

# Taking Your Examination Offline

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.
- Once you have finished entering your answers, be sure to save them by clicking “Save.” If you close the answer sheet page without clicking one of these links, your answers will not be saved.
- You may return to the answer sheet to enter or review answers as many times as you like during the testing window as long as you do not submit your answers or select “End Exam” in the online exam.

When you are ready to submit your final answers for scoring, click the “Submit” link. A pop-up box will appear, asking you to confirm your decision to submit your responses at this time. Click “OK” to continue with submission or “Cancel” to return to the answer sheet. Once you click “Submit” and respond “OK” to the pop-up box, you will receive a message indicating your responses have been submitted. If you have selected the option for an email confirmation, an email will be sent to you indicating that the examination has been completed. Once you submit your final answers for scoring, you will not be able to review or modify your answers. All final answers must be submitted **by 3pm Eastern Time on April 7, 2016.**

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.

# American Society of Plastic Surgeons In-Service Examination



AMERICAN SOCIETY OF  
PLASTIC SURGEONS®

Copyright © 2016 by the American Society of Plastic Surgeons® (ASPS) as to all content and test materials. All rights reserved. Copyright © 2016 by Internet Testing Systems (ITS) as to the computer presentation of test materials. All rights reserved.

This examination contains test materials that are owned and copyrighted by the ASPS. Any reproduction of these materials or any part of them, through any means, including but not limited to, copying or printing of electronic files, reconstruction through memorization and/or dictation, and/or dissemination of these materials or any part of them is strictly prohibited.

Prepared in cooperation with the National Board of Medical Examiners®.

The mission of the American Society of Plastic Surgeons® is to support its members in their efforts to provide the highest quality patient care and maintain professional and ethical standards through education, research and advocacy of socioeconomic and other professional activities.

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 2016.

**ASPS In-Service Exam Committee**  
**Writing 2016 In-Service Exam**  
*John A. Girotto, MD, MMA, FAAP, FACS, Overall Chair*

| <b>Comprehensive</b>                      | <b>Hand and Lower Extremity</b>                  | <b>Craniomaxillofacial</b>                  | <b>Breast and Cosmetic</b>                   | <b>Core Surgical Principles</b>    |
|-------------------------------------------|--------------------------------------------------|---------------------------------------------|----------------------------------------------|------------------------------------|
| <i>Karol A. Gutowski, MD, FACS, Chair</i> | <i>Sean M. Bidic, MD, MFA, FAAP, FACS, Chair</i> | <i>Peter J. Taub, MD, FAAP, FACS, Chair</i> | <i>Lawrence S. Glassman, MD, FACS, Chair</i> | <i>C. Scott Hultman, MD, Chair</i> |
| James Boehmler, MD                        | Glenn A. Becker, MD                              | Ash Bhattacharya, MD, FACS                  | Andrew Barnett, MD                           | Richard Baynosa, MD                |
| Albert Chao, MD                           | Jerome D. Chao, MD                               | Edward Caterson, MD                         | John Bauer, MD                               | Mark Brzezienski, MD               |
| Umar Choudry, MD                          | Andrew Chen, MD, FACS                            | Lisa R. David, MD, FACS                     | Devra Becker, MD                             | Jeffrey Larson, MD                 |
| Arin Greene, MD, MMSc                     | Thomas Davenport, MD, FACS                       | Wellington Davis, MD                        | Marc Elkowitz, MD                            | James Liau, MD                     |
| Eric Halvorson, MD                        | William W. Dzwierzynski, MD                      | Alexander Davit, III, MD                    | Thomas Fiala, MD                             | Jonathan Mathy, MD                 |
| Adam Hamawy, MD, FACS                     | Scott Hansen, MD, FACS                           | Jeffrey Flagg, MD                           | Brian Glatt, MD, FACS                        | Samuel Poore, MD                   |
| Jeffrey E. Janis, MD                      | Randy Hauck, MD                                  | Brian Gastman, MD                           | Robert Goldstein, MD                         | J. Gui Christiano, MD, FACS        |
| Ergun Kocak, MD                           | Scott Lifchez, MD                                | Jesse Goldstein, MD                         | Tad Grenga, MD                               | Albert Losken, MD                  |
| Bernard T. Lee, MD                        | Zubin J. Panthaki, MD                            | Matthew M. Hanasono, MD                     | David M. Kahn, MD                            | Bruce Mast, MD                     |
| Reza Mirali, MD                           | Brian Pinsky, MD                                 | Anand Kumar, MD                             | Bram Kaufman, MD                             | Cindy Wu, MD                       |
| Ivo Pestana, MD                           | Gary F. Rogers, MD                               | Kerry Latham, MD                            | Michele Manahan, MD                          |                                    |
| Hani Sbitany, MD                          | A. Neil Salyapongse, MD                          | Evan Matros, MD                             | Nicole Nemeth, MD                            |                                    |
| PhD Schierle, MD                          | Alexander Spiess, MD                             | Gary F. Rogers, MD                          | Julie Park, MD                               |                                    |
| Matthew Steele, MD                        | Simon Talbot, MD                                 | Rachel Ruotolo, MD                          | Aldona Spiegel, MD                           |                                    |
| Michael Suzman, MD                        |                                                  | June Wu, AB, MD                             | Sarvam TerKonda, MD                          |                                    |

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 the 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.

## **Disclosure Policy and Disclosures**

The American Society of Plastic Surgeons® (ASPS) requires all instructors, planners, reviewers, managers, and other individuals in a position to control or influence the content of an activity to disclose all relevant financial relationships or affiliations. All identified conflicts of interest must be resolved and the educational content thoroughly vetted by ASPS for fair balance, scientific objectivity, and appropriateness of patient care recommendations. The ASPS also requires faculty/authors to disclose when off-label/unapproved uses of a product are discussed in a CME/CE activity or included in related materials.

**All identified conflicts of interests have been resolved.**

## **Disclosures of all Chairs, Speakers, Authors, Moderators, Reviewers, Committee Members and other appropriate individuals:**

Devra Becker, MD – Food/Beverage recipient relationship with Sientra; Food/Beverage recipient relationship with Allergan

Mark Brzeziński, MD – Speaker relationship with LifeCell Corporation/KCI; Consultant relationship with Allergan; Consultant relationship with Mentor Corporation/Ethicon/J&J; Grant recipient relationship with PACIRA

Thomas Davenport, MD – Speaker's bureau member relationship with Mimedx

William Dzwierzynski, MD – Speaker relationship with Auxillium

Marc Elkowitz, MD – Shareholder (excluding diversified mutual funds) relationship with Pfizer

Jeffrey Flagg, MD – Speaker's bureau member relationship with HealthPoint Biotherapeutics, Soluble Systems, LLC

Karol Gutowski, MD – Speaker's bureau member relationship with Surgical Specialties Corporation; Speaker's bureau member relationship with Viora; Speaker relationship with Suneva Medical; Advisor relationship with RTI

Jeffrey Janis, MD – Honorarium recipient relationship with PACIRA; Consultant relationship with LifeCell Corporation/KCI; Royalty recipient relationship with CRC Press/QMP

Albert Losken, MD – Speaker relationship with LifeCell Corporation

Bruce Mast, MD – Consultant relationship with RTI, Inc.; Grant recipient relationship with LifeCell Corporation/KCI; Grant recipient relationship with Mentor Corporation/Ethicon/J&J; Grant recipient relationship with Synthes

Nicole Nemeth, MD – Consultant relationship with Ethicon/J&J

Hani Sbitany, MD – Speaker's bureau relationship with LifeCell Corporation/KCI

Aldona Spiegel, MD – Consultant relationship with Mentor Corporation/Ethicon/J&J, Consultant relationship with Musculoskeletal Transplant Foundation

Matthew Steele, MD – Consultant relationship with LifeCell Corporation/KCI

**With the exception of those indicated above, the Chairs, Authors, Reviewers, Committee Members, Volunteers and Staff involved with developing and producing the 2016 In-Service Exam have indicated that they have no conflicts of interest relating to the activity to disclose.**

## **Accreditation and Designation Statement**

The American Society of Plastic Surgeons® (ASPS) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The ASPS designates this enduring material for a maximum of **37.5 AMA PRA Category 1 Credits™**. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Of the 37.5 credits, 7.5 have been identified as being applicable to Patient Safety.

---

The management, discussion and recommended answers for this test represent the combined opinions of the authors and reviewers. They are not endorsed by nor do they constitute a standard of practice of the American Society of Plastic Surgeons.

© 2016 American Society of Plastic Plastic Surgeons®. All rights reserved.

Prepared in cooperation with the National Board of Medical Examiners®.

# The American Society of Plastic Surgeons

## HONOR CODE STATEMENT

for the

In-Service Examination



AMERICAN SOCIETY OF  
PLASTIC SURGEONS®

I understand that successful completion of this examination is intended to attest to my current knowledge of the specialty of plastic surgery. I understand also that this is a proctored examination for resident participation and is a non-proctored examination for surgeons in practice. I am bound on my honor to take it alone – without the aid of, or consultation with, any other individual. Thus, I may not contact, directly or indirectly, other participants in this In-Service Examination.

Although the images and questions may be downloaded and printed for use by participants during the examination period, they remain the property of the American Society of Plastic Surgeons and may not be shared with anyone else or used in any other context. Electronic files of the examination must be deleted.

By taking this examination, I acknowledge that I have read this honor code statement and agree to abide by the terms stated therein.

# Section 1: Comprehensive

1. A 45-year-old man sustains a laceration of the ulnar nerve proximal to the elbow. He has loss of intrinsic hand function. At the time of surgical repair, there is a 1-cm gap in the nerve. Which of the following is the most appropriate management of this injury?
- A) Interposition nerve conduit
  - B) Interposition nerve grafting
  - C) Primary repair only
  - D) Primary repair with anterior transposition
  - E) Primary repair with distal nerve transfer

The correct response is Option E.

The most appropriate management of this injury is to repair the ulnar nerve primarily and perform a distal nerve transfer as well.

The ulnar nerve is one of the two upper extremity nerves that supply motor input to the intrinsic muscles of the hand (the other being the median nerve). It supplies the interossei, hypothenar muscles, ulnar lumbricals, and the adductor pollicis muscles. These small muscles of the hand are vital for proper thumb and finger function. Because of their small size and delicate nature, they are very sensitive to denervation, and over a period of 9 to 12 months atrophy beyond repair. The aim of nerve repair is to reestablish nerve signals to the end-organ (i.e., muscle) prior to irreversible denervated muscle. The injury described is a good 18 inches or so away from the hand, and regeneration of the motor fibers to the intrinsic muscles would only occur after at a rate of an inch a month, by which time permanent atrophy would have already occurred. Primary repair alone can lead to suboptimal intrinsic muscle function despite excellent technical repairs. Distal nerve transfers help prevent the denervational atrophy by "babysitting" the muscles during the time it takes for the ulnar nerve to regenerate its motor fibers to the end-organ/muscles. The terminal branch of the anterior interosseous nerve (AIN) is most commonly used as the donor nerve. An end-side neurorrhaphy is performed to the ulnar motor fascicles in the distal forearm, a distance which results in reinnervation of the intrinsic muscles well before the 9- to 12-month mark.

The known topography of the ulnar nerve allows the surgeon to coapt the donor nerves to the appropriate motor recipient site of the ulnar nerve. An end-end coaptation of the terminal AIN to the motor fascicle of the ulnar nerve is also an option.

Nerve grafts or conduits are not required to repair the nerve injury in this clinical scenario. A 1-cm gap can usually be primarily repaired after dissecting the nerve and freeing it up proximally and distally. If further length is needed for tension-free repair, the ulnar nerve can be transposed anteriorly out of its natural position, giving another few centimeters of length.

## REFERENCES:

1. Novak CB, Mackinnon SE. Distal anterior interosseous nerve transfer to the deep motor branch of the ulnar nerve for reconstruction of high ulnar nerve injuries. *J Reconstr Microsurg*. 2002 Aug;18(6):459-464.
2. Haase SC, Chung KC. Anterior interosseous nerve transfer to the motor branch of the ulnar nerve for high ulnar nerve injuries. *Ann Plast Surg*. 2002 Sep;49(3):285-290.
3. Wang Y, Zhu S. Transfer of a branch of the anterior interosseus nerve to the motor branch of the median nerve and ulnar nerve. *Chin Med J (Engl)*. 1997 Mar;110(3):216-219.
4. Moore AM, Franco M, Tung TH. Motor and sensory nerve transfers in the forearm and hand. *Plast Reconstr Surg*. 2014 Oct;134(4):721-730.

2. A 50-year-old woman is scheduled to undergo bilateral deep inferior epigastric artery perforator (DIEP) flap breast reconstruction. A donor site regional block with liposomal bupivacaine is planned for analgesia. Which of the following injection locations is most likely to improve pain control and decrease narcotic use in this patient?
- A) Between external oblique and internal oblique fascias
  - B) Between internal oblique and transversus abdominis fascias
  - C) Deep to rectus abdominis fascia
  - D) Deep to transversus abdominis fascia
  - E) Subcutaneous plane

The correct response is Option B.

The patient is undergoing a transversus abdominis plane (TAP) block. TAP blocks have become popular adjunctive pain control measures for a variety of abdominal surgeries. They can either be performed transcutaneously with ultrasound guidance or under direct visualization in the operating room prior to closure of the abdominal donor site in deep inferior epigastric artery perforator (DIEP) or transverse rectus abdominis musculocutaneous (TRAM) flap surgeries. The segmental innervation to be blocked in the TAP block is located between the internal oblique and transversus abdominis muscles. Either infiltration of liposomal bupivacaine or placement of epidural catheters in the TAP space has been described.

## REFERENCES:

1. Zhong T, Ojha M, Bagher S, et al. Transversus abdominis plane block reduces morphine consumption in the early postoperative period following microsurgical abdominal tissue breast reconstruction: a double-blind, placebo-controlled, randomized trial. *Plast Reconstr Surg*. 2014 Nov;134(5):870-878.
2. Zhong T, Wong KW, Cheng H, et al. Transversus abdominis plane (TAP) catheters inserted under direct vision in the donor site following free DIEP and MS-TRAM breast reconstruction: a prospective cohort study of 45 patients. *J Plast Reconstr Aesthet Surg*. 2013 Mar;66(3):329-336. Epub 2012 Nov 9.
3. Rafi AN. Abdominal field block: a new approach via the lumbar triangle. *Anesthesia*. 2001 Oct;56(10):1024-1026.

3. A 35-year-old paraplegic man presents with a 5 × 5-cm pressure ulcer over his left ischium involving the skin, subcutaneous tissue, and bone. After debridement, a gluteal rotation flap is planned for closure. Compared with a transposition flap, which of the following is the most significant benefit of using a rotation flap for coverage of this patient's wound?
- A) Ability to reuse flap for future surgery
  - B) Decreased recurrence rate
  - C) Improved pressure relief
  - D) Improved scar placement
  - E) Improved vascularity

The correct response is Option A.

Ischial pressure ulcers can be one of the most difficult wounds for which to achieve long-term coverage and success. The best outcomes arise from multidisciplinary care teams that focus on pressure alleviation (both perioperative and chronic), nutrition, smoking cessation, muscle spasm management, and vigilant observation. Despite best efforts, ischial pressure ulcers still have up to a 70% recurrence rate. Because of high recurrence rates, surgical planning needs take potential future wounds into consideration. Large rotation or advancement flaps have the benefit of being able to be re-rotated or re-advanced, whereas transposition flaps do not, and can make future surgery more difficult. With good surgical planning, rotation and transposition flaps would not have a difference in vascularity, scar placement, pressure relief, or recurrence rates.

## REFERENCES:

1. Cushing CA, Phillips LG. Evidence-based medicine: pressure sores. *Plast Reconstr Surg*. 2013 Dec;132(6):1720-1732.
2. Rubayi S, Chandrasekhar BS. Trunk, abdomen, and pressure sore reconstruction. *Plast Reconstr Surg*. 2011 Sep;128(3):201e-215e.

4. A 45-year-old woman undergoes reconstruction of the right breast with a deep inferior epigastric artery perforator flap. Postoperatively, the flap shows signs of ischemia and is reexplored. During flap salvage, which of the following agents should be administered to inactivate thromboxane?
- A) Aspirin
  - B) Dextran
  - C) Heparin
  - D) Hirudin
  - E) Streptokinase

The correct response is Option A.

Aspirin, or acetylsalicylic acid, inhibits the enzyme cyclooxygenase. Cyclooxygenase ordinarily functions to form multiple compounds from arachidonic acid, including thromboxane and prostacyclin. Thromboxane is a platelet aggregator and vasoconstrictor. Prostacyclin is also a platelet aggregator. By decreasing formation of these compounds, aspirin acts as an anticoagulant.

Dextran is a polysaccharide whose mechanism of action is thought to involve decreasing platelet aggregation by altering the electric charge of platelets, as well as by decreasing blood viscosity. Dextran also acts as a volume expander.

Heparin is a glycosaminoglycan that binds to antithrombin III and enhances its ability to inactivate thrombin (which ordinarily converts fibrinogen to fibrin), as well as clotting factors IX, X, XI, and XII. Heparin may also additionally decrease thrombosis by causing nitric oxide-mediated vasodilation.

Hirudin is derived from the medicinal leech *Hirudo medicinalis* and functions by directly inhibiting thrombin, in contrast to heparin, which requires the antithrombin III cofactor.

Streptokinase is a thrombolytic agent that functions by activating plasminogen and its conversion to plasmin. In turn, plasmin breaks down fibrin into fibrin degradation products.

## REFERENCES:

1. Hanasono MM, Butler CE. Prevention and treatment of thrombosis in microvascular surgery. *J Reconstr Microsurg*. 2008 Jul;24(5):305-314. Epub 2008 Jul 9.
2. Askari M, Fisher C, Weniger FG, et al. Anticoagulation therapy in microsurgery: a review. *J Hand Surg Am*. 2006 May-Jun;31(5):836-846.

5. A 25-year-old woman who is considering female-to-male gender reassignment surgery inquires about penile reconstruction. The patient is interested in a technique that would involve the fewest number of total procedures. Which of the following techniques would be most appropriate?
- A) Free fibula flap
  - B) Free radial forearm flap
  - C) Metoidioplasty
  - D) Pedicled groin flap
  - E) Tissue expansion

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

The correct response is Option C.

Currently, there are several techniques available for penile reconstruction in patients undergoing female-to-male sex reassignment. Multiple goals are sought, including good appearance, standing micturition, sexual sensation, coital ability, and sufficient bulk to accommodate a stiffener.

In metoidioplasty, the clitoris is partially released and stretched, and the urethra is lengthened to reach the tip of the phallus using an anterior musculomucosal vaginal flap, which is done as a single-stage procedure. The advantages of this technique are a shorter procedure and lower risk of complications. Its disadvantages are a shorter phallus with decreased possibility of standing micturition.

Phalloplasty, in which a phallus is created de novo, can be performed using a variety of possible flaps, including anterolateral thigh, fibula, groin, latissimus dorsi, and radial forearm. Phalloplasty can seldom be performed in one stage because of the need to create a competent neourethra and is associated with a 20 to 40% rate of urinary complications (fistulas, stenoses). Soft-tissue-only flaps typically involve placement of a stiffener, which can be prosthetic or autologous, while the fibula flap results in a permanent erection. Free flaps (radial forearm, latissimus, fibula) involve lengthier microsurgical procedures, while some pedicled flaps (groin) necessitate a minimum of two stages.

Tissue expansion is not a method used for penile reconstruction in female-to-male sex reassignment surgery.

## **REFERENCES:**

1. Selvaggi G, Bellringer J. Gender reassignment surgery: an overview. *Nat Rev Urol*. 2011 May;8(5):274-281. Epub 2011 Apr 12.
2. Selvaggi G, Elander A. Penile reconstruction/formation. *Curr Opin Urol*. 2008 Nov;18(6):589-597.

6. Negative pressure wound therapy with a sponge dressing is CONTRAINDICATED in which of the following clinical scenarios?
- A) An abdominal wound with an enteric fistula
  - B) A dorsal hand wound with an exposed tendon
  - C) A lower extremity wound with acute osteomyelitis
  - D) Over a closed surgical incision
  - E) A radiated scalp wound with exposed bone

The correct response is Option C.

The use of negative pressure therapy (NPT) is contraindicated in wounds with active infection including osteomyelitis. Negative pressure dressings in these wounds convert an open, draining wound into a closed wound, which could potentially lead to abscess formation and/or sepsis. NPT has become an integral part of wound management over the past decade and a half. It is a commonly used wound dressing and/or chronic wound management tool. It is instrumental in acute wounds as well (e.g., lower extremity trauma, abdominal wall trauma), and as a skin graft bolster dressing. The major contraindications for its use include wounds with active infection such as untreated osteomyelitis, malignant wounds, wounds with exposed major vessels and/or organs, and wounds with unexplored and/or nonenteric fistulas.

Apart from the infected wound, all the wounds mentioned in the option set may benefit from the use of NPT. It may not be the definitive management for those wounds, but it could be used as a temporary measure prior to the definitive treatment. Recently, studies have shown that the use of NPT over closed incisions may reduce the risk for dehiscence and infections.

## REFERENCES:

1. Desai KK, Hahn E, Pulikkottil B, et al. Negative pressure wound therapy: an algorithm. *Clin Plast Surg*. 2012 Jul;39(3):311-324. Epub 2012 Jun 2.
2. Janis J, Harrison B. Wound healing: part II. Clinical applications. *Plast Reconstr Surg*. 2014 Mar;133(3):383e-392e.

7. A healthy 5-year-old boy is evaluated after he is bitten on the hand by a dog. He has an allergy to penicillin. Which of the following prophylactic antibiotic regimens is most appropriate to prescribe?
- A) Amoxicillin and clindamycin
  - B) Ciprofloxacin and metronidazole
  - C) Clindamycin only
  - D) Doxycycline and metronidazole
  - E) Trimethoprim-sulfamethoxazole and clindamycin

The correct response is Option E.

The most appropriate prophylactic regimen to prescribe in this clinical scenario is trimethoprim-sulfamethoxazole and clindamycin.

Dog bites to the hand are potentially dangerous bites that could lead to serious hand infections. The common microorganisms that cause infections in such bites are *Pasteurella* species, anaerobes, *Staphylococcus aureus*, and *Streptococcus*. The ideal antibiotic would have been amoxicillin-clavulanic acid, which covers most of these microorganisms. However, the child is allergic to penicillin, and, therefore, this drug is contraindicated. Another good option would have been amoxicillin and clindamycin (for the anaerobic coverage). However, for the same reason described above, it too cannot be used. Tetracyclines are contraindicated in children under 8 years of age owing to the ill effects on growing teeth and bones. Quinolones are also contraindicated in children under 18 years of age owing to their harmful effects on cartilage and joints. Although this is debatable, currently the use of quinolones in children is restricted by the Food and Drug Administration to certain specific conditions (cystic fibrosis, multidrug-resistant urinary tract infection, and inhalational anthrax). Clindamycin alone does not adequately cover most of the organisms involved, including *Pasteurella*, which is gram-negative.

## REFERENCES:

1. Ong YS, Levin LS. Hand infections. *Plast Reconstr Surg*. 2009 Oct;124(4):225e-233e.
2. Grady RW. Systemic quinolone antibiotics in children: a review of the use and safety. *Expert Opin Drug Saf*. 2005 Jul;4(4):623-630.

8. An otherwise healthy 55-year-old man with paraplegia is evaluated because of a recurrent ischial pressure ulcer. History includes previous coverage of the ulcer with a posterior thigh rotation-advancement flap. After appropriate optimization of both patient and wound, which of the following is the most appropriate surgical intervention for reclosure of the wound?
- A) Gracilis musculocutaneous flap
  - B) Inferior gluteal flap
  - C) Re-rotation of posterior thigh flap
  - D) Tensor fascia lata flap
  - E) V-Y hamstring flap

The correct response is Option C.

The most appropriate surgical treatment option would be to re-rotate the posterior thigh flap.

One of the main principles in surgical flap closure of pressure ulcers (PUs) is to utilize large rotation flaps so that they may be re-rotated in the case of recurrences. Although it is debatable whether to re-flap a patient who has a PU recurrence, some clinical situations require a redo flap closure. In those circumstances, instead of using a new flap or donor site, re-elevation of the original flap and re-advancing it is usually the first-line flap option. The posterior thigh flap is a fasciocutaneous flap based on the descending branch of the inferior gluteal artery (if elevated as a purely V-Y flap, or if raised as a superiorly based "tongue" flap). However, if elevated as a rotation-advancement flap, it also has blood flow from medial or lateral thigh skin perforators depending on where the flap incisions are made on the posterior thigh.

In all forms of the flap, the entire posterior thigh skin and fascia is elevated off the hamstring muscles (semitendinosus, semimembranosus, biceps femoris), thus severing all the musculocutaneous perforators from those muscles to the overlying skin and fascia. Therefore, the V-Y hamstring flap (a musculocutaneous flap) is not available after a posterior thigh flap has been raised. Though the inferior gluteal artery flap, gracilis, and possibly the tensor fascia lata flaps may be used, they are not the most appropriate surgical option when a re-rotation thigh flap is still available.

## REFERENCES:

1. Rubayi S, Chandrasekhar BS. Trunk abdomen, and pressure sore reconstruction. *Plast Reconstr Surg*. 2011 Sep;128(3):201e-215e.
2. Cushing CA, Phillips LG. Evidence based medicine: pressure sores. *Plast Reconstr Surg*. 2013 Dec;132(6):1720-1732.
3. Friedman JD, Reece GR, Eldor L. The utility of the posterior thigh flap for complex pelvic and perineal reconstruction. *Plast Reconstr Surg*. 2010 Jul;126(1):146-155.

9. A 3-month-old male infant is brought to the office for evaluation of a 10 × 10-cm purple lesion of the right thigh that was present at birth. Medical history includes nosebleeds. On physical examination, bruising over the trunk is noted. Complete blood cell count shows thrombocytopenia. Which of the following is the most likely diagnosis?
- A) Arteriovenous malformation
  - B) Capillary malformation
  - C) Congenital hemangioma
  - D) Infantile hemangioma
  - E) Kaposiform hemangioendothelioma

The correct response is Option E.

The most likely diagnosis is kaposiform hemangioendothelioma, which is a vascular tumor that is usually present at birth. The lesion can cause Kasabach-Merritt phenomenon: extreme thrombocytopenia ( $<25,000/\text{mm}^3$ ) from platelet trapping within the tumor which leads to spontaneous bleeding and bruising. Treatment is either vincristine or rapamycin. Infantile hemangioma, congenital hemangioma, capillary malformation, and arteriovenous malformation do not cause Kasabach-Merritt phenomenon or any other type of coagulopathy.

## REFERENCES:

1. Sarkar M, Mulliken JB, Kozakewich HP, et al. Thrombocytopenic coagulopathy (Kasabach-Merritt phenomenon) is associated with kaposiform hemangioendothelioma and not with common infantile hemangioma. *Plast Reconstr Surg*. 1997 Nov;100(6):1377-1386.
2. Greene AK. Vascular anomalies: current overview of the field. *Clin Plast Surg*. 2011 Jan;38(1):1-5.
3. Greene AK. Management of hemangiomas and other vascular tumors. *Clin Plast Surg*. 2011 Jan;38(1):45-63.

