapy has not been demonstrated to be effective in preventing capsular contracture. Thus, all of the answers involving antibiotic prophylaxis are incorrect.

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213. A 55-year-old man undergoing excision of a soft-tissue mass of the left thigh develops malignant hyperthermia shortly after induction of general anesthesia. The surgical procedure is promptly aborted, and the patient is successfully treated. Six months later, he returns for another attempt at excising the mass. The use of which of the following anesthetic agents is most appropriate in this case?

- A) Ether
- B) Halothane
- C) Propofol
- D) Sevoflurane
- E) Succinylcholine

The correct response is Option C.

Lidocaine and all other local anesthetics are considered safe to be used in patients who are susceptible to malignant hyperthermia.

Volatile anesthetic agents (halothane, sevoflurane, ether) and depolarizing muscle relaxants (succinylcholine) are considered potential triggers of malignant hyperthermia and, therefore, should be avoided in susceptible individuals.

Other anesthetic agents that are considered safe to be used in patients susceptible to malignant hyperthermia include:

- nonvolatile general anesthetics: nitrous oxide
- opioids: morphine, fentanyl, alfentanil, hydromorphone, meperidine, naloxone
- barbiturates and intravenous anesthetics: thiopental, propofol, etomidate
- nondepolarizing muscle relaxants: pancuronium, atracurium, rocuronium
- benzodiazepines: lorazepam (Ativan), midazolam (Versed), klonopin

Dozens of genetic mutations have been associated with susceptibility to malignant hyperthermia, which is generally inherited in an autosomal dominant pattern.

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214. A 78-year-old man who was recently diagnosed with low rectal cancer presents to the office for evaluation. The patient is accompanied by his daughter, who fills out all the questionnaires for him. Medical history includes hypertension, osteoarthritis, and bilateral knee replacements 20 years ago. Vital signs are within normal range. BMI is 21.5 kg/m². He ambulates with a walker. Physical examination is otherwise unremarkable. An abdominoperineal resection and perineal reconstruction are planned. Obtaining which of the following is the most appropriate next step in assessing this patient's risk for perioperative complications?
- A) APACHE II score
 - B) FEV1/FVC ratio
 - C) Frailty index
 - D) Liver function tests
 - E) Sequential Organ Failure Assessment (SOFA) score

The correct response is Option C.

Obtaining a frailty score would help providers assess the perioperative risk for this elderly patient with limited ambulation and possible cognitive impairment who is about to undergo a significant colorectal and reconstructive operation.

Frailty is a state of functional compromise in an elderly patient, which may include declined ability to maintain homeostasis, loss of physiological reserve, and increased vulnerability to adverse outcomes in the perioperative period.

Chronological age alone has been found to be a poor predictor of cancer and/or surgery tolerance by elderly patients. This subgroup of surgical patients has been rapidly increasing in number due to overall aging of the US population and can be quite heterogeneous when it comes to individual health status. Therefore, preoperative evaluation of elderly patients should include medical comorbidities and baseline functional status.

Several frailty scoring systems have been described, including the Phenotype Model, Cumulative Deficit Model, Comprehensive Geriatric Assessment, Risk Analysis Index, Charlson Comorbidity Index, Hopkins Score, and Frailty Index, along with its 11- and 5-item modified/simplified versions. Scored variables include physical characteristics (unintentional

weight loss, slow gait, weak grip strength, etc.), medical history (stroke with deficit, myocardial infarction, congestive heart failure, etc.), and laboratory results (kidney function, nutrition, etc.).

Higher frailty scores have been associated with higher risk for in-hospital complications, longer hospital stay, discharge disposition to a skilled nursing facility, increased postoperative complications, and decreased postoperative survival at 30, 180, and 365 days.

Liver function may not be indicated in this patient without any history of abnormal bleeding or jaundice or signs of liver disease. FEV1 (forced expiratory volume) to FVC (forced vital capacity) ratio is used to monitor airway flow and assess response to therapy in patients with asthma. APACHE (Acute Physiology and Chronic Health Evaluation) II and SOFA (Sequential Organ Failure Assessment) are used to grade severity of illness in critically ill patients and predict clinical outcomes in the ICU setting.

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215. A 22-lb (10-kg), 8-month-old infant is undergoing cranial vault reconstruction. The anesthesiologist informs the surgeon that the estimated blood loss is 150 mL. Approximately which of the following percentages of this patient's circulating blood volume has been lost?

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

The correct response is Option B.

In infants, the formula used for estimated circulating blood volume is 75 to 80 mL per kg of body weight. This infant's estimated circulating volume is 750 mL total. When performing surgery with blood loss that is large relative to circulating volume, blood loss control and blood replacement need to be watched carefully.

Estimated circulating blood volume in a 154-lb (70-kg) adult is 5.5 L. For neonates, the formula is increased to 85 to 90 mL/kg, and for children, the formula is decreased to 70 to 75 mL/kg. The surgeon should be aware when working on infants of the changing estimate of circulating blood volume based on weight. A reference for a recent nomogram for prediction of hemoglobin and hematocrit shifts after blood loss and resuscitation is included in the resources, as well as classic papers on fluids in pediatric patients and estimations of estimated circulating volume.

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216. A 42-year-old man is referred to the office for evaluation and treatment of a 1.2-cm skin lesion of the volar forearm after being evaluated by a dermatologist. The lesion appears benign, and excision with closure is performed with local anesthesia as an outpatient procedure (CPT 11402). The patient is seen postoperatively at 7 days and 8 weeks. According to Medicare global surgery payment procedures, which of the following is the length of the global period for this procedure?

- A) 0 days
- B) 7 days
- C) 10 days
- D) 14 days
- E) 30 days

The correct response is Option C.

The global surgical package, also called global surgery, includes all the necessary services normally provided pre-, intra-, and postoperatively. Surgical CPT codes cover care provided in the global period, which may be days or months, depending on the procedure. The global period is 90 days for many operative procedures performed by plastic surgeons, but may be as short as 10 days for minor procedures (such as in the case presented).

Services included in the global surgery payment include:

- Preoperative visits after the decision is made to operate
- Intraoperative services
- All additional medical or surgical services required during the postoperative period because of complications, which do not require a return to the operating room
- Follow-up visits during the global period (which for the case presented [a minor procedure] would be 10 days; therefore, a postoperative clinic visit at 8 weeks is not within the global period)
- Postoperative pain management
- Routine supplies
- Miscellaneous services, e.g., dressing changes, etc.

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Services not included in the global surgery payment include:

- Initial consultation to determine the need for major surgery; the initiation evaluation for minor surgical procedures (such as the case presented) is included in the global surgery package
- Diagnostic tests and procedures, including diagnostic radiologic procedures
- Services of other physicians related to the surgery
- Treatment for postoperative complications requiring a return trip to the operating room

0, 7, 14, and 30 days all represent incorrect responses and do not represent the global period associated with the minor procedure presented here.

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217. An otherwise healthy 45-year-old woman presents for abdominoplasty. Administration of liposomal bupivacaine for postoperative pain control is planned. Which of the following is the maximum dose of liposomal bupivacaine that can be administered in a single dose in this patient?

- A) 50 mg
- B) 133 mg
- C) 200 mg
- D) 266 mg
- E) 399 mg

The correct response is Option D.

Liposomal bupivacaine is frequently used to manage postoperative pain. The mechanism of action is bupivacaine loads into multivesicular liposomes, thus allowing for slow release of bupivacaine. The potential efficacy of liposomal bupivacaine can last between 72 to 96 hours. Thus, studies have shown that administration of liposomal bupivacaine can decrease postoperative pain and also decrease the usage of opioids. The administration of liposomal bupivacaine is not weight-dependent, and the maximum dose recommended is a single administration of 266 mg or 20 mL. To cover a larger area, volume expansion with saline or bupivacaine can be used by dilution of the 266 mg; however, it is not recommended to exceed this dose.