10. A 53-year-old woman comes to the office with an exposed vascular graft in the left groin caused by postoperative wound infection. After operative debridement, a proximally based sartorius muscle flap is transferred to cover the graft. Several days after surgery, it is evident that the distal portion of the muscle flap is necrotic. This most likely occurred because the sartorius muscle demonstrates which of the following Mathes-Nahai types of vascular pattern?

| Type    | Description                                               |
|---------|-----------------------------------------------------------|
| (A) I   | single vascular pedicle                                   |
| (B) II  | dominant and minor vascular pedicle(s)                    |
| (C) III | two dominant vascular pedicles                            |
| (D) IV  | segmental vascular pedicles                               |
| (E) V   | single dominant and secondary segmental vascular pedicles |

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

The correct response is Option D.

The sartorius muscle demonstrates a Mathes-Nahai Type IV vascular pattern with multiple segmental vascular pedicles. For this reason, it is important to preserve as many segmental pedicles as possible when transferring this flap. The sartorius flap is usually transferred as a distally based flap, and not a proximally based flap as presented in the clinical scenario. When based proximally, it is necessary to ligate multiple segmental pedicles to achieve an adequate arc of rotation, and this can lead to flap necrosis. When based distally, it is often necessary to divide 1 to 2 segmental pedicles superiorly to allow an adequate arc of rotation, but this usually does not compromise the flap. If there is any concern regarding flap perfusion, the pedicles can be temporarily clamped before division to assess the effects of pedicle ligation.

Examples of muscle flaps with the other Mathes-Nahai types of vascular pattern include the following:

- Type I – tensor fascia lata
- Type II – gracilis
- Type III – gluteus maximus
- Type V – latissimus dorsi

## REFERENCES:

1. Mathes SJ, Nahai F. Classification of the vascular anatomy of muscles: experimental and clinical correlation. *Plast Reconstr Surg*. 1981 Feb;67(2):177-187.
2. Mathes SJ, Nahai F. *Reconstructive Surgery: Principles, Anatomy & Technique*. Vol 1. Philadelphia: Churchill Livingstone; 1997:39-48.

11. A 55-year-old man who underwent abdominal surgery 10 years ago undergoes lysis of adhesions for treatment of ongoing intermittent bowel obstruction symptoms. He does not smoke cigarettes and has a history of hypertension and diabetes mellitus. A single enterotomy is made and repaired primarily. During abdominal wall closure after the intra-abdominal procedure, the fascial edges cannot be approximated without marked tension with a relaxed defect diameter maximum of 7 cm. Which of the following is the best method of repair?
- A) Bioprosthetic mesh bridging
  - B) Component separation and bioprosthetic mesh underlay
  - C) Component separation and synthetic mesh underlay
  - D) Component separation with no mesh
  - E) Synthetic mesh bridging

The correct response is Option B.

Given the size of the defect, the patient's comorbidities, and bowel violation, the best method to optimize results is a component separation with a bioprosthetic mesh underlay.

The use of bridging mesh without approximation of the fascia is not recommended due to a high recurrence rate. Instead the Ventral Hernia Working Group (VHWG) recommends reapproximation of the rectus muscle at the midline whenever possible without undue tension. This can be done by using the component separation technique originally described by Ramirez. The procedure calls for a release of the external oblique aponeurosis 1 cm lateral to the linea semilunaris, which allows for medialization of the rectus abdominis and underlying lateral musculature for primary approximation.

Given the enterotomy, a bioprosthetic mesh would be recommended as opposed to a synthetic mesh, because it is likely more resistant to infection and does not necessarily need removal in a contaminated wound. It is the VHWG's preferred method to place mesh in an underlay manner, because intra-abdominal pressure pushes the mesh against the native abdominal wall instead of away from it. It also adds another layer of tissue over the prosthetic material and would be preferred with a bioprosthetic because of decreased risk for bowel adhesions.

Additionally, lower rates of hernia recurrence have been shown in patients who underwent component separation with mesh as opposed to those without.

## REFERENCES:

1. Althubaiti G, Butler CE. Abdominal wall and chest wall reconstruction. *Plast Reconstr Surg*. 2014 May;133(5):688e-701e.
2. Ventral Hernia Working Group, Breuing K, Butler CE, et al. Incisional ventral hernias: review of the literature and recommendations regarding the grading and technique of repair. *Surgery*. 2010 Sep;148(3):544-558. Epub 2010 Mar 20.
3. Ko JH, Wang EC, Salvay DM, et al. Abdominal wall reconstruction: lessons learned from 200 "components separation" procedures. *Arch Surg*. 2009 Nov;144(11):1047-1055.
4. Tong WM, Hope W, Overby DW, et al. Comparison of outcome after mesh-only repair, laparoscopic component separation, and open component separation. *Ann Plast Surg*. 2011 May;66(5):551-556.

12. A 5-year-old boy is brought to the emergency department after sustaining a crush injury to the index finger of his right dominant hand, resulting in amputation through the distal interphalangeal (DIP) joint. X-ray study shows a comminuted fracture of the proximal phalanx. Which of the following is the most significant CONTRAINDICATION to replantation in this patient?
- A) Children have a difficult time adapting to functional deficits
  - B) The index finger is expendable
  - C) The mechanism and multiple-level nature of the injury preclude a functional result
  - D) Microvascular anastomosis is unlikely to be successful in a child of this age
  - E) Replantation will adversely affect epiphyseal growth

The correct response is Option C.

In the patient described, the most significant contraindication to replantation is the mechanism (crush injury) and multiple-level nature of the injury. It is highly unlikely that replantation will be successful with a crush mechanism due to the zone of injury. In addition, the multiple-level injury including the proximal phalanx and distal interphalangeal (DIP) joint precludes a functional result.

Replantation in children does not adversely affect epiphyseal growth. Children adapt quite well to functional deficits of the hand. Microvascular surgery in children, while challenging, has been shown to have a very high success rate when performed by skilled microsurgeons. The index finger can be considered expendable; however, children tend to have more favorable results than adults when it comes to replantation and, therefore, whenever feasible, replantation should be attempted, even if it is an isolated index finger injury. The mechanism of injury plays a greater role than the type of digit in determining the feasibility of replantation in the pediatric population.

## REFERENCES:

1. Berlin NL, Tuggle CT, Thomson JG, et al. Digit replantation in children: a nationwide analysis of outcomes and trends of 455 pediatric patients. *Hand (N Y)*. 2014 Jun;9(2):244-252.
2. Saies AD, Urbaniak JR, Nunley JA, et al. Results after replantation and revascularization in the upper extremity in children. *J Bone Joint Surg Am*. 1994 Dec;76(12):1766-1776.

13. A 56-year-old man comes to the office because of recurrent and locally advanced rectal cancer 2 years after undergoing low anterior resection and adjuvant chemotherapy and radiation therapy. Surgical extirpation involving the external perianal skin, anus, rectum, and musculature of the pelvic floor is performed. Which of the following is the most appropriate method of perineal reconstruction in this patient?
- A) Gracilis flap
  - B) Local propeller flap
  - C) Omental flap
  - D) Rectus abdominis musculocutaneous flap
  - E) Rectus femoris flap

The correct response is Option D.

In the clinical setting of the patient described, the method for perineal reconstruction that has the most evidence to support it is the vertical rectus abdominis myocutaneous (VRAM) flap. Omental flaps are effective for smaller defects that primarily involve internal structures. Primary skin closure, local advancement flaps, and propeller flaps are not ideal in the setting of prior radiation because of the high risk of wound-healing complications. Gracilis flaps are low in volume and may be useful for smaller defects, although bilateral flaps can be adequate for moderate-sized defects. This patient has a large composite defect that will benefit from the large volume and cutaneous component of a VRAM flap.

## REFERENCES:

1. How should perineal wounds be closed following abdominoperineal resection in patients post radiotherapy--primary closure or flap repair? Best evidence topic (BET). *Int J Surg*. 2013;11(7):514-517. Epub 2013 May 21.
2. Campbell CA, Butler CE. Use of adjuvant techniques improves surgical outcomes of complex vertical rectus abdominis myocutaneous flap reconstructions of pelvic cancer defects. *Plast Reconstr Surg*. 2011 Aug;128(2):447-458.

14. A 28-year-old woman comes to discuss primary augmentation mammoplasty options and is deciding between form-stable shaped implants and less cohesive round silicone gel implants. She inquires about the benefits of each type of implant. Compared with smooth round silicone gel implants, highly cohesive form-stable gel implants have a decreased incidence of which of the following?

- A) Capsular contracture
- B) Implant malposition
- C) Infection
- D) Seroma

The correct response is Option A.

Form-stable silicone gel implants are fifth-generation, shaped, and textured implants that have additional cross-linking between molecules. They are purported to have several advantages over other round saline and silicone gel implants because they retain their shape and decrease the incidence of folding and rippling. This has translated into significantly lower capsular contracture rates.

However, they do have some disadvantages. Because they are shaped and maintaining orientation is critical, they have a higher incidence of malposition. They are also more prone to seroma formation, which may be associated with their textured surface.

Infection and resorption rates remain similar.

## REFERENCES:

1. Adams WP, Potter JK. Breast implants: Materials and Manufacturing Past, Present, and Future. In: Spear SL, Willey SC, Robb GL, et al, eds. *Surgery of the Breast: Principles and Art*. 3rd ed. Vol 1. Philadelphia: Lippincott Williams & Wilkins; 2010:344-356.
2. Stevens WG, Hirsch EM, Tenenbaum MJ, et al. A prospective study of 708 form-stable silicone gel breast implants. *Aesthet Surg J*. 2010 Sep;30(5):693-701.
3. Lista F, Tutino R, Khan A, et al. Subglandular breast augmentation with textured, anatomic, cohesive silicone implants: a review of 440 consecutive patients. *Plast Reconstr Surg*. 2013 Aug;132(2):295-303.

15. A 45-year-old man is hospitalized in the intensive care unit for 3 weeks after sustaining blunt force trauma to the head during an assault and develops a pressure ulcer over the right ischium. Six weeks later, the wound has not healed despite multiple bedside debridements and daily wound care. The patient is ambulatory. Physical examination shows an 8 × 4 × 4-cm stage III pressure ulcer at the right inferior gluteal fold with an indurated bursa. After nutritional optimization, which of the following surgical techniques is most appropriate for closure after excising the bursa?
- A) Gracilis musculocutaneous rotation flap
  - B) Negative pressure wound therapy then primary closure
  - C) Posterior thigh fasciocutaneous rotation flap
  - D) Superiorly based gluteal musculocutaneous rotation flap
  - E) Tensor fasciae latae island rotation flap

The correct response is Option C.

The best reconstructive option for an ambulatory patient with a chronic ischial pressure sore is to spare muscle and use a fasciocutaneous flap. Fasciocutaneous flaps offer an axial blood supply with durable coverage and minimal potential for a functional deformity. The flaps closely reconstruct the normal anatomical arrangement over bony prominences. Disadvantages include limited bulk to fill large defects.

Musculocutaneous flaps offer excellent blood supply and bulky tissue and can be re-rotated like fasciocutaneous flaps. However, in an ambulatory patient, they may cause functional impairment.

The tensor fasciae latae flap is occasionally used to close the ischial ulcer. Unfortunately, the distal aspect of the flap that is used to reach the ischial region is usually too thin to offer adequate padding to be effective. Therefore, this is not the most appropriate option.

Primary closure is associated with an increased rate of wound recurrence. A large dead space is usually present due to the absence of tissue, and the induration of adjacent areas makes them difficult to mobilize for a tension-free closure.

## REFERENCES:

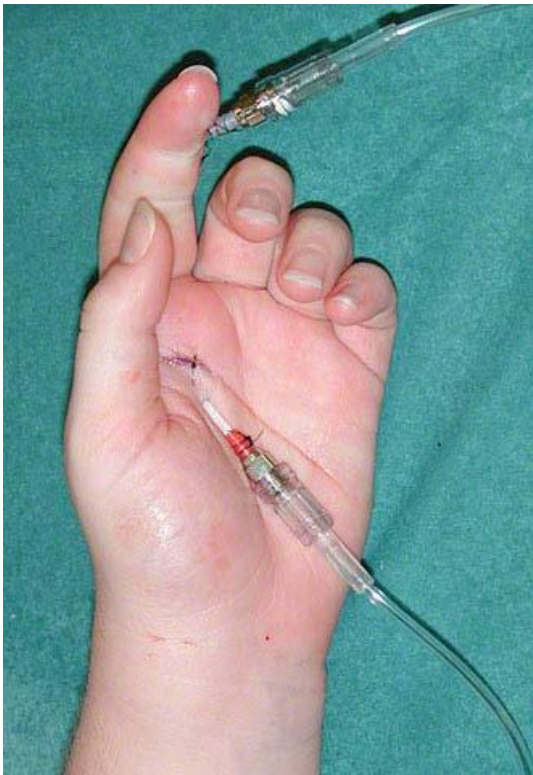
1. Rubayi S, Chandrasekhar BS. Trunk, abdomen, and pressure sore reconstruction. *Plast Reconstr Surg*. 2011 Sep;128(3):201e-215e.
2. Tchanque-Fossuo CN, Kuzon WM Jr. An evidence-based approach to pressure sores. *Plast Reconstr Surg*. 2011 Feb;127(2):932-939.



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

16. A 34-year-old woman comes to the emergency department 5 days after sustaining a cat bite to the left index finger. A photograph is shown. Medical history includes diabetes mellitus type 1. Physical examination shows punctures to the dorsum and volar surfaces of the proximal phalanx, mild fusiform swelling of the digit with tenderness over the flexor tendon sheath, pain with passive extension, and partially flexed posture of the digit. The symptoms have worsened over the past 3 days. Temperature is 99°F (37.2°C). Which of the following is the most appropriate next step in management?
- A) Incision and drainage of the puncture sites
  - B) Inpatient intravenous antibiotics
  - C) Irrigation of the flexor sheath
  - D) Outpatient oral antibiotics
  - E) Splinting immobilization and elevation

The correct response is Option C.



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

The most appropriate option for this patient is to proceed to the operating room for decompression/drainage of the flexor tendon sheath. This patient has all four of Kanavel's signs, specifically pain on passive extension, fusiform swelling, flexor tendon sheath tenderness, and flexion of the affected digit. These point towards a diagnosis of flexor tenosynovitis, with the cause being the cat bite she sustained several days prior. Although cat bites only reflect 5% of all animal bites, they represent 76% of all infected bites, thought to be because of the morphology of their long teeth, which simulate a deep puncture wound.

Outcomes studies demonstrate that because of this patient's diabetes, she is at risk for a poor outcome, specifically the need for amputation and/or decreased total active motion. Other risk factors that can lead to these outcomes include age greater than 43 years, presence of subcutaneous purulence, digital ischemia, and polymicrobial infection. Given that she is at risk and that she has all four Kanavel's signs, any intervention that is more conservative than operative decompression and drainage may lead to suboptimal outcomes.

Administration of antibiotics (orally or intravenously) is not a substitute for drainage of the flexor sheath, especially in a case that presents more than 48 hours out from initiation of symptoms. Drainage in the emergency department is not as optimal as in the operating room given that the infection may limit efficacy of local anesthesia as well as the need for possible conversion to an open drainage procedure if closed catheter irrigation is insufficient.

## REFERENCES:

1. Pang HN, Teoh LC, Yam AK, et al. Factors affecting the prognosis of pyogenic flexor tenosynovitis. *J Bone Joint Surg Am*. 2007 Aug;89(8):1742-1748.
2. Kanavel AB. The symptoms, signs, and diagnosis of tenosynovitis and major fascial space abscesses. In: Kanavel AB, ed. *Infections of the Hand*. 6th ed. Philadelphia: Lea and Febiger; 1933:364-395.
3. Malahias M, Jordan D, Hughes O, et al. Bite injuries to the hand: microbiology, virology and management. *Open Orthop J*. 2014 Jun 27;8:157-161. eCollection 2014.
4. Gutowski KA, Ochoa O, Adams WP Jr. Closed-catheter irrigation is as effective as open drainage for treatment of pyogenic flexor tenosynovitis. *Ann Plast Surg*. 2002 Oct;49(4):350-354.

17. A 52-year-old woman undergoes immediate unilateral breast reconstruction with a free deep inferior epigastric flap. Near completion of the procedure, the flap skin paddle is noted to have venous congestion. On exploration of the pedicle, the anastomosis between the vena comitans and the internal mammary vessel appears patent. Which of the following preventive measures would most likely have averted this issue?
- A) Administration of heparin immediately before release of vessel clamps and flap revascularization
  - B) Anastomosis of the veins using sutures instead of a venous coupling device
  - C) Preservation and anastomosis of the superficial inferior epigastric vein
  - D) Routine anastomosis of two venae comitantes per flap
  - E) Use of near-infrared fluorescence imaging to assess flap blood flow

The correct response is Option C.

Preservation of the superficial inferior epigastric veins (SIEV) during flap harvest is a useful preventive measure in microsurgical free tissue transfer operations. These veins can serve as important lifeboats to augment venous outflow in the setting of venous congestion. Typically, if a free flap demonstrates venous congestion, the inset should be taken down and the pedicle, recipient vessels, and anastomoses interrogated. Simple issues, such as mechanical compression or twisting of the vein should be ruled out. Next, the SIEV should be inspected. If it is engorged, it is likely that the flap is reliant on superficial outflow, and this vein should be connected to a recipient vessel to augment the venous outflow of the flap. Options for recipient veins include an antegrade branch on the pedicle vena comitans, or in a retrograde fashion to the vena comitans that was not used in the initial set of anastomoses.

Near-infrared fluorescence imaging technology can assist with flap design and may be useful for assessing the arterial inflow of the flap, but it has not been shown to correlate with flap loss or venous complications.

The use of one or two veins in microsurgical free tissue transfer is a topic that has been debated for several years. While some studies indicate that the use of two venous connections may decrease the velocity of blood flow across the anastomosis, there are no data to support differences in flap outcomes or thrombotic events. Therefore, the routine use of a second vein is largely up to surgeon preference.

Heparin may be a useful adjunct when thrombosis of the arterial or venous anastomosis is excised and a revision of the anastomosis is performed. Without evidence of thrombosis, it is unlikely to have any added benefit.

For venous anastomoses, the use of venous coupling devices has not been associated with patency issues or increased thrombosis rates. Therefore, a hand-sewn anastomosis is not likely to prevent the issue presented in this question.

## **REFERENCES:**

1. Bui DT, Cordeiro PG, Hu QY, et al. Free flap reexploration: indications, treatment, and outcomes in 1193 free flaps. *Plast Reconstr Surg*. 2007 Jun;119(7):2092-2100.
2. Galanis C, Nguyen P, Koh J, et al. Microvascular lifeboats: a stepwise approach to intraoperative venous congestion in DIEP flap breast reconstruction. *Plast Reconstr Surg*. 2014 Jul;134(1):20-27.



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

18. A 52-year-old man who has a ventral hernia with fascial defect that is 18 cm long and 14 cm wide is scheduled for abdominal wall reconstruction. A photograph is shown. Which of the following techniques is most likely to result in a functional tension-free closure?
- A) Advancement of the vertical rectus abdominis musculocutaneous flaps
  - B) Release and advancement of the external oblique muscles
  - C) Release and advancement of the rectus, internal oblique, and transversus abdominis muscles
  - D) Rotation of the anteriolateral thigh flaps
  - E) Rotation of the transverse rectus abdominis myocutaneous flaps

The correct response is Option C.

A component separation procedure allows for the primary closure of central abdominal wall musculofascial defects without excessive tension. In the classically described procedure, the external oblique aponeurosis is released lateral to the linea semilunaris, allowing for medial advancement of the rectus abdominis along with the internal oblique and transversus muscles. The innervation and vasculature to these structures are preserved in order to maintain functional integrity of these abdominal wall muscles.

The vertical and transverse rectus abdominus musculocutaneous flaps along with the anterolateral thigh flaps are primarily used to reconstruct soft-tissue defects but are unlikely to result in a functional abdominal wall.

## **REFERENCES:**

1. Ramirez OM, Ruas E, Dellon AL. "Components separation" method for closure of abdominal-wall defects: an anatomic and clinical study. *Plast Reconstr Surg*. 1990 Sep;86(3):519-526.
2. Althubaiti G, Butler CE. Abdominal wall and chest wall reconstruction. *Plast Reconstr Surg*. 2014 May;133(5):688e-701e.

19. A 36-year-old woman with genetic susceptibility to breast cancer is scheduled to undergo bilateral prophylactic mastectomy. She has elected to proceed with immediate single-stage reconstruction using permanent silicone implants and acellular dermal matrix. Which of the following is the most sensitive method to detect implant rupture in this patient?

- A) CT scan
- B) Mammography
- C) MRI
- D) Physical examination
- E) Ultrasonography

The correct response is Option C.

Implant rupture is one of the most common reasons for implant removal. While implant rupture can be associated with symptoms such as capsular contracture, it is often completely asymptomatic or “silent.” For this reason, screening imaging to detect such ruptures has been recommended.

According to the 2011 Update on the Safety of Silicone Gel-Filled Breast Implants published by the U.S. Food and Drug Administration, it is currently recommended that women with silicone implants get their first MRI 3 years after they receive the implants and every 2 years thereafter to detect silent ruptures.

Since the rate of rupture increases the longer an implant is in place, not screening is unacceptable.

Mammograms can detect extracapsular silicone when an implant ruptures, but they do not detect intracapsular ruptures.

The accuracy of ultrasound largely depends on the skill of the ultrasound technologist, the type of equipment used, and the experience of the interpreting physician. Furthermore, ultrasound is limited in its ability to detect ruptures in the back wall of the implant and in the breast tissue behind it.

CT scans can detect intracapsular silicone gel-filled breast implant rupture, but they are limited in their ability to detect extracapsular ruptures.

## REFERENCES:

1. Handel N, Garcia ME, Wixtrom R. Breast implant rupture: causes, incidence, clinical impact, and management. *Plast Reconstr Surg*. 2013 Nov;132(5):1128-1137.
2. U.S. Food and Drug Administration. Update on the Safety of Silicone Gel-Filled Breast Implants (2011). Available at: <http://www.fda.gov/downloads/MedicalDevices/ProductsandMedicalProcedures/ImplantsandProsthetics/BreastImplants/UCM260090.pdf>. Accessed December 1, 2014.

20. A 63-year-old man underwent resection of a chest wall sarcoma that was covered with an anterolateral thigh flap. He now undergoes external beam radiation therapy, and there is erythema, edema, and dry desquamation of the surgical sites. Which of the following is the most appropriate treatment?

- A) Diphenhydramine
- B) Hyaluronic acid
- C) Hydrocortisone
- D) Salicylate
- E) Vitamin E

The correct response is Option C.

Radiation dermatitis is one of the most common side effects of radiotherapy for cancer and can occur any time, from hours to weeks after radiation exposure.

Acute radiation-induced skin changes depend on the radiation dose and include erythema, edema, pigment changes, epilation, and dry or moist desquamation. They can also be accompanied by pain and pruritis.

For the lower grade changes described for this patient, topical corticosteroids with low to medium potency, such as hydrocortisone 1% cream, are recommended. This is in addition to a skin-washing protocol to keep skin clean and dry before treatments.

All of the other topical agents listed – antihistamines, salicylate analgesics, vitamin E, and hyaluronic acid – have all been previously studied and shown to have no added benefit.

More severe skin changes such as moist desquamation, skin necrosis, or intractable pain may require radiation to be stopped, resulting in inadequate disease treatment.

## REFERENCES:

1. Brown KR, Rzucidlo E. Acute and chronic radiation injury. *J Vasc Surg*. 2011 Jan;53(1 Suppl):15S-21S. Epub 2010 Sep 16.

2. Ulf E, Maroti M, Serup J, et al. A potent steroid cream is superior to emollients in reducing acute radiation dermatitis in breast cancer patients treated with adjuvant radiotherapy. A randomised study of betamethasone versus two moisturizing creams. *Radiother Oncol*. 2013 Aug;108(2):287-292. Epub 2013 Jul 2.

21. A 65-year-old man comes to the office because of a 6 × 8-cm open wound on the forearm. The wound currently has healthy granulation tissue and does not appear infected. Which of the following is an advantage of split-thickness skin grafting over full-thickness skin grafting in this patient?
- A) Less metabolic demand required from wound bed
  - B) Less secondary contraction from elastin fibers
  - C) More primary contraction from myofibroblasts
  - D) Occurrence of inosculation before plasmatic imbibition
  - E) Presence of intact skin appendages within graft

The correct response is Option A.

Split-thickness skin grafts require less metabolic demand from the wound bed compared with full-thickness skin grafts. In situations where the wound bed may not supply adequate nutrient diffusion through the graft, a full-thickness graft may develop superficial epidermolysis.

Skin graft viability is initially based on plasmatic imbibition from the serous exudate of the wound, followed by inosculation and angiogenesis. After graft take, remodeling and scar maturation occur. Primary contracture of a graft is from elastin fibers in the dermis, whereas secondary contracture is from myofibroblast activity.

Split-thickness grafts contain epidermis and a variable amount of dermis compared with full-thickness grafts, which, by definition, contain both epidermis and the entire dermal layer. Full-thickness grafts contain intact skin appendages, whereas split-thickness grafts do not; this allows the donor site for split-thickness grafts to reepithelialize. Split-thickness grafts therefore undergo less primary and more secondary contraction.

## REFERENCES:

1. Buchanan PJ, Kung TA, Cederna PS. Evidence-based medicine: wound closure. *Plast Reconstr Surg*. 2014 Dec;134(6):1391-1404.
2. Hallock GG, Morris SF. Skin grafts and local flaps. *Plast Reconstr Surg*. 2011 Jan;127(1):5e-22e.

22. A 60-year-old woman who works as a nurse in the intensive care unit (ICU) is scheduled for cardiac bypass surgery. Because she has taken care of many patients with methicillin-resistant *Staphylococcus aureus* infection, she is interested in topical agents for decolonization. Which of the following regimens is most appropriate for this patient?

- A) Clindamycin
- B) Linezolid
- C) Mupirocin and chlorhexidine
- D) Trimethoprim-sulfamethoxazole
- E) Vancomycin

The correct response is Option C.

The currently accepted decolonization protocol from the Infectious Diseases Society of America is a combination of topical nasal mupirocin ointment and a chlorhexidine body wash for 5 days. The most robust data for decolonization are in the cardiac surgery literature; the Society of Thoracic Surgeons guidelines recommend routine prophylaxis for all patients undergoing cardiac surgery. These guidelines are based on studies that show a decreased rate of sternal wound infections.

The carriage rate of methicillin-resistant *Staphylococcus aureus* for health care workers is approximately 5% based on large review studies. As a substantial portion of cases originate from nasal colonization, routine screening and decolonization are recommended in areas where the carriage rate exceeds 10% (Centers for Disease Control and Prevention recommendation).

The other antibiotics listed are reserved for the treatment of infection rather than as part of a decontamination protocol.

## REFERENCES:

1. O'Reilly EB, Johnson MD, Rohrich RJ. Comprehensive review of methicillin-resistant *Staphylococcus aureus*: screening and preventive recommendations for plastic surgeons and other surgical health care providers. *Plast Reconstr Surg*. 2014 Nov;134(5):1078-1089.

2. Liu C, Bayer A, Cosgrove SE, et al. Clinical practice guidelines by the infectious diseases society of america for the treatment of methicillin-resistant *Staphylococcus aureus* infections in adults and children: executive summary. *Clin Infect Dis*. 2011 Feb 1;52(3):285-292.
3. Elward AM, McAndrews JM, Young VL. Methicillin-sensitive and methicillin-resistant *Staphylococcus aureus*: preventing surgical site infections following plastic surgery. *Aesthetic Surg J*. 2009 May-Jun;29(3):232-244.
4. Bode LG, Kluytmans JA, Wertheim HF, et al. Preventing surgical-site infections in nasal carriers of *Staphylococcus aureus*. *N Engl J Med*. 2010 Jan 7;362(1):9-17.

23. A 40-year-old woman has an extravasation injury following a CT scan. An automated power injector was used to inject 100 mL of nonionic contrast medium into an intravenous cannula on the dorsum of the hand approximately 60 minutes ago. On examination, the hand appears edematous with mild erythema and is moderately tender. The skin is intact with no blistering. Capillary refill time is normal, and there is no neurologic deficit. Which of the following is the most appropriate next step in management?
- A) Administration of a corticosteroid
  - B) Bedside exploration of the intravenous cannula site
  - C) Elevation of the extremity
  - D) Surgical exploration with dorsal fasciotomy and carpal tunnel release
  - E) Surgical exploration with dorsal fasciotomy only

The correct response is Option C.

In a patient with an intravenous extravasation, if the symptoms are mild (pain, swelling, or erythema), elevation and cold compresses will usually lead to complete resolution. Patients who have more severe symptoms, such as neurovascular compromise, may need additional evaluation of compartment pressures and potentially surgical exploration for decompression; however, the first step in treatment is still elevation of the extremity.

Extravasation injury was once a difficult problem. The extravasation of ionic contrast at high osmolality had increased risk for soft-tissue complications, and plastic surgery consultation was often necessary. The switch to nonionic, low-osmolality contrast over the past decade has resulted in a significant decrease in complications. In a recent study of 69,657 patients undergoing a CT scan, the rate of extravasation was 0.7% (476 patients), and only one patient required operative intervention and decompressive fasciotomy.

Corticosteroids do not have a role in extravasation injuries.

## REFERENCES:

1. Wang CL, Cohan RH, Ellis JH, et.al. Frequency, management, and outcome of extravasation of noniodinated contrast medium in 69,657 intravenous injections. *Radiology*. 2007 Apr;243(1):80-87.

2. Schaverien MV, Evison D, McCulley SJ. Management of large volume CT contrast medium extravasation injury: technical refinement and literature review. *J Plast Reconstr Aesthet Surg*. 2008;61(5):562-565. Epub 2007 Apr 25.

24. A 28-year-old woman comes to the office to discuss augmentation mammoplasty. She is interested in silicone implants, specifically highly cohesive gel shaped implants. Which of the following is the most likely result of increasing the cross-linking in these implants?
- A) Decreased risk of gel fracture
  - B) Decreased risk of shell delamination
  - C) Improved form stability
  - D) Increased risk of folds
  - E) Softer implants

The correct response is Option C.

Increasing the cross-linking in a highly cohesive gel shaped silicone implant improves form stability. This allows for the creation of shaped implant designs that persist despite position or external forces on the implant.

The current, fifth-generation silicone breast implants derive their cohesiveness from the cross-linking of the silicone. Increasing the amount of cross-linking leads to an increase in cohesiveness and a firmer implant. This may lead to less rippling and folding because of resistance to collapse; however, recent MRI studies have shown folds and distortions are still possible. Increasing cohesiveness, however, does have some disadvantages with potential risks for gel fracture and delamination of the implant shell.

## REFERENCES:

1. Calobrace MB, Capizzi PJ. The biology and evolution of cohesive gel and shaped implants. *Plast Reconstr Surg*. 2014 Jul;134(1 Suppl):6S-11S.
2. Kinney BM, Jeffers LL, Ratliff GE, et al. Silicone gel breast implants: science and testing. *Plast Reconstr Surg*. 2014 Jul;134(1 Suppl):47S-56S.
3. Weum S, de Weerd L, Kristiansen B. Form stability of the Style 410 anatomically shaped cohesive silicone gel-filled breast implant in subglandular breast augmentation evaluated with magnetic resonance imaging. *Plast Reconstr Surg*. 2011 Jan;127(1):409-413.

25. A 62-year-old woman with biopsy-proven basal cell carcinoma of left mid cheek presents for consultation for surgical treatment. On physical examination, the lesion is 0.6 cm in diameter and has indistinct borders. Which of the following criteria is the most likely indication for Mohs micrographic surgery in this patient?
- A) Anatomical location of the cancer
  - B) Diagnosis of basal cell carcinoma
  - C) Indistinct borders
  - D) Patient age
  - E) Size of the carcinoma

The correct response is Option C.

In the case presented above, the strongest indication for Mohs micrographic surgery comes from the anatomic finding of indistinct borders. Other findings are not necessarily indications for Mohs. Other proven indications are recurrent cancer, high risk zones of the face, morpheaform basal cell cancer, or evidence of neurovascular involvement. By some studies, larger sized basal cell cancers ( $>2$  cm) may be indications.

By definition, Mohs micrographic surgery is a technique for treatment of complex or ill-defined skin cancers with examination of 100% of tissue. One physician performs the procedure, acting in two distinct capacities: surgeon (excising the cancer) and pathologist (reading the slides). Usually, the final pathologic clearance is given on the same day as the resection. This is in comparison with a wide local excision technique, which is performed by two different physicians: a surgeon who removes the cancer and a pathologist who reads it separately. In the latter scenario, although a "wet" read can be done on the same day, the final pathologic evaluation has to await the permanent preparation of slides and a final read. Also, using the routine pathologic evaluation, only 2% of the margins are looked at (using the common "bread loafing" technique), compared with the 100% of tissues evaluated using the Mohs technique.

The vast majority of Mohs resections is done with one or two excisions. Although at times there is a need for multiple excisions, the need for excisions is driven by the positive margins detected pathologically. In Mohs technique, the amount of healthy tissue taken to obtain "clear" margins is the minimum needed to do so, thus preserving the healthy tissue, which can be critically useful in the ensuing reconstruction. These margins are definitively assessed on that same day of surgery,

so once the patient leaves the Mohs surgeon's office, he or she knows the cancer has been completely removed. This is why the margin control is superior in Mohs technique compared with other surgical techniques.

## REFERENCES:

1. Snow SN, Gunkel J. Mohs Surgery. In: Bologna JL, Jorizzo JL, eds. *Dermatology*. 3rd ed. Philadelphia: Elsevier-Saunders; 2012:2445-2457.
2. Ariyan S, Berger A. Melanoma. In: Neligan PC, Gurtner GC, eds. *Plastic Surgery*. Vol 1. Philadelphia: Elsevier-Saunders; 2013:743-785.
3. Ogawa R. Benign and malignant nonmelanocytic tumors of the skin and soft tissue. In: Neligan PC, Gurtner GC, eds. *Plastic Surgery*. Vol 1. Philadelphia: Elsevier-Saunders; 2013:707-742.
4. Connolly SM, Baker DR, Coldiron BM, et al. AAD/ACMS/ASDSA/ASMS 2012 appropriate use criteria for Mohs micrographic surgery: a report of the American Academy of Dermatology, American College of Mohs Surgery, American Society for Dermatologic Surgery Association, and the American Society for Mohs Surgery. *J Am Acad Dermatol*. 2012 Oct;67(4):531-550. Epub 2012 Sep 5.

26. A 9-year-old boy with unilateral cleft lip and palate undergoes alveolar bone grafting with a cancellous iliac bone graft. Which of the following best describes the mechanism of bone healing?
- A) Endochondral ossification
  - B) Osteochondrosis
  - C) Osteoconduction
  - D) Osteogenesis
  - E) Osteoinduction

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

The correct response is Option E.

Osteoinduction refers to the direct stimulation of mesenchymal cells at the recipient site by bone morphogenetic protein to differentiate into osteoprogenitor cells. This mechanism of action is associated with the healing of cancellous bone grafts and demineralized bone matrix.

Osteoconduction (creeping substitution) is the primary method by which cortical bone grafts heal. During osteoconduction, cells and blood vessels from the recipient bed grow into the graft. The bone graft becomes a template for the deposition of new bone and the graft resorbs. Neovascularization is complete by 6 to 8 weeks, but ultimate strength of cortical grafts is not seen until 6 to 12 months, at which time the graft is comparable to a vascularized bone graft.

Osteogenesis is the formation of new bone by cells in a flap/graft that survive the transfer. This is the primary mechanism by which a vascularized bone graft heals. The pedicle keeps the bone alive so that primary bone healing can occur between the graft and recipient site. Osteoblasts from both locations participate in the formation of new bone at the interface between graft and native bone. Advantages of a vascularized bone graft include the ability to place the graft into a hostile environment such as an irradiated wound bed and immediate structural support with shortened time to bony union compared with nonvascularized cortical grafts.

Osteochondrosis refers to a family of ossification disorders in children. Endochondral ossification is the process by which the cartilaginous soft callus covering a fracture is

transformed into bone.

## REFERENCES:

1. Constantino PD, Hiltzik D, Govindaraj S, et al. Bone healing and bone substitutions. *Facial Plast Surg*. 2002 Feb;18(1):13-26.
2. Gosain AK, McCarthy JG, Staffenberg D, et al. The histomorphologic changes in vascularized bone transfer and their interrelationship with the recipient sites: a 1-year study. *Plast Reconstr Surg*. 1996 Apr;97(5):1001-1013.
3. Mehrara BJ, McCarthy JG. Repair and Grafting of Bone. In: Mathes SJ, Hentz VR, eds. *Plastic Surgery*. 2nd ed. Philadelphia: Elsevier-Saunders; 2006:639-718.
4. Finkemeier CG. Bone-grafting and bone graft substitutes. *J Bone Joint Surg Am*. 2002 Mar;84-A(3):454-464.

27. A 65-year-old man with a history of squamous cell carcinoma of the perioral skin managed with resection, reconstruction, and postoperative radiation therapy is evaluated because examination of a specimen obtained on biopsy confirmed carcinoma recurrence. History includes tobacco use. CT scan of the head and neck shows involvement of a 7-cm segment of the right mandibular parasymphiseal and body bone. Preoperative metastatic workup shows no other abnormalities. Operative perioral skin and mandibular resection is planned. Which of the following is the most appropriate method of mandibular reconstruction in this patient?
- A) Autologous corticocancellous bone graft
  - B) Cadaveric bone graft and anterolateral thigh flap
  - C) Reconstruction plate and rectus abdominis musculocutaneous flap
  - D) Vascularized bone flap

The correct response is Option D.

Composite tissue reconstruction after tumor ablation is a significant challenge to the plastic surgeon. Generally, bony defects of the anterior mandible require bony replacement and defects greater than 6 cm require vascularized bone for reconstruction. For large defects, the optimum choice of bone is the vascularized fibula. Reconstruction with free flaps can be successfully performed in a patient with a smoking history and, in fact, is often the optimal method of reconstruction in smokers. The use of allograft cadaveric bone is not indicated, especially in a patient with a history of smoking. For defects of the size described, the fixation plate alone would not give adequate long-term support and would likely result in plate exposure or extrusion in the face of previous radiotherapy. Nonvascularized bone grafts are indicated in bony defects less than 6 cm in length.

## REFERENCES:

1. van Gemert JT, van Es RJ, Rosenberg AJ, et al. Free vascularized flaps for reconstruction of the mandible: complications, success, and dental rehabilitation. *J Oral Maxillofac Surg*. 2012 Jul;70(7):1692-1698. Epub 2011 Nov 12.
2. Cordeiro PG, Disa JJ, Hidalgo DA, et al. Reconstruction of the mandible with osseous free flaps: a 10-year experience with 150 consecutive patients. *Plast Reconstr Surg*. 1999 Oct;104(5):1314-1320.

3. Wei FC, Celik N, Yang WG, et al. Complications after reconstruction by plate and soft-tissue free flap in composite mandibular defects and secondary salvage reconstruction with osteocutaneous flap. *Plast Reconstr Surg*. 2003 Jul;112(1):37-42.4(5):1314-1320.

28. A 55-year-old man undergoes biopsy of a pigmented lesion on the neck. Examination of a biopsy specimen shows superficial spreading of a malignant melanoma with no ulceration, 1.2-mm thickness, and less than 1 mitosis per mm<sup>2</sup>. In addition to wide local excision, which of the following is most appropriate treatment?

- A) Interferon therapy
- B) Radiation therapy
- C) Regional lymphadenectomy
- D) Sentinel lymph node biopsy
- E) Observation

The correct response is Option D.

According to National Comprehensive Cancer Network guidelines, melanomas with Breslow thickness greater than 1 mm should be treated with wide local excision and sentinel lymph node biopsy.

Wide local excision alone, with no additional lymph node sampling, may be appropriate for some melanomas less than 1 mm, but additional factors such as mitotic rate and ulceration should be assessed.

Random lymph node sampling would not necessarily assess the first node in the draining basin, therefore, it is important that the sentinel lymph node be identified with techniques such as tracking of an intradermally injected radionucleotide using a handheld gamma probe and visual identification with blue dye.

In the past, melanomas with thickness between 1 and 4 mm were treated with elective lymph node dissection. Since several randomized, prospective studies failed to clearly demonstrate a survival advantage and the significant associated morbidity, sentinel lymph node biopsy has replaced this procedure.

While there are growing indications for the use of radiation therapy for skin cancers, intraoperative radiation therapy is not routinely used.

## REFERENCES:

1. Dzwierzynski WW. Managing malignant melanoma. *Plast Reconstr Surg*. 2013 Sep;132(3):446e-460e.
2. Kimbrough CW, McMasters KM, Davis EG. Principles of surgical treatment of malignant melanoma. *Surg Clin North Am*. 2014 Oct;94(5):973-988. Epub 2014 Aug 15.
3. <http://www.nccn.org/patients/guidelines/melanoma/index.html#68>

29. A 64-year-old woman is evaluated because of the aged appearance of the dorsal surfaces of the hands. Physical examination of the hands shows lipodystrophy. Autologous fat grafting is planned to improve the cosmetic appearance. Which of the following maneuvers is most likely to decrease the risk of fat necrosis and improve fat graft viability?

- A) Placement of fat grafts in small aliquots
- B) Postoperative prevention of pressure on grafted regions
- C) Preparation of fat grafts with centrifugation
- D) Use of ultrasound-assisted liposuction for fat graft harvest

The correct response is Option A.

The results of fat grafting are dependent upon the surgeon's experience and technique. Strategies to increase the take of the fat graft and decrease fat necrosis include atraumatic harvest techniques. Placement of the graft in multiple small aliquots increases the availability for vascularity, and creating a lattice-like framework when depositing the grafts avoids large-volume deposits. Placement of the grafts in a few large-volume deposits is avoided to minimize fat necrosis and creation of fatty oil cysts. Centrifugation has mixed results in fat grafting.

## REFERENCES:

1. Gutowski KA, ASPS Fat Graft Task Force. Current applications and safety of autologous fat grafts: a report of the ASPS fat graft task force. *Plast Reconstr Surg*. 2009 Jul;124(1):272-280.
2. Coleman SR, Saboeiro AP. Fat grafting to the breast revisited: safety and efficacy. *Plast Reconstr Surg*. 2007 Mar;119(3):775-785.
3. Salgarello M, Visconti G, Barone-Adesi L. Fat grafting and breast reconstruction with implant: another option for irradiated breast cancer patients. *Plast Reconstr Surg*. 2012 Feb;129(2):317-329.

30. A 42-year-old woman is scheduled to undergo penile reconstruction with a fibula flap as part of gender reassignment. She has been evaluated by all appropriate specialists in the context of a multidisciplinary transgender clinic. Which of the following is the most significant advantage of the fibula flap over the forearm flap in this patient?

- A) Ability to create an innervated skin island
- B) Avoidance of prosthesis to provide sexual function
- C) Decreased incidence of urethral stricture
- D) Improved sensory recovery
- E) More reliable and constant anatomy

The correct response is Option B.

The most significant advantage of the fibula flap over the forearm flap in penile reconstruction is the avoidance of a prosthesis to provide erectile and sexual function. Another advantage is the less conspicuous donor site. Both flaps allow for the creation of an innervated skin island. The fibula skin island can be innervated via the superficial peroneal nerve, and the forearm skin island can be innervated via the medial and lateral antebrachial cutaneous nerves. The forearm flap utilizes vascularized forearm skin for the neourethra, whereas the fibula flap employs a full-thickness skin graft. Thus, the incidence of urethral stricture is greater with the fibula flap. Both flaps are based on reliable and relatively constant anatomy, although the septocutaneous branch of the peroneal artery to the skin of the fibula flap can be variable or even absent. One disadvantage of the fibula flap is that sensation is not as good as with the forearm flap.

## REFERENCES:

1. Gottlieb LJ, Aycock JK. Reconstruction of the genitalia. In: Guyuron B, Eriksson E, Persing JA, eds. *Plastic Surgery: Indications and Practice*. Philadelphia: WB Saunders; 2009:213-227.
2. Papadopoulos NA, Schaff J, Biemer E. Usefulness of free sensate osteofasciocutaneous forearm and fibula flaps for neophallus construction. *J Reconstr Microsurg*. 2001 Aug;17(6):407-412.

31. A 25-year-old man has a 5 × 5-cm soft-tissue foot defect with exposed bone after trauma. Free tissue transfer reconstruction of the defect is planned. Intraoperatively, 15-cm proximal dissection of the pedicle is required to perform microvascular anastomoses outside of the zone of injury. Which of the following flaps will minimize the need for vein grafting in this patient?

- A) Anterolateral thigh
- B) Gracilis
- C) Radial forearm
- D) Scapular

The correct response is Option C.

On the basis of the scenario described, a fasciocutaneous free tissue transfer is the most appropriate management option to reconstruct the soft-tissue coverage of the tibia and foot extensor mechanism. There are several donor site options for the harvest of fasciocutaneous free tissue, and each flap has distinct characteristics.

The scapular/parascapular flaps are frequently employed regionally for axilla, shoulder, posterior thorax, and upper extremity reconstruction. This donor site also provides a large surface area of fasciocutaneous tissue for distant use and is commonly used in cutaneous, head and neck, and upper and lower extremity reconstruction. The tissue transfer can measure 12 × 25 cm with primary closure of the donor site, pedicle length is 3 to 5 cm, arterial diameter is 2.5 to 4 mm, and venous diameter ranges from 1.5 to 4 mm. Due to the extent of the zone of injury, this pedicle length would be too short to minimize the need for vein grafts.

The anterolateral thigh (ALT) flap has proven to be one of the most versatile free tissue transfers in reconstructive surgery. Based on perforators from the descending branch of the lateral circumflex femoral artery that traverse the vastus lateralis (VL) (80%) or the septum between the rectus femoris and VL (18 to 20%), this flap can be fashioned as large as 10 cm wide by 25 cm long. Its pedicle length can extend 10 to 12 cm, arterial diameter is 2 mm, and venous diameter is 2 to 3 mm. Due to the extent of the zone of injury, this pedicle length would be too short to minimize the need for vein grafts.

The volar forearm donor site is utilized both regionally and in distant locations such as the head and neck, and upper and lower extremities. It is also employed in specialized areas such as esophageal and penile reconstruction. The skin paddle can

extend  $10 \times 40$  cm and pedicle length can extend up to 20 cm with similar arterial and venous vessel diameters when compared with the scapula and the ALT. In the scenario described, the pedicle characteristics of the radial forearm flap make this the best option for reconstruction and to decrease the need for vein grafting in this patient.

## REFERENCES:

1. Choudry U, Moran S, Karacor Z. Soft-tissue coverage and outcome of Gustilo grade IIIB midshaft tibia fractures: a 15-year experience. *Plast Reconstr Surg*. 2008 Aug;122(2):479-485.
2. Zenn MR, Jones G. *Reconstructive Surgery: Anatomy, Technique, and Clinical Applications*. 2nd ed. Boca Raton: CRC Press; 2012:1108-1135.

32. A 50-year-old man is brought to the emergency department after a high-speed motor vehicle collision. CT scan is obtained and shows a highly comminuted fracture of the mandible involving the symphysis, body, and angle on the left. Which of the following types of vessels supplies perfusion to these mandibular segments?

- A) Diaphyseal
- B) Epiphyseal
- C) Galeal
- D) Metaphyseal
- E) Periosteal

The correct response is Option E.

In severely comminuted fractures of the mandible, the viability of the bony fragments depends on the blood supply from the periosteum and periosteal vessels. Significant periosteal stripping during an open repair would place these patients at risk for necrosis and bony resorption. This is the premise behind closed reduction of these injuries when indicated.

There are two major types of bone: tubular (long bone) and flat bones (primarily of the facial skeleton). Tubular bones include the long bones of the extremities, clavicles, hands, and feet, and are composed of a diaphysis, paired metaphyses, and epiphyses. Tubular bones have a dual blood supply. The predominant supply is the nutrient diaphyseal arteries that often enter the middle third of the diaphysis and bifurcate upon entering the medullary canal. At the distal aspect, the smaller metaphyseal and epiphyseal arteries generally arise from arteries that supply the joint and anastomose with the diaphyseal arteries. This less robust blood supply at the joints explains why fractures in this location can lead to growth retardation. The other major blood supply is the periosteal vascular plexus; this plexus relies on connections with overlying skeletal muscle.

Flat bones of the facial skeleton, as well as the scapulae, sternum, and ribs, do not contain a diaphysis, metaphyses, or epiphyses. They contain a dual blood supply with nutrient arteries (generally based off of the maxillary artery or middle meningeal artery for the calvaria) and the periosteal vessels and vascular plexus. Although the vascular connections with the periosteum are poorly developed, vascularized

calvarial grafts could be based on this system if the galea and vessels were adherent to the graft. There is no galea on the mandible and, therefore, no galeal vessels.

## **REFERENCES:**

1. Buck DW 2nd, Dumanian GA. Bone biology and physiology: Part I. The fundamentals. *Plast Reconstr Surg*. 2012 Jun;129(6):1314-1320.
2. Buck DW 2nd, Dumanian GA. Bone biology and physiology: Part II. Clinical correlates. *Plast Reconstr Surg*. 2012 Jun;129(6):950e-956e.
3. Cutting CB, McCarthy JG, Berenstein A. Blood supply of the upper craniofacial skeleton: the search for composite calvarial bone flaps. *Plast Reconstr Surg*. 1984 Nov;74(5):603-610.



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

33. A 75-year-old man comes to the office because of a 5-year history of a pruritic lesion on the right groin that has been enlarging gradually in size. A photograph is shown. Examination of a specimen obtained on biopsy shows Paget disease. Which of the following is the most appropriate next step in management?

- A) Oral miltefosine
- B) Topical hydrocortisone
- C) Topical miconazole
- D) Wide excision
- E) Observation

The correct response is Option D.

This patient described has extramammary Paget disease and the treatment is wide excision. Paget disease of the breast also presents with eczematous skin changes and is associated with breast cancer. Extramammary Paget disease, however, is an intraepithelial carcinoma that commonly involves the vulvar, perianal, perineal, scrotal, and penile regions. It presents as well-defined, moist, erythematous plaques associated with pruritis. Histopathologic examination shows epidermal acanthosis and elongated rete ridges. Paget cells are large intraepidermal cells with a large nucleus and abundant pale cytoplasm. There is a 7 to 40% rate of associated malignancy. Wide excision is the standard of care, and recent reports have shown that Mohs micrographic surgery can improve evaluation of resection margins.

Observation is not appropriate for extramammary Paget disease given the potential risk for malignancy. Topical treatment with steroids or antifungals is also not appropriate. Oral miltefosine is a treatment for leishmaniasis, an infectious disease that can involve the skin, mucous membranes, and internal organs. Although cutaneous leishmaniasis can present with ulcerating lesions or a dense dermal infiltrate, the histology is predominantly histiocytes, lymphocytes, and plasma cells.

## REFERENCES:

1. O'Connor EA, Hettinger PC, Neuburg M, et al. Extramammary Paget's disease: a novel approach to treatment using a modification of peripheral Mohs micrographic surgery. *Ann Plast Surg*. 2012 Jun;68(6):616-620.
2. Reveiz L, Maia-Elkhoury AN, Nicholls RS, et al. Interventions for American cutaneous and mucocutaneous leishmaniasis: a systematic review update. *PLoS One*. 2013 Apr 29;8(4):e61843. Print 2013.
3. Douglas SR, Narayan D. Extramammary Paget's Disease in Males: A Caveat for the Plastic Surgeon. *Plast Reconstr Surg*. 2013 Apr;131(4):652e-653e.

34. A 38-year-old unconscious and intoxicated woman is brought to the emergency department after being struck by a motor vehicle. She sustained multiple injuries, including a wound on the right thigh, which measures 12 × 18 cm with areas of exposed fat and muscle. There is dirt and gravel in the wound. Which of the following is the most appropriate next step in management?
- A) Broad-spectrum antibiotic therapy
  - B) Injection of tetanus toxoid
  - C) Negative pressure wound therapy
  - D) Split-thickness skin grafting
  - E) Wound irrigation and debridement

The correct response is Option B.

In a patient with a grossly dirty wound, it is appropriate to administer a tetanus shot. Tetanus (also known as lockjaw) is characterized by a prolonged contraction of skeletal muscle fibers. The primary symptoms are caused by tetanospasmin, a neurotoxin produced by *Clostridium tetani*, a gram-positive, rod-shaped, obligate anaerobe. Infection generally occurs through wound contamination and often involves a cut or deep puncture wound.

In the acute period before definitive wound closure can be achieved, it is critical to debride all devitalized tissue such that there is a healthy, viable wound bed. The administration of broad-spectrum intravenous antibiotics has not been shown to decrease the risk of wound infection, and may, in fact, lead to the development of selecting out for resistant pathogens. The mainstay of treatment is performing repeat surgical debridement as often as necessary until the wound is clean. Debridement and cleansing of the wound are ideally performed in the operating room under controlled conditions; however, depending upon the condition of the patient, concomitant injuries, and the ability of the patient to tolerate the procedure, it may be necessary to perform a limited, conservative wound washout at the bedside or in the emergency department. Over the course of the initial hospital stay, debridement should continue until healthy tissue is encountered, which can be identified by visual inspection and the presence of punctate bleeding.

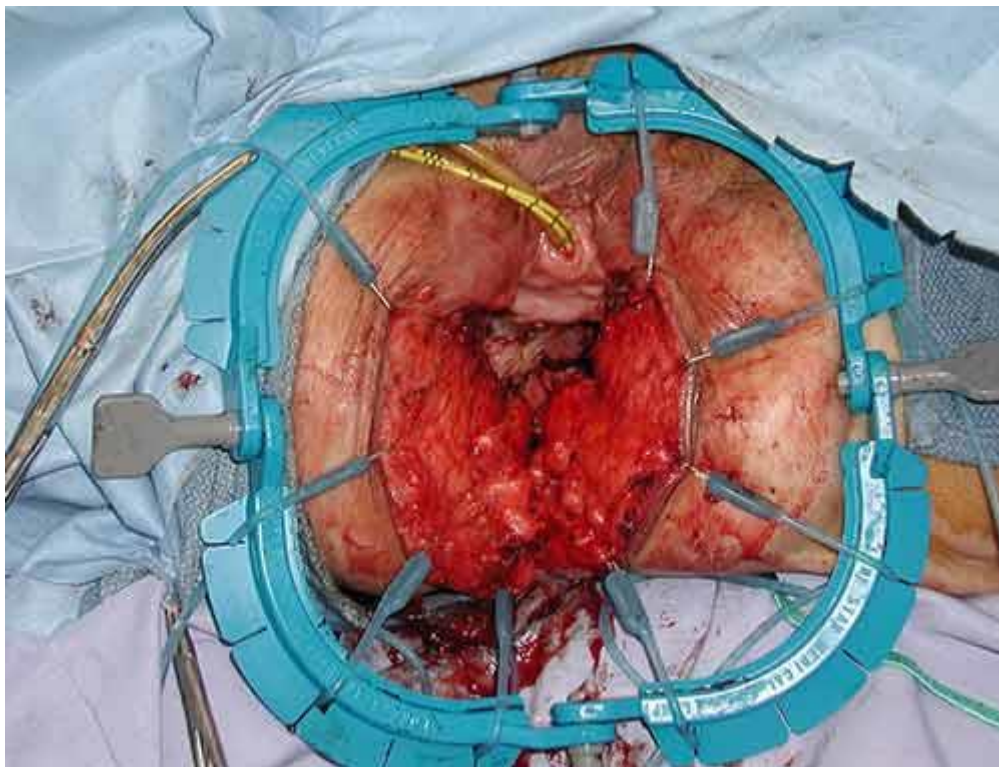
The surgeon must consider several things when deciding between closure with a flap or a graft. The defect in this patient is too large to achieve primary closure. The use of negative pressure wound therapy for such a large wound may be helpful as a

temporary measure, but, as a method of definitive wound closure, would result in healing by secondary intention, scarring, and prolonged wound care. If there were exposed bone, tendon, nerves, blood vessels, or significant dead space, this would make a stronger argument for a flap-over-skin graft. Although not provided as an option in this question, the use of biosynthetic materials or dermal matrix tissues has been reported in the literature as an intermediate step to skin grafting, but it is important to consider the necessity of these materials in effecting outcomes in light of the significant cost of using them.