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218. Based on a systematic evidence review, which of the following is the most appropriate preoperative recommendation for women of average breast cancer risk undergoing reduction mammoplasty?

- A) Annual mammography screening for women 45 to 54 years of age
- B) Biennial breast MRI screening for women over age 55 years
- C) *BRCA* testing
- D) Establish a baseline mammogram for women over age 30 years
- E) Screening breast thermography

The correct response is Option A.

The American Cancer Society 2015 guidelines for women undergoing reduction mammoplasty based on evidence-based medicine include: 1) annual screening for women aged 45 to 54 years; 2) biennial screening for women 55 years of age and older; 3) women aged 40 to 44 years have the opportunity to begin annual screening; 4) clinical breast examination is not indicated for cancer detection and surveillance. *BRCA* testing is currently recommended for high-risk familial inheritance concerns. Breast thermography and MRI are not used for screening patients of average risk.

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219. A 46-year-old woman underwent immediate tissue expander/implant-based breast reconstruction after right mastectomy. Postoperatively adjuvant chemotherapy or radiation therapy are not required. Two months later, the patient has completed the expansion process, is happy with her current breast size, and would like to move forward with placement of permanent implants. In addition to the primary code for exchange of expander for permanent implant, which of the following CPT modifiers must be added to ensure payment of the second-stage procedure during her initial global period?
- A) -22
 - B) -50
 - C) -57
 - D) -58
 - E) -62

The correct response is Option D.

Staged procedures performed on the same operative site and within the standard 90-day global period require the -58 modifier to indicate that the procedure was either planned or anticipated, was more extensive than the original procedure, or needed for therapy following or related to the original procedure. Procedures that are not designated with the modifier -58 may not be authorized and/or reimbursed, since major surgery allocates a 90-day global period in which the surgeon is responsible for all related surgical care one day before surgery through 90 postoperative days with no additional charge.

Modifier -22 is used to denote increased procedural services when the performed surgery required significantly more effort and/or was more difficult than the planned procedure, and supporting documentation is provided to justify why this was the case. Modifier -50 is used to denote bilateral procedures where this is applicable. Modifier -57 is associated with urgent or emergent procedures, and it is typically appended to the evaluation and management code after the provider evaluates the patient and determines that surgery must be performed either that day or the next day. This allows the provider to bill for both the procedure as well as the evaluation and management service so that the two are not bundled into the global surgery payment. Modifier -62 denotes two surgeons working together as primary surgeons, which was not applicable in this case.

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220. Absence of which of the following structures is most characteristic of patients with Poland syndrome?

- A) Clavicular head of the pectoralis major muscle
- B) Ipsilateral ribs
- C) Pectoralis minor muscle
- D) Serratus anterior muscle
- E) Sternocostal head of the pectoralis major muscle

The correct response is Option E.

What follows is the description from the original records found in Paris, France: "In 1841, Alfred Poland, a 19-year-old medical student at Guy's Hospital in London, England, published the classic description of the syndrome that bears his name. Serving as an anatomy demonstrator, Poland recorded that, in his subject: 'the whole of the sternal and costal portions of the pectoralis-major muscle were deficient; but its clavicular origin quite normal. In the left hand, the middle phalanges were absent. The web between the fingers extended to the first articulation the hand was shorter than the right the left thumb was quite normal.' In a footnote, he indicated that 'the hand has been deposited in the Museum of Guy's Hospital.' Poland was a popular teacher and later pursued a distinguished surgical career." (Charlier P, Deo S, Galassi FM, Benmoussa N. Poland syndrome before Alfred Poland: the oldest medical description [Paris, France, 1803]. *Surg Radiol Anat.* 2019;41[10]: 1117-1118.)

Today, Poland syndrome presents a spectrum of chest wall anomalies ranging from simple to complex. These deficiencies are largely cosmetic, with the most common (simple) form presenting as a unilateral absence of the sternocostal head of the pectoralis major muscle. The deformity can also be complex, with ipsilateral absence of ribs, axillary webbing, and foreshortening of the hemithorax. Reconstructive options for the chest wall depend on anatomical severity, gender, associated anomalies, and, of course, the patient's preference.

Clavicular head of pectoralis major muscle is generally present in these patients. Pectoralis minor, absence of serratus anterior, and rib absence may or may not be present in patients with Poland syndrome.

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221. A 45-year-old woman presents for consultation for reduction mammoplasty. On examination, a 1-cm mass in the upper outer quadrant is noted. Which of the following is the most appropriate initial imaging test for this patient?

- A) Diagnostic mammography
- B) MRI
- C) Positron emission tomography
- D) Sestamibi scan
- E) Thermography

The correct response is Option A.

Diagnostic mammography is the initial imaging modality of choice for a clinically detected palpable breast mass in a woman aged 40 years or older. For a woman under the age of 30 years, breast ultrasonography would be the first choice. For a woman aged 30 to 39 years, either modality would be acceptable for initial evaluation. It is essential that there be correlation between the imaging and area of palpable concern to confirm the correct finding is being evaluated. Regardless of palpable findings, any highly suspicious breast mass that is detected by imaging warrants biopsy. Further, any highly suspicious breast mass that is detected by palpation warrants biopsy. Thermography has not been approved for screening.

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222. A 34-year-old woman presents for evaluation for a large abdominal pannus, frequent rashes, and skin breakdown as a result of excess skin. BMI is 41 kg/m². While in the waiting room awaiting consultation, the patient picks up patient education pamphlets on abdominoplasty and panniculectomy. According to the National Institutes of Health and the American Medical Association recommendations, readability of patient education materials should not exceed the reading level of which of the following grades?

- A) Fourth
- B) Sixth
- C) Eighth
- D) Tenth
- E) High school graduate

The correct response is Option B.

Health literacy is defined as "the capacity to obtain, interpret, and understand basic health information and services and the competence to use such information and services to enhance health." Low health literacy is associated with a poor understanding of personal disease, worse overall health, and increased hospitalizations. Most adults read between the eighth and ninth grade level, but as many as 20% of adults read at the lowest reading level, which is approximately fifth grade.

Several studies have shown that patient education materials are routinely written at a grade level above the recommendations by the National Institutes of Health (NIH) and the American Medical Association (AMA). In this vignette, patient literature written at a reading level that is too advanced may contribute to misunderstanding between the reconstructive nature of a panniculectomy and the cosmetic nature of abdominoplasty.

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223. Which of the following subtypes of basal cell carcinoma has the lowest risk for local recurrence?

- A) Infiltrating
- B) Micronodular
- C) Morpheaform
- D) Nodular
- E) Sclerosing

The correct response is Option D.

Basal cell carcinoma (BCC) is the most common human malignancy as well as the most common malignant tumor of the skin. The incidence of BCC is increasing worldwide. The most significant etiological factors are believed to be ultraviolet light exposure and genetic predisposition. Therefore, an aging population and prolonged exposure to sunlight may explain the worldwide increasing incidence.

The great majority of BCCs are successfully treated and will not recur. However, it is important to know the high risk lesions and subtypes to understand when the recurrence rate may be higher. The morpheaform, sclerosing, infiltrating, micronodular, and metatypical subtypes are associated with higher risk for relapse. Anatomic locations on the trunk and limbs are considered low-risk areas, while the forehead, cheek, chin, scalp, and neck are intermediate-risk areas. The nose and perioral areas are high-risk areas. Size greater than 1 cm for head and neck tumors and greater than 2 cm in other body areas also predisposes to a higher recurrence risk.

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224. A 63-year-old woman with a history of breast cancer presents for delayed reconstruction with bilateral latissimus dorsi muscle flaps. Medical history includes coronary artery disease, hypertension, and rheumatoid arthritis. Current medications include aspirin, propranolol, and prednisone, which she has taken for 8 years. In preparation for surgery, prednisone is discontinued 6 weeks before and aspirin is discontinued 1 week before surgery. The surgical procedure is uneventful. In the PACU, her heart rate is 115 bpm and blood pressure is 80/40 mmHg. Physical examination shows no signs of hematoma. A total of 3 L of intravenous fluid boluses are administered, with no hemodynamic improvement. Chest x-ray, ECG, hematocrit and serum electrolytes, and troponins are normal. Despite increasing doses of vasopressors during the next 2 hours, the patient remains hypotensive. Administration of which of the following is the most appropriate next step in management?

- A) Dantrolene
- B) Desmopressin (DDAVP)
- C) Hydrocortisone
- D) Insulin and dextrose
- E) Labetalol

The correct response is Option C.

The most appropriate next step in managing this patient with otherwise unexplainable refractory hypotension and a recent history of long-term steroid use is intravenous administration of hydrocortisone, with the presumptive diagnosis of adrenal crisis.

The first case reports of surgery-induced acute adrenal insufficiency in patients on long-term steroid therapy were published in the early 1950s, just a few years after the release of oral cortisone in 1949. Today, over 6 decades later, significant controversy remains in the prevention, diagnosis, and treatment of this disease, despite its fatality if not appropriately prevented or managed.

Clinical signs of acute adrenal insufficiency, or adrenal crisis, include hypotension, hypoglycemia, dehydration, altered mental status, and hyponatremia, which can quickly progress to fatal hemodynamic collapse.

Prescribed steroid therapy (PST) can cause suppression of the hypothalamo–pituitary–adrenal (HPA) axis, placing these patients at risk for acute adrenal insufficiency as a consequence of surgical stress. Prednisone doses ≥ 5 mg/day (or hydrocortisone-equivalent dose) in adults via any route of administration (oral, inhaled, topical, intranasal, intra-articular) are sufficient to raise concern. There is no consensus on the minimal duration of PST to place patients at risk for an adrenal crisis, but 3 weeks is commonly cited. The risk may remain for up to 1 year after discontinuation of PST.

There seems to exist no consensus on the preoperative evaluation of patients at risk. Laboratory evaluation of their HPA axis is possible (e.g., ACTH challenge), but results correlate poorly with actual incidence of adrenal crisis. There is also no consensus on a prophylactic steroid regimen for patients at risk, although a recent trend away from the perioperative administration of high-dose steroids purely as prophylaxis can be observed, particularly in the inflammatory bowel disease literature.

Apart from all the controversy, at least a couple of principles related to this disease seem to be universally accepted: 1) a high degree of suspicion should be exercised when encountering unexplained refractory hemodynamic instability in a patient on PST subjected to stress by surgery or illness; 2) in such a case, preference should be given to prompt administration of rescue steroids, considering the expected mortality of untreated crises and the lack of evidence of long-term adverse consequences from short-term steroid administration.

None of the other drugs listed are directly pertinent to the management of the adrenal crisis in this patient. Desmopressin (DDAVP) causes the release of von Willebrand factor from platelets and endothelial cells. It is used in cases of factor VIII or von Willebrand factor deficiency. Insulin and dextrose solutions are used to shift potassium intracellularly in the treatment of hyperkalemia. Dantrolene is used in the treatment of malignant hyperthermia. Labetalol, a beta-adrenergic blocker, would probably worsen the patient's hypotension.

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225. When combined with liposuction, which of the following is the maximum concentration of lidocaine that can be safely injected with subcutaneous tumescent solution?

- A) 4.5 mg/kg
- B) 7 mg/kg
- C) 35 mg/kg
- D) 45 mg/kg
- E) 70 mg/kg

Upon further review, this item was not scored as part of the examination.

The correct response is Option D.

When combined with liposuction, lidocaine tumescent solution can contain up to 45 mg/kg without producing toxic serum lidocaine concentrations. The maximum dose for undiluted lidocaine injections is 4.5 mg/kg. The maximum dose for injection of undiluted lidocaine with epinephrine is 7 mg/kg. Higher concentrations of lidocaine can be injected when diluted in tumescent solution, which contains epinephrine as well. When liposuction is performed in the area of tumescent injection, a portion of the tumescent is ultimately removed with the lipoaspirate.

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226. Tranexamic acid inhibits which of the following enzymatic conversions?

- A) Factor VII to factor VIIa
- B) Factor X to factor Xa
- C) Fibrinogen to fibrin
- D) Plasminogen to plasmin
- E) Prothrombin to thrombin

The correct response is Option D.

Tranexamic acid (TXA) has seen an expanding role in plastic surgery in recent years to decrease blood loss. Its mechanism of action is to inhibit the conversion of plasminogen to plasmin, which in turn inhibits the fibrinolytic pathway (clot degradation). All of the other options are steps involved in the clotting cascade, which are required for hemostasis (clot formation). TXA does not have an effect on any of those steps.

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227. A 37-year-old woman undergoes breast augmentation and lipo-abdominoplasty with an overnight stay. She has no history of complicated or drug-resistant infections and no known drug allergies. To decrease the risk for surgical site infection, which of the following is the most appropriate antibiotic, dosing, and duration for this patient?
- A) Cefazolin, first and only dose within 1 hour of incision
 - B) Cefazolin, first dose within 1 hour of surgery, continue for 23 hours postoperatively
 - C) Cefuroxime, first and only dose within 1 hour of incision
 - D) Cefuroxime, first dose within 1 hour of incision, continue for 23 hours postoperatively
 - E) No antibiotic therapy necessary

The correct response is Option A.

Due to growing concern over antibiotic misuse, patterns of antibiotic prescribing and adherence to guidelines must be surveyed. In 2003, Lyle et al. examined the prescribing practices of plastic surgeons with respect to different surgical procedures and compared with previous surveys. Authors found that surgeons were prescribing prophylactic antibiotics in more than 70% of cases for all procedures with the exception of blepharoplasty and chemical peel.

Though the evidence supports judicious antibiotic prescribing and consistently denounces long-term antibiotic therapy, surgeons often fail to adhere to these guidelines, in favor of longer duration antibiotic prophylaxis.

Ariyan et al. published an evidence-based consensus statement in 2015, detailing antibiotic prophylaxis to prevent surgical site infections (SSI) in plastic surgery. They performed a meta-analysis of the best available evidence across common plastic surgery procedures.

With respect to cosmetic breast and body surgery, authors analyzed data from 12 breast studies (three RCTs, nine non-RCTs) and 1 abdominal study (non-RCT). They concluded that the meta-analysis of the RCTs in clean breast surgery showed a significant reduction in risk for SSI with antibiotic prophylaxis versus control (2.5 vs 11.4%; OR, 0.16; 95% CI, 0.04 to 0.061; $p = 0.01$). When combined with non-RCTs, there was still a significant risk reduction (3.8 vs 6.7%; OR, 0.50; 95% CI, 0.26 to 0.94; $p = 0.03$).

With respect to abdominoplasty, the authors of the consensus statement reported the results of a pseudorandomized study in which antibiotic prophylaxis did not result in a significant reduction in SSI (6.5 vs 13.0%; OR 0.47; 95% CI, 0.18 to 1.23; $p = 0.12$).

Assuming that there is no contraindication, Cefazolin is generally recommended as a first-line, prophylactic antibiotic for clean plastic surgery procedures. CDC guidelines recommend antibiotic administration between 30 to 60 minutes from the initial incision. Two grams of cefazolin is indicated for patients less than 120 kg, and 3 grams is recommended for those over 120 kg.