Split-thickness skin grafts can provide wound coverage over a large area. A mechanical dermatome is often used. Typical thicknesses may range from 8/1000th of an inch to 14/1000th of an inch. The graft can be meshed in various ratios such as 1:1.5, 1:2, and 1:3 to allow for a larger area of coverage per unit of harvested skin. It is important that the underlying wound bed be viable and free of necrotic tissue or infection to allow for healing of the skin graft ("skin graft take"). Adequate immobilization of a skin graft is important for "take" of the graft, and can be achieved with negative pressure wound therapy, or tie-over bolster dressing. The thigh has an abundant amount of soft tissue and muscle, which is why skin grafts are often sufficient for wound coverage rather than flaps.

## REFERENCES:

1. Attinger C, Bulan EJ, Blume PA. Pharmacological and mechanical management of wounds. In: Mathes S, ed. *Plastic Surgery*. Vol 1. Philadelphia: Elsevier-Saunders; 2006:863-900.
2. Thornton J, Gosman A. Skin grafts and skin substitutes and principles of flaps. *Selected Readings in Plastic Surgery*. 2004;10(4).
3. Paletta CE, Pokorny JJ, Rumbolo PM. Skin grafts. In: Mathes S, ed. *Plastic Surgery*. Vol 1. Philadelphia: Elsevier-Saunders; 2006:293-316.



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

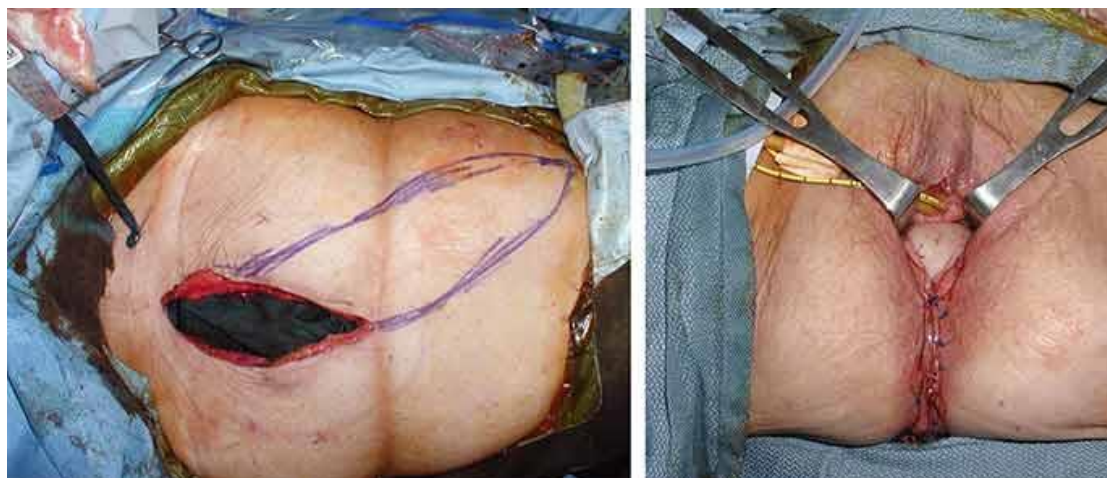
35. A 56-year-old woman undergoes abdominoperineal resection secondary to aggressive rectal cancer. Neoadjuvant chemotherapy and radiation therapy have been performed. Surgical examination shows defect of the anus, rectum, and posterior vaginal wall. An intraoperative photograph is shown. Which of the following is the most appropriate reconstructive option in this patient?
- A) Bilateral Singapore (pudendal thigh) flaps
  - B) Gracilis muscle flap
  - C) Omental flap
  - D) Rectus femoris flap
  - E) Vertical rectus abdominis musculocutaneous flap

The correct response is Option E.

As the treatment of anorectal cancers has shifted to more sphincter-preserving surgeries and radiochemotherapy, the need for abdominoperineal resection (APR) has

decreased. However, in cases of locally persistent disease, involvement of nearby structures (vagina), or recurrent disease, there is an increased rate of survival and improved quality of life with pelvic extirpation. These cases typically result in problematic wounds secondary to previous radiation therapy, with complication rates as increased as 60%. Complications include delayed wound healing, infection, internal hernia, chronic sinus formation, and the psychological and physical concerns associated with vaginal resection in the female patient. In an effort to minimize these complications and restore sexual function in the female patient, musculocutaneous flap reconstruction is recommended.

In the patient described, the most appropriate option for reconstruction is the vertical rectus abdominis musculocutaneous (VRAM) flap.



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

The advantages of the rectus flap include an excellent and safe pedicle (Mathes/Nahai Type III flap), rapid technique, abundant well-vascularized tissue, wide arc of rotation, acceptable donor-site morbidity, and ease of access in relation to the APR procedure. The well-vascularized bulky tissue is effective in obliterating the pelvic dead space, minimizes the risk of internal herniation of the abdominal contents, and provides healthy tissue in the event of suture line dehiscence allowing more rapid healing by secondary intention if necessary. The disadvantages of the VRAM include lack of sensation in the vagina/perineum, loss of secretory function that may result in dyspareunia, abdominal weakness/hernia, and unsightly bulk in the perineum that may require a secondary debulking procedure for aesthetic improvement. In the patient described, the decision was made to close the perineal skin over the de-epithelialized flap. Another patient is shown below with a perineal skin paddle.



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

Primary closure is inappropriate secondary to the increased rate of complications and poor sexual function without reconstruction as noted above. Bilateral pudendal thigh (Singapore) flaps are a great option for vaginal or labial reconstruction in the congenital or ablative setting when there is not a need for a large volume of tissue. In this case, the flaps are not an option because of the need for bulky tissue, previous radiation therapy administered to the base of the flaps, and transection of the flap's blood supply (posterior labial artery). The extended groin flap is inappropriate for the same reason.

A skin graft is not likely to be successful, given the patient's radiation history and violation of the rectum.

## REFERENCES:

1. Pusic AL, Mehrara BJ. Vaginal reconstruction: an algorithm approach to defect classification and flap reconstruction. *J Surg Oncol*. 2006 Nov 1;94:515-521.
2. Bell SW, Dehni N, Chaouat M, et al. Primary rectus abdominis myocutaneous flap for repair of perineal and vaginal defects after extended abdominoperineal resection. *Br J Surg*. 2005 Apr;92(4):482-486.
3. Buchel EW, Finical S, Johnson C. Pelvic reconstruction using vertical rectus abdominis musculocutaneous flaps. *Ann Plast Surg*. 2004 Jan;52(1):22-26.
4. Tei TM, Stolzenburg T, Buntzen S, et al. Use of transpelvic rectus abdominis musculocutaneous flap for anal cancer salvage surgery. *Br J Surg*. 2003 May;90(5):575-580.
5. Wee JTK, Joseph VT. A new technique of vaginal reconstruction using neurovascular pudendal-thigh flaps: a preliminary report. *Plast Reconstr Surg*. 1989 Apr;83(4):701-709.
6. Cordeiro PG, Pusic AL, Disa JJ. A classification system and reconstructive algorithm for acquired vaginal defects. *Plast Reconstr Surg*. 2002 Sep 15;110(4):1058-1065.



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

36. A 22-year-old woman is evaluated in the emergency department because of necrotizing fasciitis of the right upper extremity. BMI is 35 kg/m<sup>2</sup>. After adequate debridement, the entire extensor and flexor compartments are open with exposed tendon. A photograph is shown. Which of the following is the most appropriate initial method of reconstruction?

- A) Anterolateral thigh free flap
- B) Bilaminate neodermis
- C) Full-thickness skin grafts
- D) Pedicled abdominal flap
- E) Split-thickness skin grafts

The correct response is Option B.

Although a bilaminate neodermis (Integra) artificial skin substitute has been traditionally used in the acute management of burns, there have been many successful reports incorporating its use in general reconstructive plastic surgery. Integra is a bioengineered dermal substitute consisting of a bilayer membrane system. The dermal replacement layer is composed of a cross-linked bovine tendon collagen-glycosaminoglycan (chondroitin-6-sulfate) matrix coated on one side with a synthetic polysiloxane polymer (silicone) layer. This layer functions as an epidermis to control moisture loss from the wound. The collagen matrix serves as a scaffold for ingrowth of fibroblasts, macrophages, lymphocytes, and capillaries and is ultimately replaced

by host tissue. Integra “take” mirrors skin graft “take” and follows the sequence of 1) imbibition, 2) fibroblast migration, 3) neovascularization, and 4) maturation.

As the host tissue infiltrates the dermal layer, the collagen layer is biointegrated with the wound to form a vascular neodermis capable of accepting a split-thickness skin graft after a period of approximately 4 weeks. Proper patient selection and careful monitoring for infection or hematoma accumulation are crucial in this time period. After approximately 4 weeks, the silicone layer is removed and a thin (0.008- to 0.010-inch) skin graft can be applied.

Advantages of Integra use include improved cosmesis, diminished scar contracture or development of hypertrophic scar, off-the-shelf availability in large quantities, increased elasticity, and the ability to use thinner skin grafts with subsequent improvement in donor-site morbidity, scar, and time to heal. Other cited advantages include commensurate growth of the grafted tissue in children, potential avoidance of a microsurgical procedure, and placement over tendons with no significant reduction in tendon mobility. The disadvantages of Integra include its high cost, steep learning curve, need for at least two stages with subsequent increased time to final closure, potential for infection under the silicone layer, and lack of adnexal structures with patient concerns of skin dryness.



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

In this patient, use of Integra with delayed thin split-thickness skin grafts at 4 weeks will give the best outcome in terms of cosmesis and function. A photograph is shown. Split-thickness skin grafts are not a good option in this location because of the risk of graft loss with tendon exposure due to lack of viable paratenon and the risk of secondary contracture at the wrist and elbow. Full-thickness skin grafts would diminish the risk of secondary contracture but harvesting enough tissue to cover the entire arm would be impossible using the inguinal region as a donor site. Full-thickness grafts also require a healthier wound bed for optimal graft “take” and are not likely to heal over exposed tendons.

Free tissue transfer is an excellent technique for resurfacing the forearm, but in this patient, the thigh donor site would be difficult secondary to tissue thickness and the need for an extremely large flap. A better choice could be the scapular or parascapular donor site, perhaps in combination with a preliminary tissue expansion of that location. Obtaining enough tissue would be difficult. Banking the forearm in the abdomen would be less desirable as well, given her obesity and the need for a large surface area.

## REFERENCES:

1. Jones I, Currie L, Martin R. A guide to biological skin substitutes. *Br J Plast Surg*. 2002 Apr;55(3):185-193.
2. Stanton RA, Billmire DA. Skin resurfacing for the burned patient. *Clin Plast Surg*. 2002 Jan;29(1):29-51.
3. Dantzer E, Braye FM. Reconstructive surgery using an artificial dermis (Integra): results with 39 grafts. *Br J Plast Surg*. 2001 Dec;54(8):659-664.
4. Moiemmen NS, Vlachou E, Staiano JJ, et al. Reconstructive surgery with Integra dermal regeneration template: histologic study, clinical evaluation, and current practice. *Plast Reconstr Surg*. 2006 Jun;117(7 Suppl):160S-174S.



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

37. A 20-year-old woman comes to the office to discuss reconstruction for hemifacial atrophy. A photograph is shown. The atrophy began when she was 13 years old and stabilized by 16 years of age. Workup suggests mixed connective tissue etiology that falls within the lupus spectrum. Which of the following is the most appropriate intervention to correct this patient's deformity?
- A) Buried anterolateral thigh free flap
  - B) Custom silicone prosthesis
  - C) Gracilis free flap
  - D) Injectable poly-L-lactic acid
  - E) Pedicled pectoralis major flap

The correct response is Option A.

Facial contour deformities can result from a variety of causes, can be unilateral or bilateral, and may range in severity. The most common cause is Romberg disease, progressive hemifacial atrophy. The cause is unknown but may be a localized form of scleroderma. Systemic lupus erythematosus and scleroderma are the most common connective tissue disorders resulting in soft-tissue atrophy with facial involvement.

Systemic lupus erythematosus is an inflammatory connective tissue disorder of unknown cause that predominantly affects women (90%). The clinical course can be variable and involve almost all organ systems. Cutaneous manifestations include soft-tissue atrophy, telangiectasia, and extremity ulcerations. Scleroderma refers to a spectrum of disorders characterized by diffuse fibrosis of the skin, blood vessels, synovia, and vital organs, such as the kidneys. Women are affected four times more frequently than men and the skin is involved in 95% of cases. The pathogenesis is unclear but may include vascular abnormalities (vasculitis), excess collagen deposition, and excess proteoglycan production in the involved tissues.

Surgical options for correction of hemifacial atrophy include alloplastic implants, free dermis/fat grafts, fat injections, and fasciocutaneous free tissue flaps. For mild defects, a custom alloplastic implant composed of silicone or porous polyethylene may be acceptable, but risks such as skin breakdown with implant exposure, scar contracture, and poor long-term patient satisfaction make an alloplastic option less desirable. In the patient described, the large nature of the defect and thin nature of her skin make an alloplastic option a poor choice.

Fat grafting using the techniques described by Coleman is a viable option for smaller defects. The large defect and need for multiple cycles of fat grafting make this a less desirable option in this patient. Various free flaps including omentum, parascapular, groin, and superficial inferior epigastric artery flaps have been described for correction of hemifacial atrophy. In this case, the anterolateral thigh flap is the most appropriate choice because it allows for harvest of a large amount of tissue, including skin, fat, fascia, and muscle. A postoperative photograph is shown.



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

A gracilis free flap is a great option for facial reanimation, but it would not have enough size and bulk to correct this patient's deformity. Similarly, a pectoralis major flap would not be acceptable due to lack of bulk and inability to position the flap without tethering because of the pedicle. Additionally, it would be difficult to transpose the muscle high enough for full correction and an unaesthetic bulge would be notable in the neck.

## REFERENCES:

1. Hansen SL, Mathes SJ. Problem Wounds and Principles of Closure. In: Mathes SJ, ed. *Plastic Surgery*. Vol 1. Philadelphia: Elsevier-Saunders; 2006:901-1030.
2. Siebert JW, Soltanian H, Hazen A. Hemifacial Atrophy. In: Mathes SJ, ed. *Plastic Surgery*. Vol 4. Philadelphia: Elsevier-Saunders; 2006:555-569.
3. Hazen A, Gurtner GC. Restoration of Craniofacial Soft Tissue Contour. In: McCarthy JG, Galiano RD, Boutros SG, eds. *Current Therapy in Plastic Surgery*. Philadelphia: Elsevier-Saunders; 2006:203-207.
4. Nasajpour H, Steele MH. Anterolateral thigh free flap for “head-to-toe” reconstruction. *Ann Plast Surg*. 2011 May;66(5):530-533.

38. An 82-year-old man is referred for reconstruction of the scalp after Mohs micrographic surgery for an aggressive squamous cell carcinoma. He is scheduled to undergo radiation therapy as soon as possible after reconstruction. The patient has pulmonary fibrosis and is receiving oxygen via nasal cannula. Physical examination shows a vertex scalp defect of 4 × 4 cm with calvarium exposed throughout. Which of the following is the most appropriate management?

- A) Bilaminate neodermis
- B) Delayed reconstruction
- C) Local tissue rearrangement
- D) Radial forearm free flap
- E) Split-thickness skin graft

The correct response is Option C.

In any reconstruction, many factors (local, regional, and systemic) have to be considered before deciding on a proper treatment option. Indeed, there may very well be multiple options. The patient described is an elderly man who is an extremely poor candidate for anesthesia (example of systemic consideration). Additionally, he will need radiation therapy to the scalp as soon as possible. Therefore, the reconstruction option needs to have excellent blood supply to heal in the first place, heal quickly, and withstand the effects of radiation. Additionally, coverage of the exposed calvarium is necessary, as periosteum has been removed by the Mohs surgeon. Out of the options given, local scalp flap coverage best accomplishes this goal.

Delay of treatment is not recommended because it only creates a greater problem after radiation therapy, because all local options as well as the calvarium will be irradiated, which severely hampers the surgeon's ability to provide a low-morbidity procedure and avoid a substantial operation.

Dermal matrices (any form) are not appropriate options here for many reasons. They are not the definitive treatment option in a patient who is about to undergo radiation. Once the matrices become incorporated, they will usually need a skin graft to complete reconstruction or they will need a prolonged period of dressing changes, neither of which is optimal in this patient (a second surgery or a prolonged healing phase). Also, they need to be placed on a well-vascularized bed in order for them to "take" and heal more effectively. An exposed calvarium (without additional burring of bone) is not an optimal bed for a dermal matrix.

Skin grafts (of any variety) lack blood supply after harvest. They also need to be placed on a well-vascularized bed in order for them to “take” and heal more effectively. An exposed calvarium (without additional burring of bone) is not an optimal bed for a skin graft. Also, a thin skin graft may not be the best form of reconstruction in a patient who is about to undergo radiation therapy, if other options exist.

Radial forearm free flap is too complex an operation for this patient with many comorbidities and a relatively small defect.

## **REFERENCES:**

1. Hallock GG, Morris SF. Skin grafts and local flaps. *Plast Reconstr Surg*. 2011 Jan;127(1):5e-22e.
2. Leedy JE, Janis JE, Rohrich RJ. Reconstruction of acquired scalp defects: an algorithmic approach. *Plast Reconstr Surg*. 2005 Sep 15;116(4):54e-72e.
3. Janis JE, Kwon RK, Lalonde DH. A practical guide to wound healing. *Plast Reconstr Surg*. 2010 Jun;125(6):230-244.

39. Which of the following antibiotics is most effective in decreasing *Staphylococcus aureus* infections in irradiated wounds?

- A) Cefazolin
- B) Doxycycline
- C) Nafcillin
- D) Trimethoprim-sulfamethoxazole

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

The correct response is Option D.

The prophylactic use of trimethoprim/sulfamethoxazole (TMP/SMZ) in irradiated wounds, primarily in the setting of implant-based breast reconstruction, has been shown to reduce the rate of skin-derived infections. Mirzabeigi et al<sup>1</sup> reported a 28% reduction in infection rates with the use of TMP/SMZ when compared with cephalosporins, in an irradiated chest wall wound. Based on their data, the authors advocate a monthlong prophylactic course of TMP/SMZ to reduce infection rates in this high-risk population. This is likely due to the ability of TMP/SMZ to treat both methicillin-resistant *Staphylococcus aureus* (MRSA) and *Staphylococcus epidermidis*. This has been supported by other published reports.<sup>2,3</sup>

Cefazolin and nafcillin do not effectively treat MRSA, reducing their clinical ability to prevent skin-related infections in this high-risk population. Doxycycline has some efficacy in treating most skin flora, including MRSA, but there is no clinical evidence to suggest it outperforms TMP/SMZ.

## REFERENCES:

1. Mirzabeigi MN, Lee M, Smartt JM Jr, et al. Extended trimethoprim/sulfamethoxazole prophylaxis for implant reconstruction in the previously irradiated chest wall. *Plast Reconstr Surg*. 2012 Jan;129(1):37e-45e.
2. Alderman A, Gutowski K, Ahuja A, Gray D; Postmastectomy Expander Implant Breast Reconstruction Guideline Work Group. ASPS clinical practice guideline summary on breast reconstruction with expanders and implants. *Plast Reconstr Surg*. 2014 Oct;134(4):648e-655e.

3. Sbitany H, Wang F, Peled AW, Lentz R, Alvarado M, Ewing CA, Esserman LJ, Fowble B, Foster RD. Immediate implant-based breast reconstruction following total skin-sparing mastectomy: defining the risk of preoperative and postoperative radiation therapy for surgical outcomes. *Plast Reconstr Surg*. 2014 Sep;134(3):396-404.

40. A 53-year-old woman comes to discuss breast reconstruction after undergoing left mastectomy for ductal carcinoma in situ. She does not require chemotherapy or radiation therapy and does not want surgery on the unaffected breast. She is obese but otherwise healthy with a large, ptotic right breast. Which of the following breast reconstruction techniques is most likely to result in the greatest long-term patient satisfaction?
- A) Autologous breast reconstruction with microvascular free tissue transfer from the abdomen
  - B) Extended latissimus dorsi musculocutaneous flap reconstruction without an implant
  - C) Immediate reconstruction with cohesive, anatomically shaped silicone gel implant
  - D) Immediate tissue expander followed by implant-based reconstruction
  - E) Latissimus dorsi musculocutaneous flap reconstruction with immediate placement of a permanent implant

The correct response is Option A.

Multiple studies have supported improved patient satisfaction with autologous breast reconstruction in the setting of a unilateral reconstruction. The clinical scenario involves an obese patient with a large, ptotic breast who does not desire a surgical procedure for symmetry and is the ideal candidate for an autologous reconstruction. Microvascular free tissue transfer of abdominal tissue for breast reconstruction demonstrates improved reliability and decreased fat necrosis compared with pedicled flap reconstruction. Implant-based reconstruction is less likely to provide adequate symmetry in this patient. An extended latissimus dorsi musculocutaneous flap-based reconstruction alone is unlikely to provide enough volume for symmetry and a traditional latissimus flap with implant is unlikely to provide adequate ptosis for symmetry.

## REFERENCES:

1. Elder EE, Brandberg Y, Björklund T, et al. Quality of life and patient satisfaction in breast cancer patients after immediate breast reconstruction: a prospective study. *Breast*. 2005 Jun;14(3):201-218.

2. Janz NK, Wren PA, Copeland LA, et al. Patient physician concordance: preferences, perceptions, and factors influencing the breast cancer surgical decision. *J Clin Oncol*. 2004 Aug 1;22(15):3091-3098.
3. Fogarty BJ, Brown AP, Miller R, et al. TRAM flap versus nonautologous breast reconstruction: what do patients really think? *Plast Reconstr Surg*. 2004 Apr 1;113(4):1146-1152.
4. Saulis AS, Mustoe TA, Fine NA. A retrospective analysis of patient satisfaction with immediate postmastectomy breast reconstruction: comparison of three common procedures. *Plast Reconstr Surg*. 2007 May;119(6):1669-1676.

41. A 43-year-old woman would like to discuss plans for breast reconstruction after her upcoming unilateral mastectomy. Postoperative radiation therapy is planned. Which of the following is the most likely benefit of tissue expander–based breast reconstruction compared with immediate autologous breast reconstruction using this patient's abdominal tissue?

- A) Better symmetry
- B) Improved postoperative sensation
- C) A larger, more ptotic breast reconstruction
- D) Lower risk of complications from radiation
- E) Preservation of the patient's options for final reconstruction

The correct response is Option E.

Immediate breast reconstruction with tissue expanders followed by reconstruction of choice preserves the patient's skin envelope and keeps open options for definitive final reconstruction of choice whether with an implant or autologous tissue.

Tissue expander-based reconstruction is associated with a higher complication rate in the setting of radiation therapy but preserves abdominal and back tissue as options for autologous reconstruction. Implant-based reconstruction does not provide the advantages of improved symmetry, sensation, or breast ptosis.

## REFERENCES:

1. Fine NA, Hirsch EM. Keeping options open for patients with anticipated postmastectomy chest wall irradiation: immediate tissue expansion followed by reconstruction of choice. *Plast Reconstr Surg*. 2009 Jan;123(1):25-29.
2. Hirsch EM, Seth AK, Dumanian GA, et al. Outcomes of immediate tissue expander breast reconstruction followed by reconstruction of choice in the setting of postmastectomy radiation therapy. *Ann Plast Surg*. 2014 Mar;72(3):274-278.

42. A 52-year-old woman seeks treatment for signs of facial aging. She reports diffuse fine rhytides caused by a long history of sun exposure and smoking. Which of the following is most likely to result in the greatest long-term increase in dermal collagen content?
- A) Deep-plane rhytidectomy
  - B) Fat grafting
  - C) Hyaluronic acid filler injection
  - D) Tretinoin therapy
  - E) Trichloroacetic acid peel

The correct response is Option D.

While all of the listed treatments are effective and employed commonly for facial aging, only tretinoin (Retin-A) has been found to have effectiveness in long-term collagen production. Retinoids are vitamin A derivatives that have profound effects on the skin. Both increases in dermal collagen production and decreases in degradation are seen over 6 to 12 months of treatment. The active form is tretinoin, a metabolite of vitamin A. Within 3 months of starting treatment, improvements in skin softness, texture, and reductions in fine rhytides and dyschromia are apparent. Treatment is typically a 0.05 to 0.01% topical cream applied nightly. Peeling and redness are common, but treatment tolerance improves with time. Early treatment reactions can be treated with decreased product concentration, longer treatment intervals, and topical hydrocortisones.

Fat grafting is a very effective volume replacement and deeper rhytides treatment. While there are some suggestions of increased vascularity and health of overlying skin, effects are secondary and not as profound as tretinoin. Rhytidectomy (facelifting) results in physical skin tightening by removal, along with deeper tissue (SMAS) repositioning. Skin texture and collagen effects are relatively minor. Hyaluronic acid fillers are also effective rhytide and volume treatments, but have little or no effect on collagen. TCA peels effectively treat the epidermis and superficial dermis and have minor collagen stimulation effects through the natural wound-healing process. While surface appearance effects can be dramatic, the amount of collagen stimulation is far less than tretinoin. Laser resurfacing can result in more dermal injury and resultant collagen production than chemical peels, although hypopigmentation and prolonged recovery are disadvantages. Pre-treatment with tretinoin prior to peels and laser resurfacing can increase the depth of treatment and, some hypothesize, improvements in healing and recovery time.

## REFERENCES:

1. Hubbard BA, Unger JG, Rohrich RJ. Reversal of skin aging with topical retinoids. *Plast Reconstr Surg*. 2014 Apr;133(4):481e-490e.
2. Huang CK, Miller TA. The truth about over-the counter topical anti-aging products: a comprehensive review. *Aesthet Surg J*. 2007 Jul-Aug;27(4):402-412.