Current data do not support prescribing additional antibiotics beyond a single preoperative dose.

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228. A 52-year-old man presents with a 1-cm invasive cutaneous squamous cell carcinoma of the penis. Which of the following is the most appropriate treatment?

- A) 5-Fluorouracil therapy
- B) Mohs micrographic surgery
- C) Penis transplantation
- D) Radiation therapy
- E) Total amputation

The correct response is Option B.

Mohs micrographic surgery involves the removal of cutaneous malignancies with concomitant circumferential histologic examination. This technique helps preserve normal tissue and has low rates of recurrence. It is most appropriately used for aggressive lesions, lesions at high risk for recurrence, and in areas where maximal preservation of normal tissue is critical for form or function, such as the "mask" areas of the face or other sensitive areas. Appropriate use criteria for Mohs micrographic surgery were developed by an ad hoc committee representing several dermatologic professional societies. This set of recommendations categorizes basal cell carcinoma, squamous cell carcinoma, lentigo maligna, and melanoma in situ as appropriate for Mohs micrographic surgery, of uncertain benefit, or as inappropriate, based on lesion characteristics and location. Squamous cell carcinoma on the genitalia, whether aggressive or nonaggressive, falls in the appropriate for Mohs micrographic surgery category. Furthermore, studies have shown excellent results with Mohs micrographic surgery of the penis, with low recurrence rates. Sexual and urinary function is better preserved by Mohs micrographic surgery than with traditional partial or total amputation.

5-Fluorouracil is a topical chemotherapeutic agent which may be used to treat actinic keratosis, superficial basal cell carcinoma, or squamous cell carcinoma in situ, but it is not appropriate in this patient. Radiation therapy may be useful for treatment of nonmelanoma skin cancer in patients for whom surgery is a poor option. However, when compared with Mohs micrographic surgery in this patient, radiation would likely be less effective and lead to increased morbidity. Total amputation of the penis may have a high cure rate but carries with it devastating morbidity. It is not an appropriate first-line treatment in this patient. Penis transplantation remains an experimental procedure and currently requires life-long systemic immunosuppression. It is not the correct answer.

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229. A 24-year-old woman underwent uneventful cosmetic bilateral breast augmentation. One day postoperatively, the patient reports difficulty urinating with pubic fullness and discomfort. Which of the following is the most likely cause of this patient's symptoms?

- A) Acute tubular necrosis
- B) Adverse effect of anesthesia
- C) Inadequate resuscitation
- D) Poor pain control
- E) Urinary tract infection

The correct response is Option B.

Postoperative urinary retention (POUR) is a common postoperative complication that most often arises secondary to the general anesthesia given during surgery. The prevalence of POUR has been cited as up to 70% in the literature. The anesthetic medications used during the procedure can suppress micturition control and reflexes at the level of the central nervous system and peripheral nervous system while also acting as a smooth muscle relaxant that decreases bladder contractility. Management of POUR can be conservative, including ambulation and cessation of systemic analgesics, or invasive with either intermittent or indwelling catheter placement.

Correction of poor pain control with additional narcotic medications would likely worsen POUR. Urinary tract infection, while a possibility, would be associated with pain and burning during urination as opposed to pubic fullness and discomfort. Inadequate resuscitation would present with a lack of bladder fullness associated with oliguria. Acute tubular necrosis is associated with renal failure which this patient is unlikely to have.

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230. A 57-year-old woman undergoes right mastectomy with immediate deep inferior epigastric perforator flap breast reconstruction for treatment of right breast cancer. BMI is 28 kg/m². Preoperative Caprini RAM score is 6. Perioperative pneumatic compression boots and low-dose heparin are initiated. On postoperative day 2, the patient becomes tachycardic after walking to the bathroom. Resting heart rate is 110/bpm, blood pressure is 118/40 mm Hg, respiratory rate is 24/min, and pulse oximetry is 93% on 6 L nasal cannula oxygen supplementation. Urine output is 50 mL per hour over the past 8 hours. Which of the following is the most likely diagnosis?

- A) Active bleeding
- B) Anxiety
- C) Caffeine withdrawal
- D) Hypovolemia
- E) Pulmonary embolism

The correct response is Option E.

The patient most likely has a pulmonary embolism. Pulmonary embolisms are rare but deadly complications following microsurgical breast reconstruction, and they often present with tachycardia alone (with or without hypoxia). The patient is receiving 6 L nasal cannula oxygen supplementation, so hypoxia is difficult to assess. Anxiety would commonly present as tachycardia with hypertension. Hypovolemia and active bleeding would commonly present with tachycardia with hypotension and decreased urine output. Caffeine withdrawal would commonly present with a headache.

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231. A 72-year-old man presents with a 24-hour history of a diabetic foot infection. Medical history includes type 1 diabetes. Physical examination shows palpable dorsalis pedis and posterior tibial pulses. Sensation is intact. There is skin necrosis and erythema on the dorsum of the foot between the first and second metatarsals. In addition to early surgical debridement and antibiotic therapy, which of the following interventions decreases the likelihood of below-the-knee amputation?

- A) Application of granulocyte colony-stimulating factor
- B) Hyperbaric oxygen therapy
- C) Topical antibiotic therapy
- D) Topical treatment with iodophor gauze
- E) Topical treatment with Wonder of the World plant (*Kalanchoe pinnata*)

The correct response is Option A.

There have been numerous studies on diabetic foot infection. With the mainstay of treatment being surgical debridement and systemic antibiotic therapy, multiple adjuncts to treatment have been used and studied. In a systematic analysis of the literature, papers studying multiple modalities were evaluated, including topical antibiotic therapy, hyperbaric oxygen therapy, application of granulocyte colony-stimulating factor, topical treatment with Wonder of the World plant, and using iodophor gauze. Of these treatments, the application of granulocyte colony-stimulating factor was found to reduce the likelihood of below-the-knee amputation.

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232. A 56-year-old man presents with a chronic wound of the plantar surface of the foot. Medical history includes type 2 diabetes mellitus. Which of the following characteristics most strongly indicates hyperbaric oxygen therapy may be beneficial for this patient?

- A) Ankle brachial index greater than 1
- B) Exposed bone
- C) Failed total contact casting
- D) Hemoglobin A_{1c} greater than 7.0%
- E) Peripheral neuropathy

The correct response is Option B.

Hyperbaric oxygen therapy (HBOT) is a useful adjunctive treatment for selected diabetic foot ulcers (DFUs). Studies support its use in deep ulcers to improve healing and decrease amputation risk. These include Wagner grade 3 ulcers (bone involvement, deep abscess) and grade 4 ulcers (gangrene of a portion of the forefoot). Data have not supported routine use of HBOT in DFUs involving only soft tissue (Wagner grades 1 and 2).

Serum hemoglobin A_{1c}, which provides a measure of blood glucose over the previous 2 to 3 months, is useful for monitoring glycemic control in diabetic patients.

Peripheral neuropathy is a common finding in diabetes mellitus, and it contributes to development and persistence of chronic foot ulcers.

An ankle brachial index greater than 1 can be seen in diabetic patients but is not an indication for HBOT.

Total contact casting is a useful technique which allows off-loading of pressure so that a chronic DFU might heal. However, HBOT is only indicated in DFUs which are Wagner grade 3 or greater.

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233. A 61-year-old woman presents to discuss oncoplastic reduction mammoplasty. Medical history includes a femur fracture sustained during a fall 4 months ago. Recovery was complicated by a pulmonary embolus. Current medications include warfarin therapy. Her hematologist has recommended bridging therapy to prevent recurrent embolus. Which of the following is the most appropriate regimen to bridge anticoagulation with low-molecular weight heparin (LMWH) in this patient?

	Stop Warfarin	Start LMWH	Resume Warfarin
A)	14 days before surgery	7 days before surgery	7 days after surgery
B)	14 days before surgery	3 days before surgery	7 days after surgery
C)	7 days before surgery	3 days before surgery	14 days after surgery
D)	5 days before surgery	3 days before surgery	1–2 days after surgery
E)	The day of surgery	The day of surgery	1–2 days after surgery

The correct response is Option D.

Managing anticoagulation in the perioperative period is challenging. The risk for thromboembolic phenomenon is transiently increased with any cessation in anticoagulation therapy. At the same time, this risk needs to be weighed against the risk for bleeding. For the patient described, who is high-risk for recurrent embolus (recent PE) and bleeding (due to the nature of the proposed procedure), these opposing risks need to be weighed carefully. They may be mitigated by a "bridging" strategy where short-acting agents provide prophylactic anticoagulation around the time of surgery while long-acting agents are held.

While the decision to adjust anticoagulation therapy in the perioperative period is controversial, the mechanism of bridging therapies is based on the known pharmacokinetic behaviors of anticoagulation agents. The half-life of warfarin is approximately 36 hours, so stopping warfarin prior to surgery will allow the therapeutic INR to return to normal levels by the day of surgery. To maintain therapeutic anticoagulation, low-molecular weight heparin (LMWH) may be initiated 3 days prior to surgery as the INR decreases. In the absence of other factors that predispose the patient to bleeding events, warfarin may be safely resumed 1 to 2 days after surgery.

Stopping warfarin 1 to 2 weeks prior to is unnecessary. Furthermore, a longer interval between cessation of warfarin and initiation of LMWH treatment may create a longer window where the patient is at risk for thromboembolic events.

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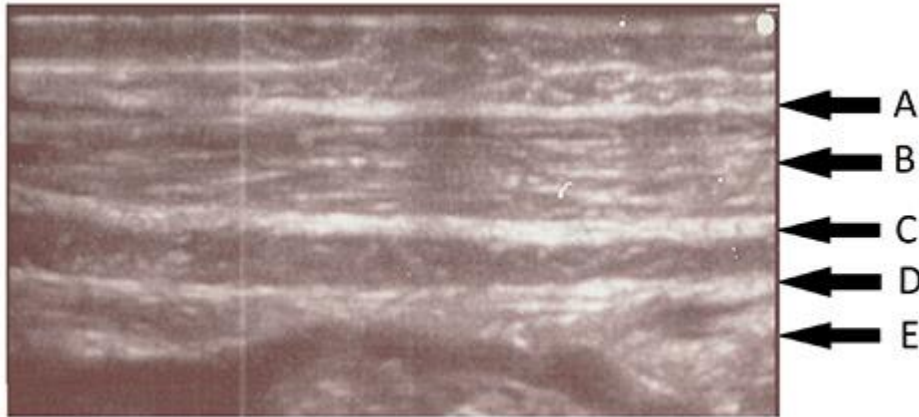
Stopping warfarin the day of surgery and initiating LMWH the same day will place the patient at an increased risk for bleeding.

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234. A 42-year-old woman undergoes deep inferior epigastric artery perforator flap breast reconstruction. An ultrasound-guided transversus abdominis plane regional block with liposomal bupivacaine is planned. The ultrasound probe is placed directly over the abdominal wall musculature in the anterior axillary line. The sonographic image is shown. Injection at which of the following levels is most appropriate?



- A)
- B)
- C)
- D)
- E)

The correct response is Option C.

Transversus abdominis plane regional anesthetic blocks have been shown to decrease narcotic consumption and abdominal pain following abdominal-based microsurgical breast reconstruction. The sensory nerves to the anterior abdominal wall run in the interfascial plane between the internal oblique and transversus abdominis muscles. A successful regional block depends on precise identification of the proper plane for the injection. The arrow indicated by letter C represents the transversus abdominis plane.

The arrow indicated by letter A indicates the interfascial plane between the internal and external oblique muscles.

The arrow indicated by letter B indicates the body of the internal oblique muscle.

The arrow indicated by letter D indicates the peritoneum.

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The arrow indicated by letter E indicates the contents of the abdominal cavity.

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235. A 23-year-old man presents 1 week after an altercation, during which he sustained a spiral fracture of the metacarpal bone of the ring finger with malrotation. No reduction was performed at the time of injury. Which of the following forms of osteosynthesis is most likely to provide sufficient stability to allow early motion in this patient?

- A) External fixation
- B) Internal plate fixation with monocortical screws
- C) Lag screw technique
- D) Noncompressive intramedullary nail
- E) Percutaneous Kirschner wire fixation

The correct response is Option C.

Absolute stability is achieved with constructs that heal by primary (Haversian) healing. These constructs do not allow micromotion, are low strain at the fracture site, and have high fixation stiffness. This form of bone healing occurs with absolute fracture stability, direct osteonal remodeling, and no callus formation.

Relative stability allows for indirect healing, which goes through the phases of inflammation, soft callus formation, hard callus formation, and then remodeling.

Of the choices, lag screw technique is the only one that will achieve primary healing of a fracture.

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236. A 24-year-old woman who works as a radiology technologist presents to the emergency room 1 hour after her right hand was exposed to an estimated 5 Gy of radiation. Examination shows no abnormalities. Which of the following is the most likely clinical outcome?

- A) Delayed dermal necrosis
- B) Extensive blistering of the entire hand
- C) Increased susceptibility to soft-tissue infections
- D) Transient erythema, pruritus, and hair loss
- E) No sequelae

The correct response is Option D.

The upper extremity is commonly affected in workplace and industrial fluoroscopy accidents.

Mild, or low, energy exposures (less than 10 Gy) are generally associated with a transient erythema, itching, and loss of hair. Moderate exposures (10 to 20 Gy) can have more immediate erythema that will resolve but then reoccur 1 to 2 weeks following injury. Higher exposures (greater than 20 Gy) are associated with more immediate symptoms of erythema and pain and can lead to complete tissue necrosis. *Pseudomonas* infection has been reported in these injuries but is more commonly involved in more severe cases that necessitate amputation.

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237. Which of the following standard tools is most appropriate for reporting systematic reviews and meta-analyses that assess the benefits and harms of health care intervention?

- A) Cochrane
- B) Introduction, Methods, Results, and Discussion (IMRaD)
- C) Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA)
- D) Quality of Reporting Meta-analyses (QUOROM)
- E) Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT)

The correct response is Option C.

The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement has been published and endorsed by many high-impact medical journals as the standard tool to be used for systematic review and meta-analysis. The PRISMA standard supersedes the Quality of Reporting of Meta-analyses (QUOROM) standards. The Cochrane is a charitable group that conducts systematic reviews of health care interventions and diagnostic tests and publishes them in the Cochrane Library. Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) provides evidence-based recommendations for the minimum content of a clinical trial protocol. The Introduction, Methods, Results, and Discussion (IMRaD) format refers to standard structure for scientific writing.

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238. A 46-year-old woman presents with new-onset pain following below knee amputation. Medical history includes a Gustilo IIIB left leg injury and failed limb salvage 3 years ago. The patient reports phantom sensation, pain in her great toe, burning that ascends the limb, and several points along the distal stump that are inappropriately tender. On examination, a well - healed amputation stump without evidence of unstable skin or skin changes consistent with pressure - related trauma is noted. Targeted muscle reinnervation surgery is planned. Which of the following is the most likely evolution of neuropathic pain at 4 weeks and 6 months postoperatively in this patient?

	4 Weeks	6 Months
A)	Decreased	decreased
B)	Decreased	increased
C)	Increased	decreased
D)	Increased	increased

The correct response is Option C.