43. A 38-year-old woman undergoes bilateral breast reconstruction using microvascular free tissue transfer from the abdomen. The patient is evaluated 8 hours later because the right breast flap appears mottled and engorged. Administration of which of the following is CONTRAINDICATED in this patient?
- A) Heparin irrigation to the flap vessels
  - B) Papaverine to the flap vessels
  - C) Systemic heparin
  - D) Systemic thrombolytics
  - E) Thrombolytics to the flap vessels

The correct response is Option D.

Heparin may be used locally or systemically during flap salvage attempts in an effort to encourage further propagation of clot and irrigate existing thrombus. Papaverine and thrombolytic agents are used locally on or within the flap vessels, but not systemically due to concern for systemic complications.

## REFERENCES:

1. Khansa I, Chao AH, Taghizadeh M, et al. A systemic approach to emergent breast free flap takeback: Clinical outcomes, algorithm, and review of the literature. *Microsurgery*. 2013 Aug 14. [Epub ahead of print]
2. Bui DT, Cordeiro PG, Hu QY, et al. Free flap reexploration: indications, treatment, and outcomes in 1193 free flaps. *Plast Reconstr Surg*. 2007 Jun;119(7):2092-2100.

44. A 30-year-old man requires bone grafting for repair of a severe nasal deformity after a bicycle collision. Which of the following is the optimal rib donor site for ease of exposure and limited morbidity?
- A) First
  - B) Third
  - C) Fourth
  - D) Seventh
  - E) Eleventh

The correct response is Option D.

Ribs five through seven are commonly described as the ideal sites for harvesting because of ease of access and ample bone material compared with the more cephalic or caudal ribs. The seventh rib has the added advantage of being situated over the abdominal cavity, reducing the risk for pneumothorax during harvest. Ribs five and six are also suitable, and may hide better in the inframammary crease of women.

Ribs may be harvested either whole or split depending on the amount of material needed. If a whole-rib graft is required, as long as multiple adjacent ribs are not removed, morbidity is limited. Split-rib harvest offers the advantage of eventual bone regrowth, and the area can be harvested for bone grafting again in the future if needed. The eleventh rib provides a wide expanse of medial cartilage for harvest, although it is not an ideal bone donor site.

Rib grafts offer both cortical and cancellous bone material. The cortical bone is rigid and provides immediate structural support, though final incorporation and strengthening occur over many months. A well-vascularized wound bed is required for bone healing and incorporation. A split-rib inset provides the cancellous bone surface, which is more rapidly revascularized. If an entire bone is needed for grafting, then a vascularized bone graft or flap with microvascular anastomosis would be better suited.

## REFERENCES:

1. Mehrara B, McCarthy J. Repair and Grafting of Bone. In: Mathes SJ, Hentz VR, eds. *Plastic Surgery*. 2nd ed. Philadelphia: Elsevier-Saunders; 2005:685-686.

2. Marin VP, Landecker A, Gunter JP. Harvesting rib cartilage grafts for secondary rhinoplasty. *Plast Reconstr Surg*. 2008 Apr;121(4):1442-1448.
3. Johnson PE, Raftopoulos I. In situ splitting of a rib graft for reconstruction of the orbital floor. *Plast Reconstr Surg*. 1999 May;103(6):1709-1711.
4. Jung DH, Choi SH, Moon HJ, et al. A cadaveric analysis of the ideal costal cartilage graft for Asian rhinoplasty. *Plast Reconstr Surg*. 2004 Aug;114(2):545-550.
5. Cervelli V, Bottini DJ, Gentile P, et al. Reconstruction of the nasal dorsum with autologous rib cartilage. *Ann Plast Surg*. 2006 Mar;56(3):256-262.

45. A 15-year-old girl has two draining nodules of axillary hidradenitis suppurativa. Each lesion is approximately 10 mm in diameter. The remaining axillary skin shows no abnormalities. After a 6-week course of oral doxycycline and topical mupirocin, the lesions drain less but are still present. Which of the following is the most appropriate treatment for this patient?

- A) Complete axillary excision and skin grafting
- B) Excision and closure
- C) Incision and drainage
- D) Intravenous antibiotics
- E) Kenalog injection

The correct response is Option B.

This young patient has limited, focal disease that has failed medical management. Local excision is useful for isolated, scattered individual, or linear lesions. More extensive disease that occupies a significant portion of the skin area may be better treated by complete axillary excision. In this younger patient with limited disease, direct excision of the affected areas is a less morbid approach. Negative pressure wound therapy and skin grafts may be optimal coverage treatments for extensive disease, and some local flaps have been described as well. This stubborn disease originates from the apocrine glands and can often be chronic and disabling. The axillae, groin, perineum, and submammary areas can all be affected. Initial treatments include local care, antibiotics, hygiene, and weight loss. Steroid injections may help in early, small lesions, but have limited effectiveness and are painful. After a 6-week course of antibiotics, this patient is not likely to benefit from more treatment. Only excision of the diseased apocrine glands is likely to be effective. Incision and drainage is a suitable treatment for a closed abscess associated with hidradenitis, but incising this patient's lesions would not improve her situation.

## REFERENCES:

1. Howland N, Sanchez E, Bunker M, et al. Approach to the severe hidradenitis suppurativa patient: a 20-year review. *Plast Reconstr Surg*. 2014 Oct;134(4 Suppl):148.
2. Jamec GB. Clinical practice. Hidradenitis suppurativa. *N Engl J Med*. 2012 Jan 12;366(2):158-164.

46. A 17-year-old boy is evaluated for scalp reconstruction because of a burn sustained 10 years ago. On examination, there is patchy alopecia and hypertrophic scarring of the left side of the temporoparietal scalp that occupies approximately 35% of the total scalp. Which of the following is the most appropriate method for reconstruction in this patient?

- A) Free latissimus dorsi musculocutaneous flap and skin grafting
- B) Hair transplantation
- C) Orticochea flap
- D) Serial excision and closure
- E) Tissue expansion

The correct response is Option E.

No other tissue or donor site in the body will approximate the hair-bearing qualities of scalp tissue. Simply, the best replacement for scalp tissue is scalp tissue. In addition to calvarial coverage and wound closure, the reconstructive surgeon should strive for a cosmetically pleasing outcome. In this patient with nearly 40% scalp loss, tissue expansion will provide the optimal functional and aesthetic outcome. Tissue expansion should be considered when local tissue rearrangements are inadequate because of defect size, trauma, or unacceptable rearrangement or distortion of the hairline. Tissue expansion increases the amount of locally available tissue, preserves sensation, and maintains hair follicles and adnexal structures.

Approximately 50% of the scalp can be reconstructed with expanded tissue with minimal change in hair density. Serial expansions can be performed if needed for ultimate closure. When performing expansion, the largest tolerated expander(s) should be placed in the subgaleal plane. Rectangular and crescent-shaped implants provide more expansion than circular devices. Expansion should continue until the expanded flap is approximately 20% larger than the expected defect to account for tissue recoil. Disadvantages of tissue expansion include prolonged time to complete the expansion process (up to 3 months not uncommon), need for at least two operations, and a high rate of complications (6 to 48%). Common problems include infection, implant exposure or extrusion, hematoma, flap necrosis, skull erosion, alopecia, and wide scars.

Serial excisions are useful for smaller defects. The amount of scar and deformity is much less when using tissue expanders versus serial reductions and complex rotation flaps.

Free tissue transfer is best utilized for reconstruction of total or near-total scalp defects, particularly in the setting of irradiation or oncologic reconstruction. The latissimus dorsi muscle free flap is one of the best choices because of its large area and long pedicle. With time, the muscle flap will atrophy and conform well to the underlying bone. Other good options include the radial forearm, anterolateral thigh, or parascapular flaps.

The Orticochea and Juri flaps are ill suited for a defect this large (>30% of scalp) or in this location. Juri flaps (temporoparietal-occipital) are useful for frontal or frontoparietal defects. The flap is based on the parietal branch of the superficial temporal artery and is best used after surgical delay of the distal aspect. The Orticochea procedure (3-flap technique) was classically described for reconstruction of acquired defects of the occiput. Each flap in the design must include a vascular pedicle and the technique can be used to cover up to 30% of the scalp. The cosmetic outcome using Orticochea flaps is often inferior to what can be obtained using tissue expansion because of unnatural resultant hair orientation. For this reason, tissue expansion should be considered in lieu of Orticochea flaps if possible.

Hair transplantation is not appropriate for a defect of this size and a scarred recipient site.

## REFERENCES:

1. Leedy JE, Janis JE, Rohrich RJ. Reconstruction of acquired scalp defects: an algorithmic approach. *Plast Reconstr Surg*. 2005 Sep 15;116(4):54e-72e.
2. Wells MD. Scalp Reconstruction. In: Mathes SJ, Hentz VR, eds. *Plastic Surgery*. 2nd ed. Philadelphia: Elsevier-Saunders; 2006:615-620.
3. Argenta LC, Marks MW. Principles of Tissue Expansion. In: Mathes SJ, Hentz VR, eds. *Plastic Surgery*. 2nd ed. Philadelphia: Elsevier-Saunders; 2006:548-551.
4. Huang C, Evans GRD. Scalp Reconstruction. In: Evans GRD, ed. *Operative Plastic Surgery*. New York: McGraw-Hill; 2000:317-319.

47. A 66-year-old man with a history of adenocarcinoma of the lung undergoes a left pneumonectomy using a posterolateral thoracotomy incision. Postoperatively, he receives radiation therapy. The patient subsequently develops a nonhealing ulcer of the chest wall measuring 5 × 6 cm in the region of the nipple-areola complex. Which of the following is the most appropriate option for reconstruction?
- A) Negative pressure wound therapy
  - B) Pedicled intercostal muscle flap and a split-thickness skin graft
  - C) Pedicled latissimus dorsi musculocutaneous flap
  - D) Pedicled vertical rectus abdominis musculocutaneous flap
  - E) Split-thickness skin graft only

The correct response is Option D.

Tissue injury from radiation results in irreversible damage that limits the ability of wounds to heal with skin grafts or by secondary intention, such as using negative pressure wound therapy. Tissues within the field of radiation are also generally affected, which would limit use of an intercostal muscle flap. Although a latissimus dorsi musculocutaneous flap would provide an adequate amount of tissue from outside of the field of radiation, it would be unreliable in the setting of prior posterolateral thoracotomy, unless there is documentation that the latissimus was spared. A vertical rectus abdominis musculocutaneous flap would provide sufficient tissue from outside of the field of radiation and would not have been affected by the patient's prior surgery.

## REFERENCES:

1. Skoracki RJ, Chang DW. Reconstruction of the chestwall and thorax. *J Surg Oncol*. 2006 Nov;94(6):455-465.
2. Knoetgen J, Lettieri SC, Arnold PG. Radiation and radiation injuries. In: Thorne CH, Bartlett SP, Beasley RW, et al, eds. *Grabb & Smith's Plastic Surgery*. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2006:162-168.

48. A 38-year-old woman seeks cosmetic enhancement of the nasolabial area to decrease deep folds. She has had good results from injection of hyaluronic acid-based soft-tissue fillers in the past but now desires a longer lasting result. Calcium hydroxylapatite is chosen based on this request. On follow-up examination 2 weeks later, white nodules are noted along the nasolabial folds. Which of the following is the LEAST effective treatment option to address the white nodules?

- A) Direct excision of the filler
- B) Injection of a corticosteroid
- C) Massage of the folds
- D) Needle disruption and unroofing of the lumps

The correct response is Option B.

Calcium hydroxylapatite is a semipermanent material that can be injected as a soft-tissue filler and lasts 1 to 2 years, which is longer than the 4 to 12 months that hyaluronic acid-based fillers last. Safe injection of this material includes prevention of overcorrection, prevention of clumping of filler due to bolus injections, injection in a subdermal plane, and postinjection massage. If nodules form (which usually occur in areas of thin soft-tissue coverage such as the eyelids, lips, and nasolabial region), there are multiple described effective treatments, which include direct excision, observation to allow for the product to resorb, and needle disruption and unroofing. However, whereas lumps caused by poly-L-lactic acid or polymethyl methacrylate respond well to intralesional steroids, these are not as effective in treating lumps caused by calcium hydroxylapatite.

## REFERENCES:

1. Lemperle G, Rullan PP, Gauthier-Hazan N. Avoiding and treating dermal filler complications. *Plast Reconstr Surg*. 2006 Sep;118(3 Suppl):92S-107S.
2. Lemperle G, Duffy DM. Treatment options for dermal filler complications. *Aesthet Surg J*. 2006 May-Jun;26(3):356-364.
3. Graivier MH, Bass LS, Busso M, et al. Calcium hydroxylapatite (Radiesse) for correction of the mid- and lower face: consensus recommendations. *Plast Reconstr Surg*. 2007 Nov;120(6 Suppl):55S-66S.
4. Cohen JL. Understanding, avoiding, and managing dermal filler complications. *Dermatol Surg*. 2008 Jun;34 Suppl 1:S92-S99.

5. Beer KR. Radiesse nodule of the lips from a distant injection site: report of a case and consideration of etiology and management. *J Drugs Dermatol*. 2007 Aug;6(8):846-847.
6. Sadick NS, Katz BE, Roy D. A multicenter, 47-month study of safety and efficacy of calcium hydroxylapatite for soft tissue augmentation of nasolabial folds and other areas of the face. *Dermatol Surg*. 2007 Dec;33 Suppl 2:S122-S126.
7. Berlin A, Cohen JL, Goldberg DJ. Calcium hydroxylapatite for facial rejuvenation. *Semin Cutan Med Surg*. 2006 Sep;25(3):132-137.
8. Ozturk CN, Li Y, Tung R, et al. Complications following injection of soft-tissue fillers. *Aesthet Surg J*. 2013 Aug 1;33(6):862-877. Epub 2013 Jul 3.

49. A 25-year-old woman is scheduled for correction of a deformity of the nasal dorsum caused by previous nasal trauma as a child. Autologous rib cartilage grafting of the dorsum is planned to correct the deformity. Which of the following complications is most likely in this patient?

- A) Extrusion
- B) Necrosis
- C) Ossification
- D) Resorption
- E) Warping

The correct response is Option E.

The most consistent complication of cartilage grafting is the propensity to change shape or warp over time. This may be due to the presence of perichondrium or the nonuniform composition of the matrix that can affect the shape when it is placed.

Pure cartilage grafts tend to maintain shape, but grafts with an intact perichondrial layer can curl significantly and lead to unpredictable results. During septal graft harvest, care must be taken to elevate mucoperichondrial flaps in the proper plane. Likewise, auricular or costal cartilage grafts must be harvested in a subperichondrial plane. Removal of the perichondrium and softer outer cartilage layer leaves the more rigid cartilage core, which maintains shape more predictably.

Extrusion, necrosis, ossification, and resorption are not known to be affected by the presence or absence of the perichondrial layer. Fresh autologous grafts easily survive transplantation procedures and do not appear to resorb over time.

Autologous cartilage from septum, concha, or rib is considered the ideal graft material. These grafts have very low risk for infection or extrusion compared with an allograft. Cartilage grafts are tolerated well by nasal tissue.

## REFERENCES:

1. Randolph MA, Yaremchuk MJ. Repair, grafting, and engineering of cartilage. In: Mathes S, Hentz V, eds. *Plastic Surgery*. 2nd ed. Philadelphia: Elsevier-Saunders; 2006:621-629.

2. Gunter JP, Landecker A, Cochran CS. Frequently used grafts in rhinoplasty: nomenclature and analysis. *Plast Reconstr Surg*. 2006 Jul;118(1):14e-29e.
3. Weber SM, Baker SR. Alar cartilage grafts. *Clin Plast Surg*. 2010 Apr;37(2):253-264.



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

50. A 58-year-old man is referred by an orthopedic surgeon after undergoing open reduction and internal fixation of a fracture of the ankle after falling down stairs. The repair is complicated by wound dehiscence with  $2 \times 2$  cm of exposed tibialis anterior tendon without paratenon. A photograph is shown. After debridement of healthy tissue, reconstruction is performed using bilaminate neodermis with placement of a standard bolster dressing. At which of the following times relative to placement of the bilaminate neodermis should split-thickness skin grafting be performed?
- A) At the same time
  - B) 1 week after
  - C) 2 weeks after
  - D) 4 weeks after
  - E) 6 weeks after

The correct response is Option D.



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

Integra is a bilaminate neodermal material that consists of an outer silicone sheet and an inner layer of bovine collagen and glycosaminoglycan (derived from shark cartilage), which acts as a scaffold for regeneration. Specifically, there is migration of host fibroblasts into the matrix, which subsequently proliferate and form collagen. Additionally, there is migration of endothelial cells that form a vascular network within the neodermis, which can subsequently act as a foundation to support staged split-thickness skin grafting, at which time the silicone outer layer is removed and a thin (usually 6–8/1000”) split-thickness autograft is applied. The success, or “take,” of the skin graft depends on whether the neodermis is vascularized sufficiently to maintain graft viability. A 2001 study by Moiemmen et al. demonstrated clinically and

histologically that this process takes 4 weeks on average, without the use of topical negative pressure.

A follow-up article from 2004 suggests this process can be accelerated from 4 weeks to an average of 7.25 days if topical negative pressure is used. Further follow-up studies based on the clinical appearance of the bilaminate neodermal matrix have suggested reduction in complication rates, improved patient tolerance, and enhanced and accelerated neovascularization with the use of topical negative pressure wound therapy. However, a study published in 2010 looking histologically at various time points could not demonstrate that topical negative pressure wound therapy accelerates neovascularization as verified by the presence of histologically patent vascular channels. The authors found that the median percentage of the template depth that demonstrated canalized channels was 0%, 20%, 61%, and 80% for days 7, 14, 21, and 28, respectively.

Because this question pertains to the use of bilaminate neodermal matrix with the use of a standard bolster dressing and not negative pressure wound therapy, most existing evidence indicates that the most appropriate timing is 4 weeks after placement of the bilaminate neodermis.

## REFERENCES:

1. Moiemens NS, Staiano JJ, Ojeh NO, et al. Reconstructive surgery with a dermal regeneration template: clinical and histologic study. *Plast Reconstr Surg*. 2001 Jul;108(1):93-103.
2. Molnar JA, DeFranzo AJ, Hadaegh A, et al. Acceleration of Integra incorporation in complex tissue defects with subatmospheric pressure. *Plast Reconstr Surg*. 2004 Apr 15;113(5):1339-1346.
3. Jeschke MG, Rose C, Angele P, et al. Development of new reconstructive techniques: use of Integra in combination with fibrin glue and negative-pressure therapy for reconstruction of acute and chronic wounds. *Plast Reconstr Surg*. 2004 Feb;113(2):525-530.
4. Baldwin C, Potter M, Clayton E, et al. Topical negative pressure stimulates endothelial migration and proliferation: a suggested mechanism for improved integration of Integra. *Ann Plast Surg*. 2009 Jan;62(1):92-96.
5. Moiemens NS, Yarrow J, Kamel D, et al. Topical negative pressure therapy: does it accelerate neovascularisation within the dermal regeneration template, Integra? A prospective histological in vivo study. *Burns*. 2010 Sep;36(6):764-768. Epub 2010 May 21.

## Section 2: Hand and Lower Extremity

51. A 60-year-old woman presents with weakness and inability to fully extend the right dominant thumb at the interphalangeal joint. History includes a Colles fracture of the right wrist 6 months ago. Management of the fracture included cast immobilization. On physical examination, the patient's thumb is at 30 degrees of flexion. Finger metacarpophalangeal joint active extension is normal. The patient cannot extend or lift the thumb with her hand flattened on a table. With the thumb adducted, she can extend it to neutral. All thumb joints are supple and have full range of passive motion. Which of the following is the most likely cause of this patient's inability to extend the thumb?
- A) Intersection syndrome
  - B) Radial nerve palsy
  - C) Rupture of the extensor pollicis longus
  - D) Saddle deformity of the basal joint
  - E) Trigger thumb with locking

The correct response is Option C.

Extensor pollicis longus (EPL) rupture is most commonly caused by late effects of distal radius fractures. Devascularization is the most likely cause leading to attritional rupture. Rupture can present 2 weeks to 11 months after fracture; the average is 7 weeks. This patient can extend her thumb when it is adducted because of connections of the intrinsic with the dorsal apparatus. Tendon transfer of the extensor indicis proprius to distal EPL stump is the first-line treatment.

Other causes of EPL rupture include synovitis from rheumatoid arthritis and lupus causing friction at Lister's tubercle, steroid injections, excessive abnormal wrist motion, bony spurs following distal radius and scaphoid fractures, scaphoid nonunion, misplaced external fixator pin, and subluxation of the distal ulna.

A trigger thumb would more likely have pain and tenderness on physical examination along the volar flexor sheath. A locked thumb would not have passive extensibility or active extension with adduction.

Saddle deformity is seen on physical examination in advanced osteoarthritis of the

basal joint. Interphalangeal joint flexion of the thumb is caused by zigzag longitudinal collapse with hyperextension of the metacarpophalangeal joint.

Intersection syndrome is characterized by pain and tenderness along the radial side of the forearm where the abductor pollicis longus and extensor pollicis brevis muscles intersect.

Radial nerve palsy would not only affect the thumb interphalangeal joint.

## **REFERENCES:**

1. Roth KM, Blazar PE, Earp BE, et al. Incidence of extensor pollicis longus tendon rupture after nondisplaced distal radius fractures. *J Hand Surg Am*. 2012 May;37(5):942-947. Epub 2012 Mar 29.
2. Bonatz E, Kramer TD, Masear VR. Rupture of the extensor pollicis longus tendon. *Am J Orthop (Belle Mead NJ)*. 1996 Feb;25(2):118-122.
3. Christophe K. Rupture of the extensor pollicis longus tendon following colles fracture. *J Bone Joint Surg Am*. 1953 Oct;35-A(4):1003-1005.
4. Kim CH. Spontaneous rupture of the extensor pollicis longus tendon. *Arch Plast Surg*. 2012 Nov;39(6):680-682. Epub 2012 Nov 14.

52. A functional 56-year-old woman who has a 20-year history of diabetes mellitus is referred for evaluation of a chronic calcaneal ulcer. The wound has failed to heal with bedside debridement, local wound care, and pressure offloading. On examination, the wound measures 6 × 8 cm with exposed bone and presumed osteomyelitis. CT angiography shows single-vessel flow to the foot through the posterior tibial artery. Clinically, the patient's foot is warm to the touch with capillary refill time of 2 seconds. Which of the following is the most effective management?
- A) Below-knee amputation
  - B) Hyperbaric oxygen therapy
  - C) Microsurgical free flap reconstruction
  - D) Operative debridement and placement of a collagen bilayer wound matrix dressing
  - E) Repeat bedside debridement and negative pressure therapy

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

The correct response is Option C.

The optimal choice in this patient is free flap reconstruction.

When possible, limb salvage is the ultimate treatment goal for patients with diabetic ulcers. As many as 25% of diabetic patients will develop lower extremity ulcers. In addition to significant physical, psychological, and economic impact, patients with diabetic ulcers have an eightfold increased chance of lower extremity amputation. Furthermore, studies show the 5-year mortality rate following lower extremity amputation ranges from 39 to 80%.

This patient has a nonhealing diabetic foot ulcer that has failed adequate nonoperative treatment. Treatment of diabetic ulcers is multifactorial and should include optimizing glucose control and other associated medical comorbidities. If the progress of the wound has stalled despite adequate infection control, edema control, vascular inflow, and pressure offloading, the patient is a candidate for soft-tissue reconstruction. Studies show greater than 90% flap survival with microsurgical reconstruction and limb salvage greater than 80%. Microsurgical free flaps allow the transfer of well-vascularized tissue to provide wound coverage and adequate soft tissue thickness to cover a weight-bearing surface of the foot.

This patient has not had success with bedside debridement and local wound care. Negative pressure dressings often are used as advanced wound care but are not appropriate when underlying infection or necrotic tissue is present. Bedside debridements are not adequate to treat osteomyelitis.

Hyperbaric oxygen therapy can be used as an adjunct to local wound care or following flap surgery to optimize perfusion and wound healing. However, hyperbaric oxygen therapy is not the most effective treatment for a wound this large in a patient who is able to undergo surgery.

The goal of treatment in diabetic ulcers should be limb salvage. The indications for amputation in diabetic foot ulcers include systemic sepsis, major tissue loss, multiple comorbid conditions, patient noncompliance, and nonreconstructable vascular disease. These are not present in this patient.

Collagen bilayer matrix allows for the formation of a neodermis and is a useful adjunct for the management of chronic wounds or wounds with exposed vital structures when autologous tissue is unavailable or inappropriate. The collagen matrix provides a scaffold for cellular ingrowth and angiogenesis. In this case, a bilayer wound matrix may allow for wound closure but would be inferior to a free flap for durability and improving foot vascularity.

## **REFERENCES:**

1. Ducic I, Attinger CE. Foot and ankle reconstruction: Pedicled muscle flaps versus free flaps and the role of diabetes. *Plast Reconstr Surg*. 2011 July; 128(1):173-80.
2. Oh TS, Lee HS, Hong JP. Diabetic foot reconstruction using free flaps increases 5-year-survival rate. *Plast Reconstr Aest Surg*. 2013 Feb; 66(2):243-50.

53. A 19-year-old college baseball player comes for evaluation 4 weeks after he jammed and dislocated the long finger of his dominant right hand while sliding into home plate. His coach reduced the dislocation on the field. The patient says he has noticed increasing pain at the site of the injury in the past two days. Physical examination shows edema of the proximal interphalangeal (PIP) joint of the long finger. Lateral stress shows angulation of 30 degrees. X-ray study shows a congruous joint with radial side widening of 1 mm. Which of the following is the most appropriate management?
- A) Buddy taping of the long finger to the index finger
  - B) Immobilization in a dorsal extension block splint at 30 degrees
  - C) Immobilization with a volar short arm splint
  - D) Kirschner wire fixation of the PIP joint for 3 weeks
  - E) Open repair of the radial collateral ligament

The correct response is Option E.

The goal of treatment is to restore normal finger function; prevent pain, stiffness, and traumatic arthritis; and to restore activities of daily living. This patient has a complete tear of the radial collateral ligament of the proximal interphalangeal (PIP) joint of the long finger. Widening of the joint space indicates probable interposition of ligament fibers. Angulation greater than 20 degrees is associated with poor prognosis. Complete tears with subluxation and interposition require surgical repair. Most collateral ligament ruptures occur at the proximal attachment to the middle phalanx.

Partial tears can be treated with nonsurgical and conservative methods. Splinting, buddy taping, extension block placement, and temporary fixation with a Kirschner wire would be incorrect.

## REFERENCES:

1. Freiberg A. Management of proximal interphalangeal joint injuries. *Can J Plast Surg*. 2007 Winter;15(4):199-203.
2. Redler I, Williams JT. Rupture of a collateral ligament of the proximal interphalangeal joint of the fingers. Analysis of eighteen cases. *J Bone Joint Surg Am*. 1967 Mar;49(2):322-326.
3. Oetgen ME, Dodds SD. Non-operative treatment of common finger injuries. *Curr Rev Musculoskelet Med*. 2008 Jun;1(2):97-102.

54. A 30-year-old man who works as a laborer comes to the emergency department after sustaining avulsion injuries over the dorsum of the index, long, and ring fingers of his right dominant hand after being caught in a press. The wounds measure  $3 \times 1$  cm each. Physical examination shows exposed extensor tendons from the proximal interphalangeal joint to the dorsal fold. Artificial dermis was placed. Which of the following is the most appropriate method of reconstruction?

- A) Full-thickness skin graft
- B) Radial artery free flap
- C) Reverse radial forearm flap
- D) Split-thickness skin graft
- E) No further treatment

The correct response is Option D.