Targeted muscle reinnervation (TMR), as originally described by Dumanian and Kuiken, is a procedure in which sensory and/or mixed nerves are transferred or coapted to motor nerve branches, in an effort to promote organized nerve growth and also to improve prosthetic control. While initially explored for improvement of prosthetic functionality, researchers observed a concomitant reduction in neuropathic and residual limb pain.

Though more research is needed, targeted muscle reinnervation may be most successful in decreasing or preventing pain when performed at the time of the amputation. The natural history of pain following TMR performed secondarily (not at the time amputation) includes a period of immediate relief (nerves are cut proximal to the neuroma), followed by activation of the nerves and increased pain (3 to 6 weeks), and plateau and reduction of pain (6 weeks to 6 months).

Nearly all patients report a decrease in pain and improvement in quality of life. The degree with which the pain is decreased and life is improved may be related to the timing of the operation. Data suggest that the earlier the operation is performed, the better the results, perhaps because of the centralization of the somatic pain response, though more work is needed to elucidate this mechanism.

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239. Plastic surgery, like all surgical specialties, demonstrates a lack of racial and ethnic diversity in its workforce, including its resident workforce. According to the American Association of Medical Colleges' definition of racial and ethnic underrepresentation in the medical profession, which of the following is the most appropriate description of the plastic surgery resident workforce as of 2017?

- A) Asian people are proportionally represented
- B) Black people are underrepresented
- C) Latinx people are proportionally represented
- D) White, non-Latinx people are overrepresented

The correct response is Option B.

Since 2000, the white residency population has been appropriately represented, meaning commensurate with the population as a whole in the United States. The Latinx and Black populations are represented at about half of their population in the United States. The Asian populations are represented at four to five times their population in the United States. The Pacific Islanders, Native/First Peoples, and Mixed Races percentages are too small to make meaningful analysis about whether they are appropriately represented or under-represented.

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240. A 56-year-old man presents to the emergency department with fever and neck pain 2.5 weeks after undergoing posterior cervical spine fusion. Clinical examination shows peri-incisional edema and erythema. CT scan shows a deep posterior fluid collection. The orthopedic surgery team plans surgical treatment with debridement and washout and consults the plastic surgeon for obliteration of an anticipated dead space. A Mathes and Nahai type II muscle flap is planned for reconstruction. Which of the following arteries is most likely involved in this reconstruction?

- A) Circumflex scapular
- B) Occipital
- C) Thoracoacromial
- D) Thoracodorsal
- E) Transverse cervical

The correct response is Option E.

The transverse cervical artery is the main pedicle to the trapezius muscle flap (type II muscle), which is particularly suitable for high cervical defects since the paraspinal muscles are of limited size and mobility at this level. The main pedicle of the trapezius flap enters the deep aspect of the muscle approximately 8 cm from the midline at the level of C7. Following identification of the main pedicle, the lateral aspect of the muscle is divided to permit transposition into the defect.

Postoperative wound complications following spinal procedures approach 40% in high-risk patients. Thus, combined reconstructive approaches with orthopedic surgery and neurosurgery are common for management of these complex soft-tissue defects. Key management principles include timely debridement, bony fixation, and dead space obliteration. Therefore, muscle flaps are particularly suitable for reconstruction.

A branch of the occipital artery is the dominant pedicle to the sternocleidomastoid flap, which is not a suitable reconstructive option for coverage of a posterior cervical defect. The circumflex scapular artery is the dominant pedicle to the scapular/parascapular fasciocutaneous (not muscle) flaps. The thoracoacromial artery is the dominant pedicle to the pectoralis major muscle (type V muscle). The thoracodorsal artery is the dominant pedicle to the latissimus dorsi muscle (type V muscle).

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241. A 7-year-old child presents to the clinic for postoperative examination after undergoing excision of a melanocytic nevus from the left thigh 9 days ago. During the past several days, the skin has become increasingly red and itchy despite the application of antibiotic ointment three times daily. Prior treatment with similar ointment did not elicit the same response. On examination, the area around the incision shows well-demarcated erythema and scaly skin. This disease process is consistent with which of the following hypersensitivity reactions?

- A) Type I
- B) Type II
- C) Type III
- D) Type IV

The correct response is Option D.

There are two forms of contact dermatitis: irritant and allergic. Irritant contact dermatitis is caused by the non-immune-modulated irritation of the skin by a substance, leading to skin changes. Allergic contact dermatitis is a delayed hypersensitivity reaction in which a foreign substance comes into contact with the skin; skin changes occur after reexposure to the substance. Common causes include poison ivy, nickel, and fragrances. Because this patient was exposed to antibiotic ointment with no prior response, this is likely an allergic reaction to antibiotic ointment.

Allergic contact dermatitis is a type IV, T-cell mediated, delayed hypersensitivity reaction in which a foreign substance comes into contact with the skin and is linked to skin protein, forming an antigen complex that leads to sensitization. Upon reexposure of the epidermis to the antigen, the sensitized T cells initiate an inflammatory cascade, causing the skin changes associated with allergic contact dermatitis.

There are four types of hypersensitivity reactions. Type I hypersensitivity reactions (e.g., anaphylaxis) are IgE-mediated and occur very quickly after exposure. It is associated with allergens such as bee stings, peanuts, and certain medications. Type II hypersensitivity reactions are cytotoxic/antibody-mediated reactions (e.g., hemolytic reactions, Goodpasture syndrome, and hyperacute graft rejection). Type III hypersensitivity reactions are mediated by immune complex IgG and IgM antibodies, and include certain diagnoses like hypersensitivity pneumonitis, systemic lupus erythematosus, polyarteritis nodosa, and serum sickness.

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242. A 20-year-old ambulatory man with a history of prolonged hospitalization presents with an evolving sacral wound. The patient has adequate nutrition, and the wound is covered with a foam dressing. Which of the following is an independent risk factor for the development of a pressure ulcer in this patient?

- A) Dry wound environment
- B) Intact sensorium
- C) Male sex
- D) Serum prealbumin 20 mg/dL
- E) Young age

The correct response is Option C.

Pressure sores develop from unrelieved pressure over a bony prominence. There are nearly 2.5 million pressure ulcers treated each year in the United States. They represent an 11-billion-dollar, labor-intensive task for our health care system. Prevention is key. Medical and socioeconomic conditions affect outcomes and these factors cannot always be controlled. However, mechanical prophylaxis, good nutrition, and prevention of underlying infection form the cornerstones of management. Independent risk factors for pressure sores include advanced age, male sex, altered sensorium, moisture, immobility, malnutrition, and friction/shear injury.

Nutritional status can be measured by the concentration of serum prealbumin. It is now preferred over albumin because of its shorter half-life and ability to show relative changes of the nutritional state. Prealbumin, also named transthyretin, is a transport protein for thyroid hormone and is synthesized by the liver and partly catabolized by the kidneys. Normal concentrations are 16 to 35 mg/dL. Serum prealbumin concentrations less than 10 mg/dL are associated with malnutrition.

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243. A 7-year-old boy of Japanese descent is brought to the clinic by his mother because she is concerned that he is "allergic to the sun." Medical history includes sunburns, with minimal sun exposure causing severe sunburns, and significant freckling at 2 years of age. The patient's other siblings are unaffected despite having similar complexions. A biopsy of a raised skin lesion on the cheek is performed, and results demonstrate squamous cell carcinoma. Which of the following is the inheritance pattern of this child's most likely condition?

- A) Autosomal dominant
- B) Autosomal recessive
- C) Multifactorial
- D) X-linked dominant
- E) X-linked recessive

The correct response is Option B.