Split-thickness and full-thickness skin grafting directly over extensor tendons will lead to scarring due to lack of paratenon. Paratenon is necessary for tendon gliding. The use of artificial dermis can allow for tendon gliding. Artificial dermis has been shown to result in favorable aesthetic and functional outcomes. Although a second surgery is required, it results with lower donor site morbidity. Once the dermal template is adherent, it can then be grafted. The correct response is split grafting because the artificial dermis acts as the deep layer. Split-thickness grafts alone would not be useful where padding is required. Split grafts have a higher contracture rate than full grafts. Also, split grafts alone would not be beneficial because of the high potential for adherence. A full-thickness graft with its dermal elements would not be necessary in this case because the artificial skin provides the dermal elements. Full-thickness graft does not contract as much as split-thickness grafts. In this situation, the split graft contracture would result in a smaller, potentially more aesthetic scar.

Re-epithelialization is usually reserved for wounds measuring 1 cm or less; therefore, it would be inappropriate to not give additional treatment. Although the wound would close, the result would be less aesthetic with tendon adherence and potential dysesthesia, and it would require a longer period to heal. The reversed radial forearm flap would not be necessary and would not be long enough to reach the fingertips as well. Similarly, a radial forearm free flap would not be necessary.

## REFERENCES:

1. Hulsen J, Diederich R, Neumeister MW, et al. Integra dermal regenerative template application on exposed tendon. *Hand (NY)*. 2014 Dec;9(4):539-542.
2. Adani R, Rossati L, Tarallo L, et al. Use of Integra artificial dermis to reduce donor site morbidity after pedicle flaps in hand surgery. *J Hand Surg Am*. 2014 Nov;39(11):2228-2234. Epub 2014 Sep 26.
3. Lee LP, Lau PY, Chan CW. A simple and efficient treatment for fingertip injuries. *J Hand Surg Br*. 1995 Feb;20(1):63-71.
4. Hansen AJ, Duncan SF, Smith AA, et al. Reverse radial forearm fascial flap with radial artery preservation. *Hand (NY)*. 2007 Sep;2(3):159-163. Epub 2007 May 2.
5. Megerle K, Sauerbier M, Germann G. The evolution of the pedicled radial forearm flap. *Hand (NY)*. 2010 Mar;5(1):37-42. Epub 2009 Oct 14.

55. A 25-year-old surfer who sustained a shark bite to the left thigh is brought to the emergency department. The patient is hemodynamically stable. Physical examination shows a bleeding mid-thigh wound. The left foot is pale and cool; sensibility in the foot is decreased. The ankle pulses are absent. On surgical exploration, a 6-cm injury to the superficial femoral artery is identified. After local debridement, which of the following is the most appropriate next step in management of the artery?

- A) End-to-end anastomosis
- B) End-to-side anastomosis
- C) Interposition prosthetic grafting
- D) Interposition vein grafting

The correct response is Option D.

The patient has a major vascular injury that is greater than 5.5 cm in length. A shark bite is considered contaminated and requires debridement. Because of the length of arterial injury, vein grafting is the most appropriate management option. End-to-end and end-to-side anastomoses are incorrect because the arterial defect is too long. The use of prosthetic material is incorrect because this is a contaminated wound, increasing the risk for infection.

## REFERENCES:

1. Perry MO, Thal ER, Shires GT. Management of arterial injuries. *Ann Surg.* 1971 Mar;173(3):403-408.
2. Feliciano DV, Moore FA, Moore EE, et al. Evaluation and management of peripheral vascular injury. Part 1. Western Trauma Association/critical decisions in trauma. *J Trauma.* 2011 Jun;70(6):1551-1556.
3. Frykberg ER, Schinco MA. Peripheral Vascular Injury. In: Feliciano D, Mattox K, eds. *Trauma*. 6th ed. New York: McGraw-Hill; 2007:941-971.
4. Feliciano DV. Evaluation and Treatment of Vascular Injuries. In: Browner BD, Levine AM, Jupiter JB, et al, eds. *Skeletal Reconstruction*. 4th ed. Philadelphia: Elsevier-Saunders; 2009:323-340.
5. Sadjadi J, Cureton EL, Dozier KC, et al. Expedited treatment of lower extremity gunshot wounds. *J Am Coll Surg.* 2009 Dec;209(6):740-745.
6. Dorlac WC, DeBakey ME, Holcomb JB, et al. Mortality from isolated civilian penetrating extremity injury. *J Trauma.* 2005 Jul;59(1):217-222.

56. A 35-year-old woman comes for evaluation of a 6-month history of increasing numbness of the right long finger of the dominant hand. She delivered a healthy newborn 6 months ago. She reports that the numbness awakens her from sleep and resolves after she shakes her hand. Physical examination shows a two-point discrimination of 5 mm in all digits. Which of the following is the most likely abnormal electrodiagnostic finding in this patient?

- A) Motor action potential amplitude of 25  $\mu$ V
- B) Motor latency of 4 ms
- C) Occasional fasciculations
- D) Positive sharp waves
- E) Sensory action potential latency of 4 ms

The correct response is Option E.

The patient has early carpal tunnel syndrome. She only exhibits sensory findings with numbness that resolves. Two-point discrimination is abnormal in late carpal tunnel syndrome when there is irreversible nerve damage. There are no motor symptoms at this point.

Electrodiagnostic studies are a two-part examination consisting of sensory action potentials (SAP), also referred to as nerve conduction studies (NCS) and electromyography (EMG). Findings in EMG latency for muscle abnormality are  $>4.0$  ms. Normal muscles show occasional fasciculations with high fibrillations 5 weeks after denervation. Normal motor nerve shows no sharp waves and no fasciculations. Mild motor latencies on NCS/EMG are  $>4.0$  ms. Motor latencies of  $>6.0$  are considered severe. Because this is early carpal tunnel syndrome with no evidence of motor weakness, a motor latency of 4.0 is unlikely. Similarly, a motor action potential of 25  $\mu$ V is unlikely.

Findings in SAP distal latency for sensory abnormality are  $>3.5$  ms and an amplitude  $<15$   $\mu$ V (normal is 15-25  $\mu$ V). Therefore, sensory action potential latency of 4.0 ms is correct.

## REFERENCES:

1. Kwon BC, Jung KI, Baek GH. Comparison of sonography and electrodiagnostic testing in the diagnosis of carpal tunnel syndrome. *J Hand Surg Am*. 2008 Jan;33(1):65-71.
2. Werner RA, Andary M. Electrodiagnostic evaluation of carpal tunnel syndrome. *Muscle Nerve*. 2011 Oct;44(4): 597-607.
3. Watson J, Zhao M, Ring D. Predictors of normal electrodiagnostic testing in the evaluation of suspected carpal tunnel syndrome. *J Hand Microsurg*. 2010 Dec;2(2):47-50. Epub 2010 Oct 19.
4. Preston DC, Shapiro BE, eds. *Electromyography and Neuromuscular Disorders: Clinical-Electrophysiologic Correlations*. 2nd ed. Philadelphia, PA: Butterworth-Heinemann; 2005:255-279.

57. A 67-year-old man with a history of Dupuytren contracture of the right small finger comes for evaluation one week after noticing numbness and paresthesias of the outer aspect of the right small finger. Two days prior to the onset of the numbness and paresthesias, he underwent injection of collagenase *Clostridium histolyticum* to the finger. On physical examination today, there is mild edema of the finger. Extension of the finger has significantly improved, and there is good flexor tendon function. However, there is no sensation in the ulnar digital nerve distribution; two-point discrimination is greater than 10 mm. Nerve function was intact prior to the injection. Which of the following is the most appropriate next step?

- A) Electromyography and nerve conduction velocities
- B) Immediate surgical exploration and direct repair of the ulnar digital nerve
- C) Immediate surgical exploration and repair of the ulnar digital nerve with nerve conduit
- D) Observation only

The correct response is Option D.

The use of collagenase *Clostridium histolyticum* for Dupuytren contracture has been well studied. Reports of its efficacy and safety have been published in numerous papers in peer-reviewed journals. Though postulated, there have been no cases reported in the literature of digital nerve rupture during cord rupture with collagenase *Clostridium histolyticum*. Pulley rupture and flexor tendon rupture have been reported. In this case, observation would be the most appropriate next step. It is more likely that there is a neuropraxia rather than a frank rupture of the nerve.

Electromyography and nerve conduction velocities will not elucidate whether the nerve has been severed. Exploration and repair is not indicated only 1 week after injury; exploration of a neurapraxia injury is indicated 8 weeks after injury. The best option is to observe the patient's injury.

## REFERENCES:

1. Sood A, Therattil PJ, Apik AM, et al. Treatment of Dupuytren disease with injectable collagenase in a veteran population: a case series at the department of veterans affairs New Jersey health care system. *EPlasty*. 2014 Mar 27;14:e13. eCollection 2014.

2. Witthaut J, Jones G, Skrepnik N, et al. Efficacy and safety of collagenase Clostridium histolyticum injection for Dupuytren contracture: short-term results from 2 open-label studies. *J Hand Surg Am*. 2013 Jan;38(1):2-11. Epub 2012 Dec 4.

58. Which of the following compartment pressure measurements is the minimum threshold that is most consistent with compartment syndrome?

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

The correct response is Option C.

The absolute minimum compartment pressure measurements ranging from 25 to 50 mmHg are quoted as absolute indications for fasciotomy. The most frequently quoted absolute measurement is 30 mmHg.

#### **REFERENCES:**

1. Maser B. Compartment Syndrome. In: Greer SE, Benhaim P, Longaker MT, et al, eds. *Handbook of Plastic Surgery*. Boca Raton: CRC Press; 2004:417-420.
2. Zamboni WA and Kiraly EM. Compartment Syndrome. In: Achauer BM, Eriksson E, Guyuron B, et al, eds. *Plastic Surgery Indications, Operations, and Outcomes*. St. Louis, MO: Mosby; 2000:1819-1830.

59. A 7-month-old male infant with complete syndactyly is evaluated for surgical release. Which of the following is the most appropriate technique for reconstruction of the web space?
- A) Coverage with a distally based zigzag flap
  - B) Coverage with a dorsal rectangular flap
  - C) Coverage with a volar triangular flap
  - D) Full-thickness skin grafting
  - E) Split-thickness skin grafting

The correct response is Option B.

The most appropriate technique for reconstruction of the web space in patients with complete syndactyly is coverage with a dorsal rectangular flap.

In patients with complete syndactyly, separation does not typically result in sufficient skin to resurface both digits entirely. Reconstruction of the web space is a priority and is typically achieved with a proximally-based dorsal rectangular flap. Interdigitating skin flaps are designed, and skin grafts are placed to replace skin deficiency. Full-thickness skin grafts are preferred to split-thickness skin grafts because of the decreased likelihood of contracture; however, these grafts are not typically placed in the web space.

## REFERENCES:

1. Bates SJ, Hansen SL, Jones NF. Reconstruction of congenital differences of the hand. *Plast Reconstr Surg*. 2009 Jul;124(1 Suppl):128e-143e.
2. Netscher DT, Baumholtz MA. Treatment of congenital upper extremity problems. *Plast Reconstr Surg*. 2007 Apr 15;119(5):101e-129e.
3. Oda T, Pushman AG, Chung KC. Treatment of common congenital hand conditions. *Plast Reconstr Surg*. 2010 Sep;126(3):121e-133e.

60. A 24-year-old woman comes for evaluation 6 days after sustaining a jamming injury to the long finger of the left hand with resultant central slip disruption and acute boutonnière injury. X-ray studies are negative for fracture or dislocation. Treatment with splint immobilization is planned. Which of the following is the most appropriate position of the finger for application of the splint?

- A) Distal interphalangeal (DIP) joint extended, proximal interphalangeal (PIP) joint extended
- B) DIP extended, PIP free
- C) DIP flexed, PIP flexed
- D) DIP flexed, PIP free
- E) DIP free, PIP extended

The correct response is Option E.

The most appropriate position for splint immobilization of an injury leading to a boutonnière deformity is with the distal interphalangeal (DIP) joint free and the proximal interphalangeal (PIP) joint extended.

The patient sustained a central slip disruption of the long finger of the left hand, resulting in an acute boutonnière deformity. Patients with boutonnière deformity have flexion at the PIP joint and hyperextension at the DIP joint. There is tearing of the extensor tendon from its insertion at the base of the middle phalanx, resulting in decreased ability to extend the finger at the PIP joint. As a result, the lateral bands fall volar to the axis of rotation at the PIP joint, changing their force from extension to flexion at the PIP joint. The extensor force of the lateral bands is then directed toward the terminal tendon at the DIP joint, resulting in hyperextension of the DIP joint.

Splint immobilization of the PIP joint in extension and the DIP joint free to flex permits healing of the central slip back to the middle phalanx. Flexion of the DIP joint through movement will tend to cause the lateral bands to migrate dorsally again, reversing the effect of the boutonnière deformity. When the lateral bands move dorsal to the axis of rotation at the PIP joint, their extensor force is restored and the DIP hyperextension resolves.

Splint immobilization of both joints in extension will not encourage the dorsal migration of the lateral bands. Splint immobilization with the DIP joint in extension

and the PIP joint free is recommended in zone 1 extensor tendon injuries (i.e., mallet finger).

## REFERENCES:

1. Chang J. Extensor Tendons. In: Guyuron B, Eriksson E, Persing JA, et al, eds. *Plastic Surgery*. Philadelphia: Elsevier-Saunders; 2010:1127-1138.
2. Lalonde DH, Kozin S. Tendon disorders of the hand. *Plast Reconstr Surg*. 2011 Jul;128(1):1e-14e.
3. Strauch RJ. Extensor Tendon Injury. In: Wolfe SW, Pederson WC, Hotchkiss RN, et al, eds. *Green's Operative Hand Surgery*. 6th ed. Philadelphia: Churchill Livingstone; 2011:159-188.

61. A 47-year-old man undergoes repair of a laceration to the extensor tendon of the long finger at the dorsum of the left hand. He wishes to restore function of the hand as quickly as possible. Which of the following is the most appropriate course of splint immobilization?
- A) Continuous extension splint immobilization for 4 weeks
  - B) Continuous extension splint immobilization for 6 weeks
  - C) Dynamic extension splint immobilization for 6 weeks
  - D) Relative motion extension splint immobilization for 6 weeks
  - E) No immobilization

The correct response is Option D.

The most appropriate treatment is relative motion extension splint immobilization for 6 weeks.

The relative motion extension splint allows immediate controlled active motion. Placing the injured tendon in 15 to 20 degrees less motion than the adjacent tendons results in significantly less force. A splint is fashioned placing the repaired extensor tendon of the long finger in 15 to 20 degrees more metacarpophalangeal extension than the neighboring extensor tendons. Full interphalangeal joint range of motion is permitted. The finger splint is worn with a wrist component for the first 3 weeks (which may not be necessary). The finger component is used for only 3 additional weeks. This allows for earlier recovery of motion and return to work.

Without immobilization, the repair is at increased risk for rupture and failure. Extensor tendon injuries have typically been treated with continuous extension splint immobilization for 4 to 6 weeks. Although this would be a reasonable option, use of the relative motion extension splint allows immediate movement and decreases the stiffness that may result from immobilization. This may be preferred in children or noncompliant patients.

Dynamic extension splinting is a possibility and may be useful in patients who have an extensor pollicis longus injury or in patients in whom all six finger extensors are severed. Relative motion splinting is not an option in these cases.

## REFERENCES:

1. Howell JW, Merritt WH, Robinson SJ. Immediate controlled active motion following Zone 4-7 extensor tendon repair. *J Hand Ther.* 2005 Apr-Jun;18(2):182–190.
2. Lalonde DH, Kozin S. Tendon disorders of the hand. *Plast Reconstr Surg.* 2011 Jul;128(1):1e-14e.
3. Merritt WH. Relative motion splint: active motion after extensor tendon injury and repair. *J Hand Surg Am.* 2014 Jun;39(6):1187-1194.
4. Sharma JV, Liang NJ, Owen JR, et al. Analysis of relative motion splint in the treatment of Zone VI extensor tendon injuries. *J Hand Surg Am.* 2006 Sep;31(7):1118-1122.

62. A 28-year-old man is flown by helicopter to the emergency department after sustaining a deep, isolated, lateral abrasion to the right lower leg in a motorcycle collision. On physical examination, he has a segmental injury to the common peroneal nerve. Repair with a sural nerve autograft is planned. Which of the following is the maximum length at which any functional recovery is expected?

- A) 3 cm
- B) 6 cm
- C) 9 cm
- D) 12 cm
- E) 15 cm

The correct response is Option D.

Nerve repair outcomes are related to mechanism of injury, need for a graft and graft length, and timing of surgery relative to injury. Although results vary, good results are typical for grafts measuring less than 6 cm, and may be possible in approximately 25% of patients with grafts measuring 6 to 12 cm. Almost no studies report an M4 motor recovery or better when a graft greater than 12 cm is used.

## REFERENCES:

1. George SC, Boyce DE. An evidence-based structured review to assess the results of common peroneal nerve repair. *Plast Reconstr Surg*. 2014 Aug;134(2):302e-311e.
2. Demuynck M, Zuker RM. The peroneal nerve: is repair worthwhile? *J Reconstr Microsurg*. 1987 Apr;3(3):193-197, 199.
3. Roganovic Z. Missile-caused complete lesions of the peroneal nerve and peroneal division of the sciatic nerve: results of 157 repairs. *Neurosurgery*. 2005 Dec;57(6):1201-1212.

63. A 42-year-old woman comes to the emergency department after sustaining a deep laceration to the dorsal aspect of the right forearm with broken glass. She reports pain on attempted extension of the middle and ring fingers of the right hand. On physical examination, the patient cannot extend her fingers beyond the neutral position with her right hand held flat on a table. She is able to extend all digits completely at the interphalangeal joints in all positions of the hand. Which of the following is the most likely cause of these findings?

- A) Extrinsic extensor tendons are cut completely with intact intrinsic muscles
- B) Extrinsic extensor tendons can extend the digits despite the laceration injury
- C) Juncturae tendinum are extending the digits
- D) The patient has an accessory extensor tendon
- E) The patient has partial extensor tendon lacerations only

The correct response is Option A.

Extension of the interphalangeal joints (IP) and extension of the metacarpophalangeal joints (MCP) to the neutral position after an injury to the forearm extensor tendons is possible through the action of the lumbricals and dorsal interossei (intrinsic hand muscles). The extrinsic extensor tendons alone are responsible for extending the metacarpophalangeal joints beyond neutral.

The role of the juncturae tendinum is to limit the independent extension of the ulnar three digits. The juncturae tendinum will allow for some finger extension with an isolated single tendon injury at the wrist or dorsal hand but would not maintain extension in all fingers.

No meaningful accessory extensor tendon exists.

A patient with partial extrinsic tendon lacerations may present with pain on attempted extension but extension beyond neutral would be intact.

## REFERENCES:

1. Duncan SF, Saracevic CE, Kakinoki R. Biomechanics of the hand. *Hand Clin.* 2013 Nov;29(4):483-492. Epub 2013 Oct 15.

2. Griffin M, Hindocha S, Jordan D, et al. Management of extensor tendon injuries. *Open Orthop J*. 2012;6:36-42. Epub 2012 Feb 23.
3. Ranney D, Wells R. Lumbrical muscle function as revealed by a new and physiological approach. *Anat Rec*. 1988 Sep;222(1):110-114.
4. Wang K, McGlinn EP, Chung KC. A biomechanical and evolutionary perspective on the function of the lumbrical muscle. *J Hand Surg Am*. 2014 Jan;39(1):149-155.

64. A 34-year-old woman comes for evaluation because of a 4-month history of pain in the fingers of the right hand. The pain is most severe in the ring finger and is exacerbated by exposure to cold temperatures. Physical examination shows a blue discoloration under the nail of the ring finger. Which of the following is the most likely diagnosis?

- A) Cutaneous melanoma
- B) Epidermal inclusion cyst
- C) Giant cell tumor
- D) Glomus tumor
- E) Mucous cyst

The correct response is Option D.

Glomus tumors are benign neurovascular tumors. The glomus apparatus is believed to function as a thermoregulatory control mechanism. Glomus tumors generally are found in the hand, most commonly in the digit, and often in the fingertip. They are characterized by severe pain, especially with exposure to cold temperatures. Cold sensitivity can be evoked by placing the digit in an ice bath. Glomus tumors are well visualized on MRI using T-1 and T-2 weighted images. Ultrasonography may also be useful in identifying glomus tumors. Treatment for glomus tumors is complete surgical excision. Up to 25% of these tumors may have multiple lesions.

Malignant melanomas may be seen in the subungual area. These tumors usually are identified by a pigmented streak under the fingernail. These tumors are generally painless and often go unrecognized. A pigmented lesion under the nail should be biopsied if it does not resolve by 4 weeks.

Giant cell tumors are benign soft-tissue tumors. They are the second most common tumor in the hand. These tumors generally occur on the volar surface of the fingers and hand. They present as a firm, nodular, nontender mass.

Epidermal inclusion cysts are benign masses of the hand thought to be the result of implantation of the epithelial cells into the underlying soft tissue. They produce a painless mass. Treatment of these cysts is by marginal excision.

A mucous cyst is a term used to describe a ganglion cyst of the distal interphalangeal (DIP) joint. This is a misnomer because the cysts are not filled with a mucous

material, but synovial fluid. The cyst may produce nail deformities. Pain may be associated with these cysts, and is caused by the underlying arthritis of the DIP joint.

## **REFERENCES:**

1. Muramatsu K, Ihara K, Hashimoto T, et al. Subungual glomus tumours: diagnosis and microsurgical excision through a lateral subperiosteal approach. *J Plast Reconstr Aesthet Surg*. 2014 Mar;67(3):373-376. Epub 2013 Nov 21.
2. Netscher DT, Aburto J, Koepplinger M. *J Hand Surg Am*. 2012 Apr;37(4):821-823. Epub 2011 Dec 21.

65. A 45-year-old man is brought to the emergency department 2 hours after sustaining an avulsion injury to the dorsum of the left hand in a motorcycle accident. Physical examination shows complete loss of the dorsal skin and exposure of the extensor tendons in the dorsal hand with no viable peritenon. Reconstruction of the defect with a lateral arm free flap is planned. Which of the following arterial pedicles will supply this flap?

- A) Anterior interosseous
- B) Inferior cubital cutaneous
- C) Posterior radial collateral
- D) Radial recurrent
- E) Superior ulnar collateral

The correct response is Option C.

The correct answer is the posterior radial collateral artery, which is a branch of the profundus brachial artery. The profundus brachial artery arises from the brachial artery and accompanies the radial nerve. The posterior radial collateral artery passes posterior to the lateral intramuscular septum between the deltoid tubercle and epicondyle. The flap can be harvested from the same extremity, offering pliable tissue for soft-tissue coverage. The lateral arm flap also may be taken with muscle, bone, or cutaneous nerves for composite tissue reconstruction.

The anterior interosseous artery supplies the posterior interosseous artery flap (via its connection to the posterior interosseous artery through the distal interosseous membrane) located on the dorsum of the forearm. This flap may be reversed to cover small to moderate defects on the dorsum of the hand.

The superior ulnar collateral artery arises from the brachial artery in the upper arm. This artery is the blood supply of the medial arm flap. The medial arm flap offers the advantage of a well-hidden donor site; however, flap dissection may be extremely tedious and the flap may have significant subcutaneous fat.

The inferior cubital cutaneous artery may be used as a source of a fascial cutaneous flap in the forearm.

The radial recurrent artery arises from the radial artery below the elbow. This artery anastomoses with the radial collateral artery and can be used as a reversed pedicle

flap of the lateral arm skin. This flap may reach to the level of the mid-forearm but cannot reach the hand.

## **REFERENCES:**

1. Sauerbier M, Germann G, Giessler GA, et al. The free lateral arm flap-a reliable option for reconstruction of the forearm and hand. *Hand (N.Y.)*. 2012 Jun;7(2):163-171.
2. Ulusal BG, Lin YT, Ulusal AE, et al. Free lateral arm flap for 1-stage reconstruction of soft tissue and composite defects of the hand: A retrospective analysis of 118 cases. *Ann Plast Surg*. 2007 Feb;58(2):173-178.

66. A 35-year-old man who was involved in a motorcycle accident sustains fractures to the right tibia and fibula. On physical examination, he has numbness in the dorsum of the right foot and inability to dorsiflex the foot. Vascular status of the right lower extremity is normal. Which of the following nerves has most likely been injured?

- A) Calcaneal
- B) Common peroneal
- C) Lateral plantar
- D) Lateral sural cutaneous
- E) Posterior tibial

The correct response is Option B.

The common peroneal nerve derives from the dorsal branches of the fourth and fifth lumbar and first and second sacral nerves. The common peroneal nerve lies between the biceps femoris and lateral head of the gastrocnemius muscle; it continues around the neck of the fibula between the peroneus longus muscle and the fibula, and then branches into the superficial fibular and deep fibular nerves. The common peroneal nerve innervates the peroneus longus, peroneus brevis, and biceps femoris muscle. Injury to this nerve results in a foot drop and sensory loss to the dorsal surface of the foot.

The lateral sural nerve is a cutaneous nerve arising from the common fibular nerve. It supplies sensation to the posterior and lateral surfaces of the leg. This nerve does not supply motor innervation.

The posterior tibial nerve, also known as the tibial nerve, is derived from L4, L5, S1, S2, and S3. It is a branch of the sciatic nerve. The nerve gives branches to the gastrocnemius, popliteus, and soleus muscles. Below the soleus muscle it supplies the tibialis posterior, the flexor digitorum longus, and the flexor hallucis longus muscles.

The lateral plantar nerve is a branch of the tibial nerve. It supplies the quadratus plantae and the abductor digiti minimi muscles. Its sensory component supplies the skin of the fifth toe and the lateral half of the fourth toe.

The lateral calcaneal nerve is a branch of the sural nerve supplying cutaneous sensation to the lateral aspect of the heel skin. This nerve is a cutaneous nerve with no muscle innervation.

## REFERENCES:

1. George SC, Boyce DE. An evidence-based structured review to assess the results of common peroneal nerve repair. *Plast Reconstr Surg*. 2014 Aug;134(2):302e-311e.
2. Sanger JR, Kao DS, Hackbarth DA. Peroneal nerve compression by lateral gastrocnemius flap. *J Plast Reconstr Aesthet Surg*. 2009 Aug;62(8):e280-e292. Epub 2008 Jan 28.

67. A 35-year-old woman is evaluated 2 months after repair of volar lacerations to the dominant ring and long fingers at Zone III in both digits. Physical examination shows both fingers have no active flexion. There is normal passive motion and normal sensation at the fingertips of the affected digits. Surgical exploration shows transection of the tendons at both levels and 2-cm segmental tendon loss, but no tendon sheath scarring. Which of the following is the most appropriate management?

- A) One-stage tendon grafting
- B) Primary tendon repair
- C) Primary tendon repair with z-lengthening
- D) Superficialis to profundus tendon transfer
- E) Two-stage tendon grafting

The correct response is Option A.

Several conditions must be met for single-stage tendon grafting to be successful. These include a hand and finger that have good passive motion, a well-healed wound with minimal scarring, and a digit that has intact nerves and arteries. This is a Boyes grade 1 injury.

#### Boyes Preoperative Classification

- Grade 1: Good, minimal scar and mobile joints
- Grade 2: Deep scarring with mild loss of range of motion
- Grade 3: Joint injury with loss of motion
- Grade 4: Nerve injury
- Grade 5: Multiple injuries (combinations of grades 2, 3, and 4)

If the grade of injury is greater than 1, two-stage grafting should be considered with implantation of a silicone rod and additional treatment to manage the other conditions to increase motion and function, such as joint release or reconstruction for loss of motion, nerve repair/reconstruction, and pulley reconstruction.

A primary repair is not going to be possible in this instance. Two-stage tendon grafting should be considered but a single stage graft can have excellent results with only one procedure. A tendon transfer is not appropriate for this situation.

## REFERENCES:

1. Moore T, Anderson B, Seiler JG. Flexor tendon reconstruction. *J Hand Surg Am.* 2010 Jun;35(6):1025-1030.
2. Freilich AM, Chhabra AB. Secondary flexor tendon reconstruction, a review. *J Hand Surg Am.* 2007 Nov;32(9):1436-1442.
3. Goldfarb CA, Gelberman RH, Boyer MI. Flexor tendon reconstruction: current concepts and techniques. *J Hand Surg Am.* 2005;5:123-130.

68. A 55-year-old woman is evaluated for continued weakness and deformity of the right thumb 6 months after a ligamentous reconstruction, tendon interposition arthroplasty for carpometacarpal degenerative disease. Which of the following is the most likely reason for her continued symptoms after arthroplasty?
- A) Lack of a bone tunnel for the ligamentous reconstruction
  - B) Metacarpophalangeal hyperextension
  - C) Not pinning the metacarpal to maintain the joint space
  - D) Removal of the entire trapezium
  - E) Use of only half of the flexor carpi radialis for the ligamentous reconstruction

The correct response is Option B.

Hyperextension of the metacarpophalangeal (MCP) joint is part of the progression of the degeneration that affects the thumb basal joint. The hyperextension compensates for the adduction of the thumb base so that the thumb tip can be placed where it is most functional for pinch and grasp. Failure to address hyperextension greater than 30 degrees in MCP joints associated with basal joint arthritis has been shown to lead to weakness and poor hand function.

Multiple procedures have been proposed for treatment of basal joint arthritis. These include metacarpal osteotomy for early-stage conditions, trapeziectomy with or without tendon reconstruction, and interposition and trapeziometacarpal arthrodesis. Little difference in outcomes has been shown when comparing the different procedures that include trapeziectomy and the simple removal of the trapezium as the most critical portion of the procedure.

Taking the whole flexor carpi radialis (FCR) for the suspension has shown a small difference in wrist kinematics. No studies have shown whether the whole or half of the FCR makes a difference in the success of the suspension.

Multiple successful procedures have been described that do not include a bone tunnel for anchoring the suspension to the base of the thumb metacarpal. Removal of the entire trapezium is the most important part of the operative procedure when treating basal joint arthritis surgically. Pin fixation of the metacarpal after trapeziectomy helps to prevent metacarpal subsidence and maintenance of thumb length but is not necessary with a ligamentous reconstruction as in this patient.

## REFERENCES:

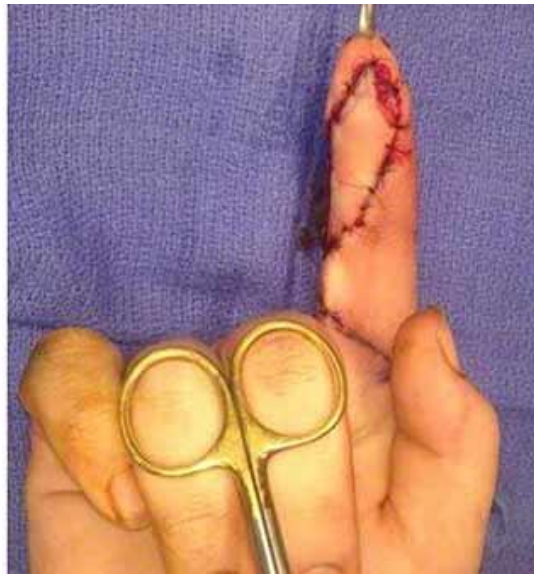
1. Brogan DM, Kakar S. Metacarpophalangeal joint hyperextension and the treatment of thumb basilar joint arthritis. *J Hand Surg Am.* 2012 Apr;37(4):837-838. Epub 2012 Feb 1.
2. Vermeulen GM, Slijper H, Feitz R, et al. Surgical management of primary thumb carpometacarpal osteoarthritis: a systematic review. *J Hand Surg Am.* 2011 Jan;36(1):157-169.
3. Vermeulen GM, Spekrijse KR, Slijper H, et al. Comparison of arthroplasties with or without bone tunnel creation for thumb basal joint arthritis: a randomized controlled trial. *J Hand Surg Am.* 2014 Sep;39(9):1692-1698. Epub 2014 Jun 10.



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

69. An 18-year-old man comes for evaluation 4 days after he sustained an avulsion injury of the pad of the index finger of his dominant right hand. A photograph is shown. The part was never recovered, and the patient has been performing dressing changes. The defect is  $2.5 \text{ cm}^2$  and extends to the distal phalanx bone. Coverage with which of the following flaps is most likely to result in fingertip sensation closest to pre-injury?
- A) Cross-finger flap
  - B) First dorsal metacarpal artery flap
  - C) Homodigital island flap
  - D) Reverse radial forearm flap
  - E) Thenar flap

The correct response is Option C.



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

The homodigital island flap raises skin and fat overlying one digital neurovascular bundle that can be advanced distally to cover a pulp defect. As long as both digital arteries are patent, the flap can be raised on either digital artery on any finger. Because the digital nerve is raised with the flap, the overlying skin retains its sensibility (figures 2b and 2c).

The first dorsal metacarpal artery flap raises skin and fat from the dorsum of the proximal phalanx of the index finger based on branches of the radial artery and superficial radial nerve. It is useful in providing sensate coverage of the thumb, but the pedicle is not long enough to allow the flap to reach the tip of a finger.

The thenar flap and cross-finger flap raise skin from the thenar eminence and dorsal middle phalanx of a finger, respectively. Innervation is not transferred in coverage with these flaps; sensation recovery must occur with growth of the tissue surrounding the original defect. Both of these flaps require two stages, making them less appealing options.

The reverse radial forearm flap is a large, robust flap that provides excellent coverage of the hand. Its pedicle allows it to reach the tip of a finger; however, when raised in a reverse pattern with retrograde vascular flow, the flap would not bring sensation with it. In addition, the flap is too large for the defect shown in the photograph.

## REFERENCES:

1. Katz RD. The anterograde homodigital neurovascular island flap. *J Hand Surg Am.* 2013 Jun;38(6):1226-1233.
2. Rehim SA, Chung KC. Local flaps of the hand. *Hand Clin.* 2014 May;30(2):137-151.

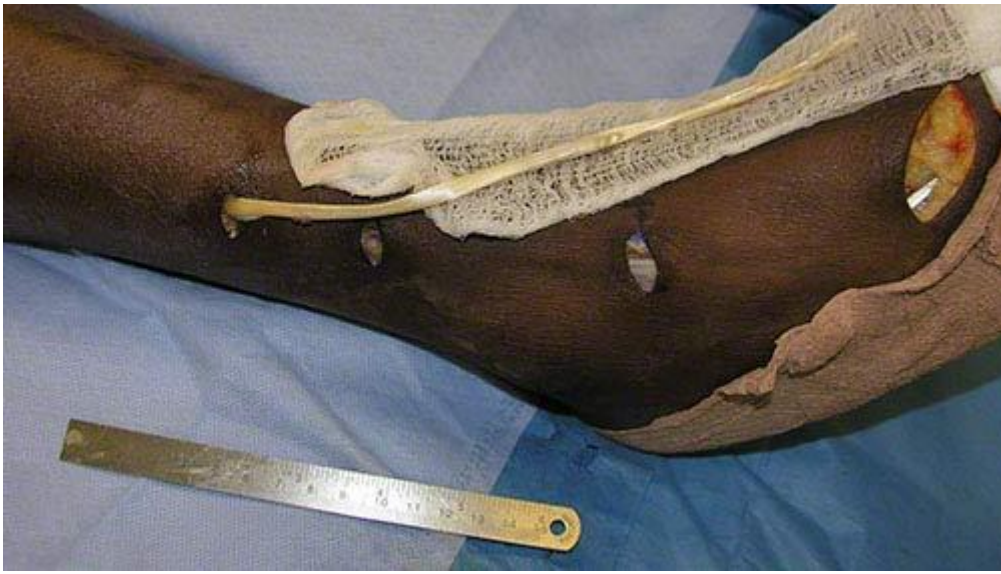


(Please note that this pictorial appears in color in the online examination)

70. A 35-year-old man has clawing of all four fingers of the right hand 2 years after repair of a forearm laceration that injured the median and ulnar nerves. Photographs are shown. Both nerves were repaired shortly after the injury. All fingers have full passive range of motion. An extensor carpi radialis longus transfer is planned to correct the clawing of all four fingers. Which of the following donor sites is most likely to provide sufficient tendon graft for this procedure?
- A) Abductor digiti quinti
  - B) Extensor digitorum longus
  - C) Flexor digitorum superficialis of the long finger
  - D) Palmaris brevis
  - E) Pronator teres

The correct response is Option B.

The Brand transfer uses the extensor carpi radialis longus or brevis as a donor motor to correct clawing of the fingers. It can be used to correct ulnar (ring and small finger) clawing or clawing of all four fingers. In either case, a tendon graft is needed to bridge the gap between the native distal limit of the extensor carpi radialis longus or brevis (on the index or long finger metacarpal base, respectively) to the transfer insertion on the lateral band at the proximal phalanx level. The transfer can be passed through the interosseous membrane in the forearm and then through the carpal tunnel or the intermetacarpal spaces in the hand. The transfer must pass volar to the deep transverse metacarpal ligament to have the correct vector of pull.



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

The extensor digitorum longus provides four tendon slips distally, each with its own paratenon, but has one tendon coming off the muscle proximally. A photograph is shown. There is minimal donor site morbidity in the foot due to the retained function of the extensor digitorum brevis.

Palmaris brevis has no tendon and cannot be used as a graft donor.

Abductor digiti quinti can be used as a donor muscle for thumb opposition transfer, most commonly in children. It has a very short tendon and cannot be used for anti-claw transfers. In addition, due to this patient's injury, the abductor digiti quinti is likely denervated and would not be functional for a transfer.

Flexor digitorum superficialis (FDS) of the long finger can be used for anti-claw transfers. The tendon can be split along the plane of Camper's chiasm to create two distal slips for insertion. It is well suited as an anti-claw transfer in patients with isolated ulnar nerve palsy. The FDS tendon cannot be split into four slips for insertion, as would be needed in this patient, and the power of one FDS muscle is insufficient to correct clawing in four fingers. In addition, the FDS resides superficial to the median nerve. In a patient who sustained a forearm laceration with injury to the median nerve, the overlying FDS is also likely to have been injured.

Pronator teres is the most common donor motor to restore wrist extension in patients with radial nerve palsy. It has a very short tendon and is not used for anti-claw transfers.

## REFERENCES:

1. Alagoz MS, Uysal AC, Tuccar E, et al. Morphologic assessment of the tendon graft donor sites: palmaris longus, plantaris, tensor fascia lata. *J Craniofac Surg*. 2008 Jan;19(1):246-250.
2. Davis TRC. Median and ulnar nerve palsy. In: Wolfe SW, Pederson WC, Hotchkiss RN, et al, eds. *Green's Operative Hand Surgery*. 6th ed. Philadelphia: Churchill Livingstone; 2011:1093-1137.
3. Wehbé MA. Tendon graft donor sites. *J Hand Surg Am*. 1992 Nov;17(6):1130-1132.

71. A 42-year-old man with carpal tunnel syndrome is evaluated for symptoms that are progressively worsening despite conservative management. Surgical release using an open, short scar technique is planned. Which of the following is the most accurate statement when comparing this technique with endoscopic release?
- A) Both techniques are equivalent in long-term symptom relief and recovery
  - B) Endoscopic release is far superior because of superior long-term symptom relief
  - C) Endoscopic release is only used for bilateral cases
  - D) Open, short scar technique requires regional block, whereas endoscopic release does not
  - E) Open technique has a higher association with recurrent median nerve injury

The correct response is Option A.

Open, short incision and endoscopic carpal tunnel release are equivalent in long-term symptom relief and recovery. Carpal tunnel syndrome is a condition caused by compression of the median nerve at the wrist. It is characterized by pain and numbness of the fingers within the median nerve distribution: the thumb, index, and long fingers, as well as the radial aspect of the ring fingers. With progressive compression, thenar atrophy can occur as well as weakness of thumb opposition. Conservative treatment includes splinting, avoidance of repetitive activities or positions that elicit symptoms, and occasionally steroid injection. With progression of symptoms, surgical release is indicated.

Open release provides transcutaneous access to the transverse carpal ligament. Traditionally, a long incision had been used extending from the proximal palm across the wrist and onto the proximal forearm. The incision has become progressively shorter, such that most surgeons employ a short scar confined to the proximal palm. Endoscopic release uses two small incisions for port access and provides transection of the transverse carpal ligament without division of the palmar aponeurosis.

Debate has existed regarding the superiority or inferiority of one technique over the others. Clearly, the endoscopic technique causes less pain and less alteration in early grip strength, when compared with the more classic, longer incision open techniques. However, when specifically comparing the open, limited scar technique to the endoscopic technique, studies have shown essentially the same outcome data regarding strength, return to work, symptom relief, and reoperation.

Virtually all studies have shown that open and endoscopic release have the same long-term symptom relief, measured at multiple points in time up to one year.

The open technique is often thought to be associated with a lower association with recurrent median nerve injury.

Bilaterality does not preclude open or endoscopic release.

Both techniques can be done during local or regional anesthesia.

## **REFERENCES:**

1. Sayegh ET, Strauch RJ. Open versus Endoscopic Carpal Tunnel Release: A Meta-analysis of Randomized Controlled Trials. *Clin Orthop Relat Res*. 2014 Aug 19. [Epub ahead of print]
2. Vasiliadis HS, Xenakis TA, Mitsionis G, et al. Endoscopic versus open carpal tunnel release. *Arthroscopy*. 2010 Jan;26(1):26-33. Epub 2009 Dec 4.
3. Michelotti B, Romanowsky D, Hauck RM. Prospective, randomized evaluation of endoscopic versus open carpal tunnel release in bilateral carpal tunnel syndrome: an interim analysis. *Ann Plast Surg*. 2014 Dec;73 Suppl 2:S157-S160.

72. A 23-year-old man comes for evaluation because of pain and swelling of the left wrist 6 hours after he fell onto his outstretched left hand. On physical examination, he has tenderness to palpation in the anatomical snuffbox. An occult fracture is suspected. In addition to standard x-ray study views of the wrist, which of the following x-ray views is the most appropriate to confirm the diagnosis?
- A) Anteroposterior view with neutral alignment and the beam angled at neutral
  - B) Clenched fist view with the wrist at neutral and the beam angled at 30 degrees distal to proximal
  - C) Lateral view with the wrist flexed 30 degrees and the beam angled 45 degrees distal to proximal
  - D) Oblique view with radial deviation and the beam angled at neutral
  - E) Posteroanterior view with ulnar deviation and the beam angled 20 degrees distal to proximal

The correct response is Option E.

The scaphoid oblique view is a posteroanterior (PA) view with the wrist in ulnar deviation and the beam angled 20 degrees distal to proximal. This view often will show scaphoid fractures not seen on standard PA, oblique, or lateral views. The other views would not extend the scaphoid and the scaphoid would not be seen as clearly.

## REFERENCES:

1. Toth F, Sebestyen A, Balint L, et al. Positioning of the wrist for scaphoid radiography. *Eur J Radiol.* 2007 Oct;64(1):126-132. Epub 2007 Mar 9.
2. Shenoy R, Pillai A, Hadidi M. Scaphoid fractures: variation in radiographic views - a survey of current practice in the West of Scotland region. *Eur J Emerg Med.* 2007 Feb;14(1):2-5.

73. A 35-year-old man is brought to the emergency department because of an injury to the left lower leg after being involved in a motorcycle collision. X-ray studies confirm a Gustilo IIIB tibia-fibula fracture. After debridement, there is a bone defect measuring 12 cm in the mid shaft of the tibia. Which of the following is the most appropriate technique to restore the bone defect?

- A) Autogenous bone grafting
- B) Cadaveric bone grafting
- C) Coverage with a fibular free flap
- D) Osteodistraction

The correct response is Option C.

Although various techniques have been used successfully to reconstruct large bony defects of the lower extremity, the most reliable technique for such a large bone gap is the fibular free flap reconstruction. The Ilizarov osteodistraction technique can be used for large defects, but would necessitate a very long period of immobilization and fixation. Neither autogenous nor cadaveric bone graft would be as reliable as vascularized bone.

## REFERENCES:

1. Yazar S, Lin CH, Wei FC. One-stage reconstruction of composite bone and soft-tissue defects in traumatic lower extremities. *Plast Reconstr Surg*. 2004 Nov;114(6):1457-1466.
2. Cavadas PC, Landín L, Ibáñez J, et al. Reconstruction of major traumatic segmental bone defects of the tibia with vascularized bone transfers. *Plast Reconstr Surg*. 2010 Jan;125(1):215-223.

74. A 68-year-old woman is evaluated because of numbness and paresthesias of the right hand. The diagnosis of carpal tunnel syndrome is confirmed by electromyography and nerve conduction velocity studies. The patient is interested in a trial of nonsurgical management. Nighttime splint immobilization and corticosteroid injection therapy to the carpal tunnel are planned. Which of the following best describes the most likely long-term outcome of this management strategy?
- A) Complete resolution of the patient's symptoms
  - B) No effect on the patient's symptoms
  - C) No initial effect on the patient's symptoms followed by gradual improvement over 6 to 12 months
  - D) Short-term improvement of the patient's symptoms followed by a recurrence in 6 to 12 months
  - E) Worsening of the patient's sensory and motor symptoms

The correct response is Option D.

Nonsurgical management of carpal tunnel syndrome has been shown to be effective for symptomatic relief of carpal tunnel syndrome for up to 3 to 6 months, depending on the type of intervention that is chosen. Most patients who choose nonsurgical management will ultimately require surgery for carpal tunnel syndrome. Studies suggest that up to 70% of patients will go on to surgical carpal tunnel release at 1 year.

Various nonsurgical interventions have been recommended for carpal tunnel syndrome. These include splint immobilization, oral corticosteroid therapy, local corticosteroid injection, ultrasonography, acupuncture, nonsteroidal anti-inflammatory drug (NSAID) therapy, and more. Many of the interventions are not supported by high-level evidence.

Studies have shown improvement in carpal tunnel syndrome with splint immobilization, oral corticosteroid therapy, local corticosteroid injections, and ultrasonography when compared with a placebo or no treatment. Local corticosteroid injection into the carpal tunnel is more effective than oral corticosteroid therapy at 1 and 3 months without the potential risks of systemic steroid therapy. Splint immobilization plus a cortisone injection is more effective than splint immobilization only at 6 months. Full-time splint immobilization has not shown any benefit when

compared with nighttime splint immobilization only.

In patients who have mild to moderate carpal tunnel syndrome without static numbness, weakness, or thenar atrophy, short-term improvement or resolution of symptoms can be expected but long-term resolution is not likely.

Patients with severe disease and signs of longstanding nerve compression including numbness and loss of abductor pollicis brevis strength may not respond to nonsurgical interventions. Worsening of symptoms as a result of nonsurgical treatment is unlikely.

Carpal tunnel release has been shown to be more effective than splint immobilization and corticosteroid injections for symptomatic relief at 3, 6, and 12 months. However, many surgeons will offer a trial of nonsurgical management based on patient preferences. Complete resolution of symptoms following nonsurgical intervention is thought to be a good prognostic indicator for the success of surgery.

## REFERENCES:

1. Graham B. Nonsurgical treatment of carpal tunnel syndrome. *J Hand Surg Am.* 2009 Mar;34(3):531-534.
2. Marshall S, Tardif G, Ashworth N. Local corticosteroid injection for carpal tunnel syndrome. *Cochrane Database Syst Rev.* 2007 Apr 18;(2):CD001554.
3. Lane LB, Starecki M, Olson A, et al. Carpal tunnel syndrome diagnosis and treatment: a survey of members of the American Society For Surgery of the Hand. *J Hand Surg Am.* 2014 Nov;39(11):2181-2187. Epub 2014 Sep 13.

75. A 28-year-old man is brought to the emergency room because of pain, swelling, and deformity of the right small finger and a laceration over the finger after being involved in a motor vehicle collision. Physical examination shows a 7-mm laceration over the fifth metacarpal shaft. X-ray studies confirm a significantly displaced transverse metacarpal shaft fracture of the right small finger. Which of the following is the most appropriate management?
- A) Closed reduction of the fracture and splint immobilization followed by 7 to 10 days of outpatient oral antibiotic therapy
  - B) Closed reduction of the fracture followed by splint immobilization only
  - C) Emergent debridement in the operating room followed by external fixation of the fracture
  - D) Inpatient intravenous antibiotic therapy and debridement in the operating room within 48 hours
  - E) Irrigation of the wound in the emergency room, splint immobilization, 24 hours of oral antibiotic therapy, and elective operative fixation of the fracture

The correct response is Option E.

This patient has a displaced Grade I open fracture of the fifth metacarpal shaft. Appropriate management includes irrigation and debridement of the wound in the emergency room, splint immobilization, and a brief course of antibiotic therapy. This allows the fracture to be managed as if it were a closed injury. Transverse shaft fractures typically are unstable and require some type of elective fixation beyond splint immobilization.

Open fractures usually are classified according to the Gustilo-Anderson scale, although outcomes of upper extremity open fractures do not necessarily correlate to this system. Grade I injuries are defined as fractures with open wounds <1 cm. Grade II fractures have open wounds measuring between 1 and 10 cm. Grade IIIA fractures have wounds >10 cm with comminution but adequate soft-tissue coverage. Grade IIIB fractures have wounds >10 cm with extensive periosteal stripping that requires soft-tissue reconstruction. Grade IIIC fractures have large wounds with associated vascular injury.

In upper extremity fractures, studies have not correlated time to operative debridement or the administration of antibiotic therapy with ultimate outcomes in terms of infection, malunion, or osteomyelitis. Factors that have been shown to

correlate to poor outcomes in large-scale studies have been high injury severity score, Gustilo grade III, and fractures of the tibia/fibula. Shorter duration of antibiotic administration for open fractures has not been shown to result in a higher rate of infection. The current recommendation from the American Society of Orthopedic surgeons is a 3-day regimen of antibiotics for Grade I/II injuries and 5 days for Grade III.

Grade I injuries have only a minor soft-tissue component and there is no role for emergent surgery, hospital admission, or the need for provisional external fixation.

Closed reduction and splint immobilization are not appropriate for unstable fractures as definitive management in a healthy, young patient. In addition, there is no role for prolonged courses of antibiotic therapy. The fracture can be treated with percutaneous pin fixation or plate fixation depending on the preference of the surgeon.

## REFERENCES:

1. Dunkel N, Pittet D, Tovmirzaeva L, et al. Short duration of antibiotic prophylaxis in open fractures does not enhance risk of subsequent infection. *Bone Joint J.* 2013 Jun;95-B(6):831-837.
2. Malhotra AK, Goldberg S, Graham J, et al. Open extremity fractures: impact of delay in operative debridement and irrigation. *J Trauma Acute Care Surg.* 2014 May;76(5):1201-1207.
3. Weber D, Dulai SK, Bergman J, et al. Time to initial operative treatment following open fracture does not impact development of deep infection: a prospective cohort study of 736 subjects. *J Orthop Trauma.* 2014 Nov;28(11):613-619.
4. Balam AK, Bednar MS. Complications after the fractures of metacarpal and phalanges. *Hand Clin.* 2010 May;26(2):169-177.

76. A 45-year-old man is evaluated because of a traumatic plantar heel wound following a calcaneal fracture of the left foot. A pedicled fasciocutaneous flap from the plantar instep is designed for reconstruction. Which of the following best describes the anatomic location of the arterial pedicle of this flap?
- A) Between the abductor hallucis and flexor digitorum brevis
  - B) Between the flexor digitorum brevis and abductor digiti minimi
  - C) Between the flexor hallucis brevis and adductor hallucis
  - D) Between the flexor hallucis longus and quadratus plantae
  - E) Between the tendons of the extensor hallucis longus and extensor digitorum longus

The correct response is Option A.

Reconstruction of the weightbearing plantar surface ideally requires skin that is sensate and glabrous. When possible, replacing like-with-like tissue is preferred. The donor site for the medial plantar artery flap is located on the non-weightbearing plantar surface and provides tissue that is structurally similar to the plantar area of the hind foot including fibro-fatty subcutaneous tissue and plantar fascia.

The medial plantar artery is a terminal branch of the posterior tibial artery, and lies between the abductor hallucis and flexor digitorum brevis. Fibers of the medial plantar nerve can be harvested with the flap to provide sensation. The flap can also be raised as a distally-based flap from retrograde flow through the lateral plantar artery for forefoot wounds, or as a free flap. This flap has been shown to provide reliable reconstruction of the plantar surfaces.

The lateral plantar artery runs between the flexor digitorum brevis and abductor digiti minimi. The dorsalis pedis artery runs between the extensor hallucis longus and extensor digitorum longus tendons. The remaining muscle intervals do not contain any major arterial branches used in flap reconstruction.

## REFERENCES:

1. Oh SJ, Moon M, Cha J, et al. Weight-bearing plantar reconstruction using versatile medial plantar sensate flap. *J Plast Reconstr Aesthet Surg*. 2011 Feb;64(2):248-254. Epub 2010 May 31.

2. Gupta A. Ther versatile medial plantar artery and its flaps. *Ann Plast Surg.* 2007 Mar;58(3):348.
3. Oberlin C, Accioli de Vasconcellos Z, Touam C. Medial plantar flap based distally on the lateral plantar artery to cover a forefoot skin defect. *Plast Reconstr Surg.* 2000 Sep;106(4):874-877.

77. A 38-year-old woman comes for evaluation 7 weeks after undergoing a Zone II flexor tendon repair of the left long finger. She reports feeling a "pop" at home and is now unable to flex the finger at the proximal or distal interphalangeal joints. On examination today, the finger is swollen with moderate stiffness. Flexor tendon rupture is suspected. During operative exploration, ruptures of the flexor digitorum superficialis (FDS) and flexor digitorum profundus tendons are noted. There is a 1.5-cm gap of the profundus tendon and scarring at the A2 pulley. Which of the following is the most appropriate next step in management?
- A) Excision of the flexor tendons with implantation of a passive silicone rod prosthesis
  - B) Fractional lengthening of the tendon in the forearm and revision of primary repair
  - C) Single-stage reconstruction with implantation of an active silicone rod prosthesis
  - D) Single-stage tendon reconstruction with palmaris graft
  - E) Tendon transfer from the ring finger FDS

The correct response is Option A.

Flexor tendon reconstruction in Zone II was originally described by Bassett and Carroll in 1963 and refined by Hunter in 1971. In the first stage, a Dacron-reinforced silicone rod is implanted after excision of the native tendons. It is secured distally to the flexor digitorum profundus stump or directly to the distal phalanx. Proximally, the rod is placed adjacent to the motor tendon but not secured. At this time, pulley reconstruction with tendon or retinacular grafts can be performed as indicated. This allows formation of a pseudosheath around the rod. Once the soft tissue has healed and the patient has regained maximum passive range of motion through therapy, the second-stage tendon grafting is performed. The most commonly reported time frame is 3 months but depends on soft-tissue stability.