This young boy has xeroderma pigmentosum (XP), an autosomal recessive disorder that affects approximately 1 in 250,000 patients. A defect in DNA cellular repair mechanisms makes them highly susceptible to DNA mutations leading to cutaneous malignancies at an early age. XP is present in all races, but it is more common in persons of Japanese ancestry. It is characterized by sensitivity to sunlight leading to severe sunburns, early freckle development, and early skin cancer development. XP patients younger than the age of 20 years have a 20,000-fold increased risk for nonmelanoma skin cancer, a 2000-fold increased risk for melanoma, a 100,000-fold increase in tongue cancers, and a 50-fold increase in neurologic cancers. The average age of diagnosis of a first nonmelanoma skin cancer in XP patients is 8 to 9 years old.

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244. A 65-year-old man undergoes hemimandibulectomy and reconstruction with a fibular flap for oral squamous cell carcinoma. On postoperative day 4, the patient develops a cough and feels ill. Temperature is 39.4°C (102°F), blood pressure is 80/40 mmHg, heart rate is 120 bpm, and respiratory rate is 32/min. On physical examination, the surgical sites are unremarkable. Intravenous fluid resuscitation is promptly initiated. Blood cultures are collected and broad-spectrum antibiotics are administered. Which of the following is the most appropriate next step in management?

- A) Administering additional fluid resuscitation with hydroxyethyl starch
- B) Initiating low-dose dopamine for renal protection
- C) Measuring lactate level
- D) Narrowing antimicrobial therapy based on culture results
- E) Placing a pulmonary artery catheter

The correct response is Option C.

Measuring lactate level is the most appropriate next step in management of this patient who is developing sepsis/septic shock in the postoperative period.

In the 2018 update of the 2016 Surviving Sepsis Campaign guidelines, an Hour-1 Bundle was modified to reflect the need to begin resuscitation and management of patients with sepsis and septic shock immediately upon presentation. The Hour-1 bundle includes:

- Measuring lactate level. To be re-measured in 2 to 4 hours if initial lactate is > 2 mmol/L
- Obtaining blood cultures prior to administration of antibiotics
- Administering broad-spectrum antibiotics
- Rapidly administering 30 mL/kg crystalloid for hypotension or lactate ≥ 4 mmol/L
- Initiating vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥ 65 mmHg

Serum lactate levels, although not a direct measure, can serve as a surrogate of tissue hypoperfusion. Randomized controlled trials have demonstrated a significant reduction in mortality when lactate-guided resuscitation is employed.

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The 2016 Surviving Sepsis Campaign recommended against using low-dose dopamine for renal protection (lack of evidence supporting its efficacy), against providing fluid resuscitation with hydroxyethyl starch (higher risk for death compared with other fluids), and against routine use of pulmonary artery catheters (lack of evidence in improving septic patient outcomes). It does recommend narrowing of antimicrobial therapy based on culture results, but these would not be available in this patient's early phase of management.

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245. A 10-month-old female infant undergoes examination for an enlarging bright red mass involving the left cheek and lower eyelid. Her parents report that the mass was not present at birth but has grown rapidly over the past 9 months. Following cardiology clearance, propranolol treatment is initiated and gradually increased to a dosage of 2 mg/kg/day. Which of the following electrolyte imbalances is the most likely side effect in this patient?

- A) Hypercalcemia
- B) Hyperkalemia
- C) Hypermagnesemia
- D) Hypernatremia
- E) Hyperphosphatemia

The correct response is Option B.

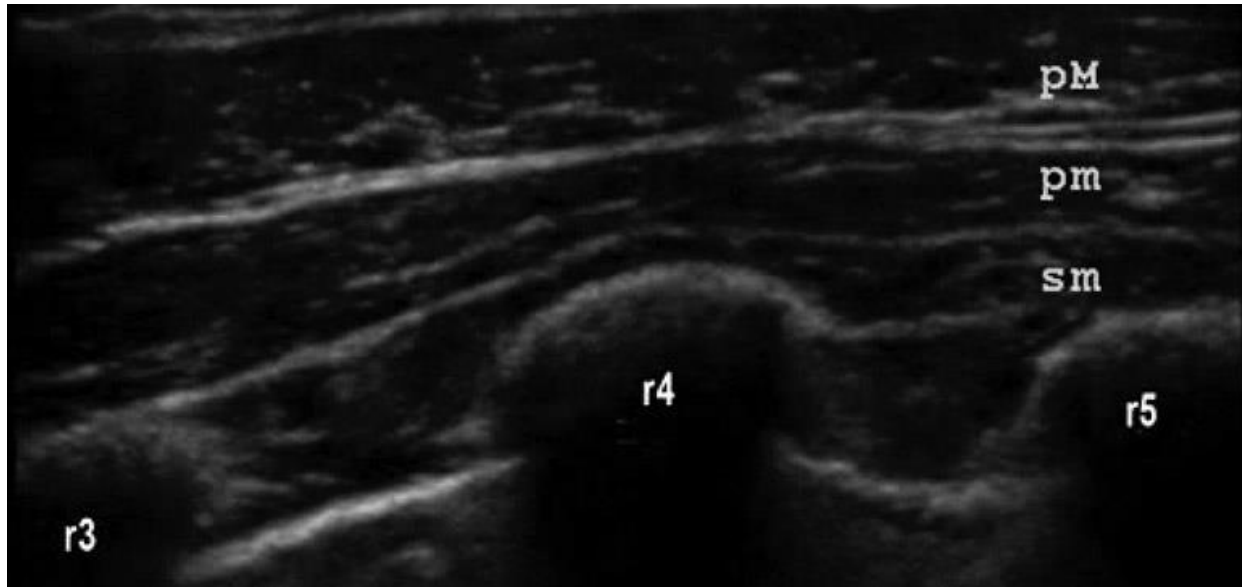
Infantile hemangiomas are the most common benign tumors in infancy. Their clinical course is characterized by a period of rapid growth over 6 to 12 months (proliferative phase), followed by slow involution over the subsequent 1 to 5 years. In the absence of visual, nasolaryngeal, and auditory canal obstruction, conservative/medical management is recommended. Recently, the efficacy of propranolol, a nonselective beta-adrenergic blocker, has been demonstrated in treating hemangiomas and has established itself as a first-line treatment option. Adverse effects, however, include bradycardia, hypoglycemia, and electrolyte imbalances, notably hyperkalemia.

Hypercalcemia, hypermagnesemia, hypernatremia, and hyperphosphatemia have not been associated with the administration of propranolol.

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246. A 43-year-old woman is scheduled to undergo bilateral tissue expander-based breast reconstruction. Preoperative pectoral nerve 1 and 2 blocks with liposomal bupivacaine with ultrasound guidance is performed. An image is shown. When performing pectoral nerve 1 block in this patient, which of the following is the most appropriate location for infiltration of the local anesthetic?

- A) Between the breast parenchyma and pectoralis major
- B) Between the pectoralis major and pectoralis minor
- C) Between the pectoralis minor and the serratus anterior
- D) Between the serratus anterior and the latissimus dorsi

The correct response is Option B.

The pectoral nerve (PECS) 1 and 2 anesthetic blocks have become increasingly common methods for regional anesthesia to decrease postoperative pain in many early recovery after surgery (ERAS) protocols. The PECS blocks are thoracic regional fascial plane blocks that typically require ultrasound guidance for proper infiltration of the anesthetic between the muscles of the thoracic wall.

A PECS 1 block is performed between the pectoralis major and pectoralis minor muscles and anesthetizes the lateral and medial pectoral nerves. A PECS 2 block, in addition to the PECS

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1 block, involves an additional injection of anesthetic between the pectoralis minor and serratus anterior muscles and blocks the intercostal and intercostobrachial nerves. The serratus plane block is another thoracic regional fascial plane block requiring injection of local anesthetic between the serratus anterior and latissimus dorsi muscles in order to block the long thoracic and thoracodorsal nerves.

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247. A 51-year-old woman with history of right breast invasive ductal carcinoma (IDC) status post right skin-sparing mastectomy, axillary node dissection, and adjuvant radiation therapy presents to discuss delayed breast reconstruction. Her recent positron emission tomography scan was negative for distant metastasis. Her pathology report shows positive estrogen receptor, positive progesterone receptor, negative human epidermal growth factor receptor, and an IDC 2.5 cm in size with three positive axillary lymph nodes. Based on these findings, which of the following is the TNM classification for this tumor?

- A) T1 N2 M0
- B) T1 N3 M1
- C) T2 N1 M0
- D) T2 N3 M0
- E) T3 N2 M0

The correct response is Option C.

The tumor node metastasis (TNM) classification helps to stage tumors. Based on the information given about this breast cancer patient, she would be staged as T2 (primary tumor is 2.5 cm), N1 (three axillary nodes involved), and M0 (no evidence of metastatic disease on systemic radiologic workup. Please see the TNM classification system below.

Tumor staging: Tx - tumor cannot be assessed; T0 - no evidence of primary tumor; T1 - tumor less than 2 cm; T2 - tumor greater than 2 cm but less than 5 cm; T3 - tumor greater than 5 cm; T4 - tumor with direct extension into chest wall or skin.

Node staging: Nx - nodes cannot be assessed; N0 - no nodal involvement; N1 - one to three ipsilateral nodes involved; N2 - four to nine ipsilateral or internal mammary nodes involved; N3 - ten or more ipsilateral nodes.

Metastasis staging: Mx - distant spread cannot be assessed; M0 - no distant spread; M1 - cancer has spread to distant organs or liver.

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248. An otherwise healthy 20-year-old man is brought to the emergency department after sustaining burns to the right forearm and upper arm while trying to light an outdoor grill. Examination of the burned extremity shows red, blistered, painful areas, as well as areas that are white in color and not tender to palpation. The burns are noncircumferential. The patient is breathing comfortably, and pulse oximetry is 99% on room air. This patient should be transferred to a burn center on the basis of which of the following criteria?

- A) Age of the patient
- B) Burn depth
- C) Burn location
- D) Burn mechanism
- E) Total body surface area of the burn

The correct response is Option B.

The depth of this patient's burns, being third-degree (white, not tender to palpation), would qualify him for transfer to a burn center for treatment. In this patient, the arm represents a total body surface area of 9% of the patient. He is young and otherwise healthy; thus, he does not warrant transfer based on age. The burn does not involve sensitive areas such as the face, hands, feet, or genitalia/perineum. Also, since this is not an electrical or chemical burn, and it occurred in an outdoor area, inhalation injury is unlikely.

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249. A 65-year-old man with C5 quadriplegia presents with a pressure ulcer of the right ischium. The ulcer has been present for several months but has been exacerbated recently since he moved into a nursing home several weeks ago. Examination of the wound shows a 5 × 5-cm open wound that extends into the subcutaneous tissue. Palpation of the base of the wound demonstrates a soft yellow eschar. There is no purulence present. The patient does not desire reconstruction, and treatment with leptospermum honey is initiated. Regarding topical wound care, which of the following is the mechanism of medical honey?
- A) Absorbs wound fluid through ion exchange
 - B) Cleaves necrotic tissue along denatured collagen strands
 - C) Creates a germicidal, bacteriostatic wound environment
 - D) Denatures nonviable protein in the wound bed
 - E) Draws fluid from deep tissues to the wound surface through osmosis

The correct response is Option E.

For patients who are not candidates for surgery, medical management of complicated wounds is a mainstay of treatment. In addition to typical behavioral modifications (pressure-offloading, nutrition optimization, managing medical comorbidities, etc), topical wound care treatments may offer additional help in controlling the wound bed of these complicated injuries.

Honey works through two key mechanisms of action: 1) it acts as an osmotic engine to draw fluid from deeper tissues to the wound surface to promote removal of devitalized tissue; 2) it makes the wound environment more acidic and more favorable for healing.

Alginate dressings work by absorbing wound fluid through ion exchange. They come in forms including hydrogels, films, foams, and sponges, absorbing wound fluid and resulting in gels that maintain a physiologically moist environment and minimize bacterial infections.

Collagenase debrides by cleaving necrotic tissue at seven specific sites along the denatured collagen strand. The denatured collagen process creates bioactive peptide byproducts, inducing a cellular response fibroblast, keratinocyte and endothelial cell migration to the wound bed, and are associated with the proliferative phase of wound healing.

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When combined together, papain and urea (Accuzyme, Panafil) bring about two supplemental chemical actions: 1) to expose by solvent action the activators of papain, and 2) to denature the nonviable protein matter in lesions, and thereby render it more susceptible to enzymatic digestion. It is no longer available in the United States.

Dakin's solution consists of a dilute solution of sodium hypochlorite (NaClO), commonly known as bleach. The main active agent in the Dakin solution is created when the chlorine in the solution reacts with water in the environment to form hypochlorous acid (HClO). This hypochlorous acid produces the potent antibacterial effect in tissues. Unlike stronger germicidal solutions that contain carbolic acid or iodine, Dakin does not damage living cells or lose potency in the presence of blood serum. It has a solvent action on dead cells that hastens the separation of dead tissue from living tissue.

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250. A 7-year-old girl presents with right facial paralysis caused by perinatal trauma. Facial reanimation is planned using a free gracilis muscle flap. When compared with the masseteric branch as the donor nerve, using a cross-facial nerve graft is more likely to provide which of the following benefits to this patient?

- A) Fewer operative procedures
- B) Greater commissure excursion when smiling
- C) Higher axon count
- D) More durable result as the patient grows
- E) More spontaneous, coordinated smile

The correct response is Option E.

Cross-facial nerve grafts result in a more spontaneous, coordinated smile when compared with using the masseteric nerve as the donor, as it employs the patient's natural neuronal pathway for smiling. In addition, the contralateral facial nerve that controls the commissure on the intact side also controls the commissure on the reconstructed side, the presumed reason for the more coordinated smile.

Free gracilis muscle transfer is the most frequently discussed dynamic reconstruction of elevation of the commissure (smiling) in the literature. Motor nerves used to power the gracilis include cross-facial nerve grafting, the motor nerve to the masseter muscle, the hypoglossal nerve, the spinal accessory nerve, or combinations of these motors.

Cross-facial nerve grafting requires a separate procedure to place a nerve graft from the contralateral facial nerve, adding to the overall number of procedures to achieve smiling, compared with using the masseteric nerve as donor. The number of required revision procedures is thought to be the same for both approaches. Excursion (the amount of rise of the commissure) is better with the masseteric motor nerve. Children do not seem to "outgrow" facial nerve reanimation surgeries in long term follow-up. The masseteric nerve has a higher axon count than the distal end of the cross-facial nerve graft.

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American Society of Plastic Surgeons
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In-Service Examination

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In-Service Examination

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238	(A)	(B)	(C)	(D)	
239	(A)	(B)	(C)	(D)	
240	(A)	(B)	(C)	(D)	(E)
241	(A)	(B)	(C)	(D)	
242	(A)	(B)	(C)	(D)	(E)
243	(A)	(B)	(C)	(D)	(E)
244	(A)	(B)	(C)	(D)	(E)
245	(A)	(B)	(C)	(D)	(E)
246	(A)	(B)	(C)	(D)	
247	(A)	(B)	(C)	(D)	(E)
248	(A)	(B)	(C)	(D)	(E)
249	(A)	(B)	(C)	(D)	(E)
250	(A)	(B)	(C)	(D)	(E)

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