The most important management decision is to determine if primary repair is possible. If not, one must then decide between single-stage and two-stage tendon reconstruction. The criteria for single-stage reconstruction include a finger with adequate passive motion of all joints, soft tissues with minimal scarring, functional tendon sheath and pulley system, a neurovascularly intact digit, and a compliant patient. If these criteria are not met, the patient should be treated with a staged reconstruction.

In this patient, primary repair is not likely with a gap  $>1$  cm 7 weeks after the initial repair. Myostatic contraction of the proximal stump would be expected. In addition, this patient's digit has significant internal scarring and poor passive motion— all factors that preclude a single-stage repair. Fractional lengthening might be considered to allow primary repair if the tendon sheath was better quality.

If a single-stage repair were indicated, one may consider a flexor digitorum superficialis transfer from an adjacent digit as a motor for the transfer. This requires only one tendon anastomosis, and studies have shown decreased adhesion formation with intrasynovial tendon grafts. However, tensioning of the transfer can be more difficult than traditional tendon grafting.

Patients who are unable to tolerate a second-stage procedure can be considered for the implantation of an active silicone rod prosthesis. This device is designed to have both a distal anastomosis to the bone and a proximal anastomosis to the motor muscle-tendon unit with integrated sutures or a loop. This would require meeting the criteria for single-stage reconstruction. Active implants were originally designed for use in two-stage reconstruction, but no studies exist that compare active with passive silicone rods or show any benefit versus a passive implant in a staged reconstruction.



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

## REFERENCES:

1. Macknin JB, Malone KJ. Zone 2 flexor digitorum profundus and superficialis rupture treated with single-stage tendon reconstruction using an Active Hunter Rod Implant. *Orthopedics*. 2012 May;35(5):e758-e761.
2. Freilich Am, Chhabra AB. Secondary flexor tendon reconstruction, a review. *J Hand Surg Am*. 2007 Nov;32(9):1436-1442.
3. Moore T, Anderson B, Seiler JG 3rd. Flexor tendon reconstruction. *J Hand Surg Am*. 2010 Jun;35(6):1025-1030.



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

78. A 50-year-old man comes to the emergency department after sustaining an injury to the right thumb. A photograph is shown. The patient declines revision amputation and states that he does not want to lose thumb length or the nail. Which of the following is the most appropriate next step in management?
- A) Complete the amputation of the thumb proximal to the germinal matrix
  - B) Obliterate the germinal matrix and remaining nail bed, followed by skin grafting
  - C) Transplant germinal matrix from the great toe
  - D) Transplant sterile matrix from the great toe
  - E) Continue to observe

The correct response is Option D.

The patient described has lost the sterile matrix of the nail bed. The germinal matrix is intact, as the nail continues to grow. The nail bed consists of the germinal matrix proximally and the sterile matrix distally. The sterile matrix allows the nail to adhere to the bed. Observation, amputation, and obliteration of the nail bed do not seem to be good options for a patient who has stated that appearance is paramount. The issue here is that the nail continues to grow, but cannot adhere to the full-thickness skin graft. The best option would be to harvest a split-thickness sterile matrix graft from the big toe. No additional germinal matrix is necessary as the germinal matrix is intact and producing nail.

## **REFERENCES:**

1. De Berker D, Mawhinney B, Sviland L. Quantification of regional matrix nail production. *Br J Dermatol*. 1996 Jun;134(6):1083-1086.
2. Zook EG. Reconstruction of a functional and aesthetic nail. *Hand Clin*. 2002 Nov;18(4):577-594.

79. A 46-year-old woman is experiencing extreme pain in the fingers and hands due to a Raynaud's crisis. Examination shows mottling of the fingers and ulcerations at the volar tips on the long, ring, and small fingers. The patient has failed to improve with calcium channel blockers and aspirin. Recent angiography did not demonstrate a surgically correctable occlusion. Which of the following is the most appropriate combination of drug and route of administration to help relieve the pain and heal the wounds in this patient?

- A) Intravascular administration of botulinum toxin type A
- B) Subcutaneous administration of botulinum toxin type A
- C) Subcutaneous injection of calcium gluconate
- D) Topical administration of calcium gluconate

The correct response is Option B.

Botulinum toxin type A (Botox) has proven an extremely helpful adjunct in treating refractory ulcers and pain in patients with Raynaud disease or scleroderma. While the mechanism remains unclear, it has been shown both to improve pain and heal wounds that had not previously responded to treatment. In many clinical situations, subcutaneous administration of Botox around the neurovascular bundles has replaced surgical sympathectomy as the treatment of choice. If, however, there is angiographic evidence of occlusion that is surgically correctable, then that surgery (and not Botox) would be the preferred treatment in that situation.

The administration of calcium gluconate is typically used to treat hydrofluoric acid exposure.

Intravascular administration of Botox is not the recommended route of administration and topical Botox would have no effect.

## REFERENCES:

1. Mannava S, Plate JF, Stone AV, et al. Recent advances for the management of Raynaud phenomenon using botulinum neurotoxin A. *J Hand Surg Am.* 2011 Oct;36(10):1708-1710. Epub 2011 Sep 8.
2. Neumeister MW. Botulinum toxin type A in the treatment of Raynaud's phenomenon. *J Hand Surg Am.* 2010 Dec;35(12):2085-2092.
3. Neumeister MW, Chambers CB, Herron MS, et al. Botox therapy for ischemic digits. *Plast Reconstr Surg.* 2009 Jul;124(1):191-201.

4. Van beek AL, Lim PK, Gear AJ, et al. Management of vasospastic disorders with botulinum toxin A. *Plast Reconstr Surg*. 2007 Jan;119(1):217-226.

80. A 28-year-old man is brought to the emergency department 3 hours after sustaining complete amputation at the level of the right mid forearm during a paper mill accident. A tourniquet was placed at the scene of the accident. He is medically stable and has no additional injuries. Which of the following is the most appropriate management of the amputated segment until vascular anastomoses are completed?

- A) Clamp distal vessels
- B) Cool amputated extremity
- C) Flush artery with thrombolytics
- D) Immerse in saline
- E) Perform fasciotomies

The correct response is Option B.

The correct response is that the limb should be cooled until vascular anastomoses are complete.

Replantation of an amputated extremity remains the primary option at initial presentation. Contraindications for immediate replantation include an unstable patient who cannot tolerate a prolonged operative procedure, and patients in whom amputation and prosthesis would provide a better functional result than reconstruction. Warm ischemia should not exceed 6 hours, but can be extended to 10 to 12 hours when a part is cooled. Therefore, keeping a replanted part cooled until reperfused is important to success.

Clamping vessels in an amputated segment damages vessels needed for microanastomoses.

Cold heparinized saline and University of Wisconsin solution are commonly used to flush amputated parts to reduce thromboses and cool the part. Systemic complications are not common with the doses used. Persistent cold intolerance is a complaint of the majority of replanted patients. Unless thrombi are present, it is not routine to flush with thrombolytics. Immersing in saline is not appropriate.

When performing vascular anastomoses on larger masses of tissue with a longer ischemia time, performing arterial anastomoses and allowing run-off of metabolites through an open venous system before venous anastomoses are performed is

recommended. Arterial perfusion may also be established early, allowing more time for repair of bone and tendon without prolonging ischemia times.

Fasciotomies are recommended as periods of ischemia can lead to compartment syndrome. However, these do not need to occur before anastomoses and should not delay reperfusion. Elevation of a replanted part is helpful to reduce post-operative edema but has no role before anastomoses.

## **REFERENCES:**

1. Maricevich M, Carlsen B, Mardini S, et al. Upper extremity and digital replantation. *Hand (N Y)*. 2011 Dec;6(4):356-363. Epub 2011 Aug 4.
2. Prucz RB, Friedrich JB. Upper extremity replantation: current concepts. *Plast Reconstr Surg*. 2014 Feb;133(2):333-342.
3. Saint-Cyr M, Wong C, Buchel EW, et al. Free tissue transfers and replantation. *Plast Reconstr Surg*. 2012 Dec;130(6):858e-878e.

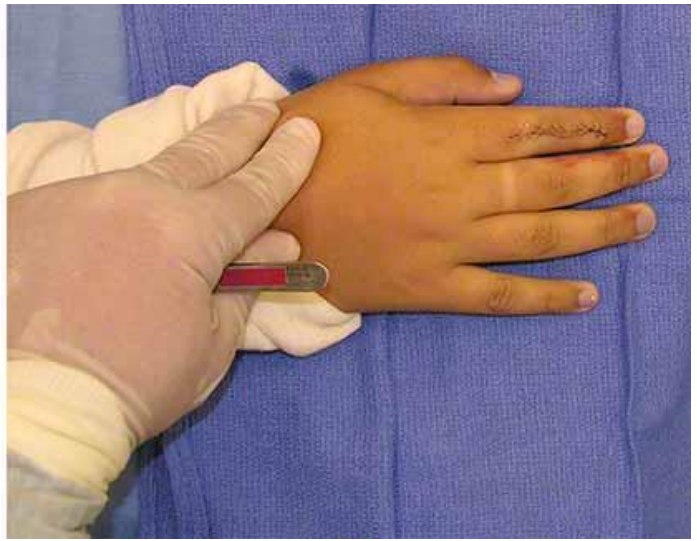


(Please note that this pictorial appears in color in the online examination)

81. A 12-year-old boy has had the lesion of the right index finger shown in the photograph since birth. The lesion has been growing in proportion to his overall growth. On physical examination, there is no thrill or bruit. Which of the following is the most likely diagnosis?

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

The correct response is Option D.



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

In 1982, Mulliken and Glowacki proposed a binary classification system for vascular anomalies based on pathologic features. This system divides vascular anomalies into two primary biological categories: 1) vasoproliferative or vascular neoplasms and 2) vascular malformations.

Vasoproliferative neoplasms, such as hemangioma and Kaposiform hemangioendothelioma, have increased endothelial cell turnover (i.e., they proliferate and undergo mitosis) because they are neoplasms. Vascular malformations do not have increased endothelial cell turnover. Instead, vascular malformations are structural abnormalities of the capillary, venous, lymphatic, and arterial systems that grow in proportion to the child.

The lesion shown in the photographs grew in proportion to the child; therefore, it is a malformation, not a vasoproliferative neoplasm. Given the absence of a bruit or thrill, it is unlikely to be an arteriovenous malformation; therefore, a slow-flow lesion such as a lymphatic malformation is the most likely diagnosis.

Although a port-wine stain is a type of venous malformation, it is characterized by its very superficial location, which causes the skin to be discolored red (hence the name). Such findings are not present in the photographs shown.

## REFERENCES:

1. Lowe LH, Marchant TC, Rivard DC, Scherbel AJ. Vascular malformations: classification and terminology the radiologist needs to know. *Semin Roentgenol.* 2012 Apr;47(2):106-117.
2. Weibel L. Vascular anomalies in children. *Vasa.* 2011 Nov;40(6):439-447.



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

82. A 26-year-old man is referred for evaluation 9 months after sustaining a lower trunk brachial plexus traction injury after being hit by a motor vehicle. At the time of injury, he had paresthesia in the ring and small fingers and weakness of grip. Today, physical examination shows intrinsic atrophy and mild ulnar claw hand. A photograph is shown. He demonstrates increased sensation in the ring and small fingers since the time of the accident, but he has no clinical or electrodiagnostic improvement in motor function. Which of the following is most likely to improve the claw hand posture?
- A) Anterior interosseous nerve branch of median nerve to ulnar nerve transfer in forearm
  - B) Brachialis branch of musculocutaneous nerve to ulnar nerve transfer in upper arm
  - C) Exploration and neurolysis of the lower trunk of the brachial plexus
  - D) Posterior interosseous nerve branch of radial nerve to ulnar nerve transfer in forearm

The correct response is Option A.

Lower trunk brachial plexus injuries can lead to deficits in hand function. Some can cause global hand dysfunction (median and ulnar nerve), while others can present as isolated ulnar nerve dysfunction. The signs and symptoms of isolated ulnar nerve dysfunction include numbness and tingling in the ring and small fingers, as well as weakness of the intrinsics. Ulnar nerve dysfunction may or may not present with clawing of the ulnar two digits, depending upon whether the flexor digitorum profundus (FDP) tendon to the ring and small fingers is involved. This patient has signs and symptoms consistent with low ulnar nerve palsy, and would benefit from an anterior interosseous nerve (AIN) to ulnar motor nerve transfer in the forearm.

The brachialis branch of the musculocutaneous nerve is classically used to reinnervate the AIN in the upper arm. This transfer is employed in cases of AIN palsy. The extensor carpi radialis brevis branch of the posterior interosseous nerve is most commonly used to reinnervate the AIN (median nerve), but can also be transferred to the ulnar nerve. This transfer occurs more proximally in the forearm and, therefore, would require a greater distance to travel to reach its endpoint (intrinsics of hand). The better and more appropriate transfer is the AIN to ulnar motor in this case.

Internal neurolysis can be used for neuromas in situ or neuropraxic nerves, but it would not be indicated for deficit in the hand. The length needed to recover function is too great, and motor end plate death is likely to occur before meaningful recovery can be seen.

## **REFERENCES:**

1. Colbert SH, Mackinnon SE. Nerve transfers for brachial plexus reconstruction. *Hand Clin.* 2008 Nov;24(4):341-361.
2. Tung TH, Mackinnon SE. Nerve transfers: indications, techniques, and outcomes. *J Hand Surg Am.* 2010 Feb;35(2):332-341.

83. A 45-year-old electrician is evaluated because of a fingertip injury to the index finger. The wound is allowed to heal by secondary intention but eventually results in hook-nail deformity. This patient is most likely to have sustained an injury to which of the following parts of the nail?

- A) Eponychium
- B) Germinal matrix
- C) Lunula
- D) Nail groove
- E) Sterile matrix

The correct response is Option E.

Loss of the distal fingertip and the associated soft-tissue defect can be treated using different methods, but the involvement of the nail influences the choice of surgical approach and makes reconstruction more difficult. If the sterile matrix is foreshortened and heals to the volar soft tissues, it can result in hook-nail deformity.

The germinal matrix is responsible for formation of nail plate elements and injury does not result in hook-nail. The nail groove is the lateral margin of the nail and the site of ingrown nails and paronychia. The eponychium is the cuticle covering the proximal nail plate. Loss of the eponychium results in a rough nail lacking the usual lustre. The lunula is similarly on the proximal nail and is under the plate.

## REFERENCES:

1. Atasoy E, Godfrey A, Kalisman M. The “antenna” procedure for the “hook-nail” deformity. *J Hand Surg Am.* 1983 Jan;8(1):55-58.
2. Kuman VP, Satku K. Treatment and prevention of “hook nail” deformity with anatomic correlation. *J Hand Surg Am.* 1993 Jul;18(4):617-620.

84. Which of the following arteries most likely supplies a vascularized bone free flap from the medial condyle of the femur?

- A) Descending genicular
- B) Medial femoral circumflex
- C) Posterior radial collateral
- D) Posterior tibial
- E) Sural artery

The correct response is Option A.

There has been recent increased interest in the use of the medial condyle of the femur as a source of vascularized bone. The blood supply appears to be robust and predictable. In one study, the descending genicular artery was present in 89%, and the superior medial genicular artery was present in 100% of specimens with average distances proximal to the articular surface of 13.7 cm and 5.2 cm, respectively.

The posterior radial collateral artery is the pedicle for the lateral arm flap. The sural artery perfuses the posterior skin of the calf. The medial femoral circumflex artery lies in the upper thigh and helps supply blood to the neck of the femur. The posterior tibial artery carries blood to the plantar surface of the foot from the posterior artery.

## REFERENCES:

1. Hertel R, Masquelet AC. The reverse flow medial knee osteoperiosteal flap for skeletal reconstruction of the leg. Description and anatomical basis. *Surg Radiol Anat.* 1989;11(4):257-262.
2. Yamamoto H, Jones DB Jr, Moran SL, et al. The arterial anatomy of the medial femoral condyle and its clinical implications. *J Hand Surg Eur Vol.* 2010 Sep;35(7):569-574 Epub 2010 Mar 17.

85. A 6-month-old boy who sustained a brachial plexus injury during delivery is brought for evaluation. On examination, the left elbow is held in extension and arm is positioned in internal rotation. He has active flexion of the fingers and wrist. Extension of the fingers and wrist is weak; anti-gravity test of the elbow extension discloses weakness. There is no active elbow flexion or shoulder abduction; Horner's sign is absent. Which of the following structures is most likely injured?

- A) C7 roots
- B) C8-T1 roots
- C) Lateral cord
- D) Posterior cord
- E) Upper trunk

The correct response is Option E.

The infant has the classic manifestations of an upper trunk (C5-6), or Erb's, palsy (weak or absent elbow flexion, shoulder abduction and external rotation, relatively preserved elbow extension and distal wrist/hand flexion). The "waiter's tip" posture of the affected extremity indicates relative sparing of lower root (C8-T1) function. Isolated injury to the C7 root is uncommon and would primarily affect radial nerve innervated muscles such as the wrist and finger extensors, and forearm pronation. Injury to the posterior cord also effects radial nerve innervated muscles and would not alter biceps or deltoid function as observed in this child. Lateral cord damage would result in weak or absent biceps and pectoral function, but would not diminish deltoid or periscapular muscle activity.

## REFERENCES:

1. Terzis JK, Kokkalis ZT. Pediatric brachial plexus reconstruction. *Plast Reconstr Surg*. 2009 Dec;124(6 Suppl):e370-385.
2. Hale HB, Bae DS, Waters PM. Current concepts in the management of brachial plexus birth palsy. *J Hand Surg Am*. 2010 Feb;35(2):322-331.
3. Borschel GH, Clarke HM. Obstetrical brachial plexus palsy. *Plast Reconstr Surg*. 2009 Jul;124(1 Suppl):144e-155e.

86. A 14-year-old girl who has flexion deformities of the right wrist and fingers, numbness of the radial-volar hand, and forearm atrophy 6 months after sustaining an electrical burn to the right upper extremity is brought for evaluation. A functional free gracilis muscle transfer is planned to improve finger flexion. Which of the following nerves innervates this flap?

- A) Femoral
- B) Genitofemoral
- C) Ilioinguinal
- D) Obturator
- E) Pudendal

The correct response is Option D.

The gracilis muscle is the workhorse for functional muscle transfer, and it has been successfully used to restore hand function in patients with severe Volkmann ischemic contracture. Innervation of the muscle is via a branch of the obturator nerve, which is composed of 2 to 3 fascicular bundles. The nerve length from its emergence from the obturator foramen to its insertion into the muscle averages 7.7 cm, and separation of the fascicular bundles can allow the muscle to be segmented. The other nerves listed do not innervate the gracilis muscle.

## REFERENCES:

1. Stevanovic M, Sharpe F. Management of established Volkmann's contracture of the forearm in children. *Hand Clin.* 2006 Feb;22(1):99-111.
2. Rodríguez Lorenzo A, Morley S, Payne AP, et al. Anatomy of the motor nerve to the gracilis muscle and its implications in a one-stage microneurovascular gracilis transfer for facial reanimation. *J Plast Reconstr Aesthet Surg.* 2010 Jan;63(1):54-58. Epub 2008 Nov 17.
3. Rozen S, Rodriguez-Lorenzo A, Audolfsson T, et al. Obturator nerve anatomy and relevance to one-stage facial reanimation: limitations of a retroperitoneal approach. *Plast Reconstr Surg.* 2013 May;131(5):1057-1064.



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

87. A 45-year-old woman who has a 15-year history of rheumatoid arthritis comes for evaluation because of the inability to actively extend the metacarpophalangeal (MCP) joints of the right small and ring fingers. On examination today, she has near full passive motion of all fingers and is able to actively extend the thumb, index, and long fingers. Photographs are shown. She is unable to hold the ring and small fingers in extension when they are passively extended. X-ray studies show severe destructive arthropathy of the wrist, MCP, and proximal interphalangeal joints. There is ulnar drift and subtle volar subluxation of the MCP joint in all fingers; the ulnar head is prominent dorsally and is unstable. Which of the following is the most likely cause of her inability to actively extend the MCP joints of the ring and small fingers?

- A) MCP joint contracture
- B) Posterior interosseous nerve palsy associated with elbow synovitis
- C) Rupture of the extensor tendons in zone VII
- D) Rupture of the sagittal bands
- E) Volar subluxation of the MCP joints

The correct response is Option C.

Extensor lag of the fingers is a common problem in patients with rheumatoid arthritis and severe wrist and finger arthropathy. Persistent synovial inflammation results in periarticular osseous destruction and weakening of the stabilizing ligaments. Any of the choices can potentially cause a restriction of finger extension at the metacarpophalangeal (MCP) joints, but only rupture of the extensor tendons would result in the constellation of findings observed here. This patient has severe wrist arthritis and dorsal prominence of the ulnar head (unstable). This can result in attritional ruptures of the extensor digiti minimi and ulnar-sided extensor digitorum communis tendons; treatment is resection of the ulnar head and tendon transfer to restore extensor function.

Posterior interosseous nerve palsy resulting from synovitis about the radiocapitellar joint is well described in patients with rheumatoid arthritis, but would affect extension of all fingers and the thumb. Rupture and subluxation of sagittal bands would lead to inability to actively extend the MCP but, in contrast to extensor tendon ruptures, full extension can be maintained after the fingers are passively extended. MCP joint contracture would limit active and passive finger motion.

## REFERENCES:

1. Williamson SC, Feldon P. Extensor tendon ruptures in rheumatoid arthritis. *Hand Clin.* 1995 Aug;11(3):449-459.
2. Schindele SF, Herren DB, Simmen BR. Tendon reconstruction for the rheumatoid hand. *Hand Clin.* 2011 Feb;27(1):105-113.
3. Trieb K. Treatment of the wrist in rheumatoid arthritis. *J Hand Surg Am.* 2008 Jan;33(1):113-123.



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

88. An otherwise healthy 10-year-old girl is brought for evaluation because of a chronic ulcer of the right leg. The ulcer first appeared 6 months ago when she scraped her leg on a boat dock at her family's lake house. The wound has increased in size despite treatment with a course of oral antibiotic therapy prescribed by her primary care physician. A photograph is shown. On evaluation today, the patient is afebrile and has no systemic signs of infection. Which of the following organisms is the most likely cause of these findings?

- A) *Candida tropicalis*
- B) Group A beta-hemolytic *Streptococcus*
- C) Methicillin-resistant *Staphylococcus aureus*
- D) *Mycobacterium marinum*
- E) *Vibrio vulnificus*

The correct response is Option D.

The history and presentation are classic for an atypical mycobacterial infection. Unlike bacterial infections, atypical mycobacteria rarely produce systemic signs of infection and often manifest as a nonhealing (sometimes progressive) wound. Given the history of injury on a boat dock, the most likely causative organism is *Mycobacterium marinum*, an acid-fast bacillus that lives in water environments. This pathogen results in localized granulomas such as the one seen in this patient. *Staphylococcus aureus* is the most common source of skin infections but typically results in a more pronounced and acute immune reaction with localized redness and purulence. These findings are not present in this patient. Cutaneous infections with Group A beta-hemolytic *Streptococcus* and *Vibrio vulnificus* tend to increase rapidly and are often accompanied by severe systemic response (i.e., necrotizing fasciitis). *Candida tropicalis* is a fungus that is often part of normal skin flora. It is related to *Candida albicans* and can produce opportunistic internal infections in susceptible individuals.

## REFERENCES:

1. Gunther SF, Levy CS. Mycobacterial infections. *Hand Clin.* 1989 Nov;5(4):591-598.
2. Bhatta MA, Turner DP, Chamberlain ST. Mycobacterium marinum hand infection: case reports and review of literature. *Br J Plast Surg.* 2000 Mar;53(2):161-165.

89. A 28-year-old woman who works as a manicurist comes for left thumb reconstruction 1 year after sustaining an amputation injury through the metacarpophalangeal joint. She desires improved pinch and grip with the best possible aesthetic appearance. Which of the following reconstruction techniques is most likely to offer her improved function with the least aesthetic donor site deformity?

- A) First webspace Z-plasty
- B) Great toe flap
- C) Great toe wraparound flap
- D) Osteocutaneous radial forearm flap
- E) Second toe flap

The correct response is Option E.

While amputations distal through the proximal phalanx may benefit from isolated webspace deepening, it is unlikely that adequate length would remain at this level to provide good pinch or grip function even with a deeper web.

Prior to the advent of free-tissue transfer, osteoplastic reconstructions, including the reversed radial forearm flap with inclusion of a radius bone segment, were the workhorses of thumb reconstruction. The resulting thumb, however, is insensate and lacks any motion except at the level of the remaining CMC joint. Aesthetically, this reconstruction looks the least like a thumb when compared to toe transfers.

The great toe wrap-around flap provides a cosmetically acceptable way to resurface a thumb when the skeletal support is already present, either due to retention from the trauma or from an osteoplastic reconstruction. In this case, the skeletal support is absent, and the wrap-around flap by itself would not allow recreation of a stable thumb.

The great toe free flap provides an excellent reconstructive choice for a sensate, mobile thumb. Functionally, it will be nearly identical to the second toe transfer, and the two have both been used extensively for functional restoration. Aesthetically, the great toe tends to be larger than the contralateral thumb, leading to the development of the "trimmed" great toe transfer. In addition, the cosmetic impact on the foot is greater than that of harvesting the second toe, making this a less aesthetically acceptable reconstruction than the second toe.

The second toe transfer offers functionality equivalent to the great toe transfer and creates a thumb closer in size to the contralateral thumb. In addition, the harvest of the second toe avoids sacrifice of the aesthetic unit of the great toe on the foot, a consideration for this patient as she may still wear open-toed footwear.

## **REFERENCES:**

1. Lin PY, Sebatian SJ, Ono S, et al. A systematic review of outcomes of toe-to-thumb transfers for isolated traumatic thumb amputation. *Hand (NY)*. 2011 Sep;6(3):235-243. Epub 2011 May 26.
2. Kvernmo HD, Tsai TM. Posttraumatic reconstruction of the hand--a retrospective review of 87 toe-to-hand transfers compared with an earlier report. *J Hand Surg Am*. 2011 Jul;36(7):1176-1181.



90. A 59-year-old woman comes for evaluation because of a 7-month history of pain over the radial aspect of the right wrist that is aggravated with forceful gripping. She denies any history of trauma to the hand or wrist. On physical examination, there is tenderness to palpation over the right anatomic snuffbox and thenar eminence. Axial load and shifting of the basal joint does not result in crepitance or pain. Resisted thumb extension at the metacarpophalangeal joint level is not painful. An x-ray study of the wrist is shown. Which of the following is the most appropriate operative management?

- A) Arthrodesis of the scaphotrapeziotrapezoid joint
- B) Arthrodesis of the trapeziometacarpal joint
- C) Hemi-resection of the distal trapezium and tendon interposition
- D) Release of the first dorsal compartment
- E) Release of the second dorsal compartment

The correct response is Option A.

Scaphotrapeziotrapezoid (STT) arthritis can often be misdiagnosed on initial presentation as basal joint arthritis. The keys to differentiating the two sites of pain include physical examination, which shows tenderness more proximal than the basal joint and absence of pain with a grind maneuver, coupled with imaging showing osteoarthritic degeneration at the STT rather than the trapeziometacarpal level. Treatment for the arthritic pain can consist of resection arthroplasty or arthrodesis. Both techniques can provide good relief of symptoms. Resection arthroplasty often is used when the scapho-trapezoid articulation is relatively preserved. Regardless of technique chosen, the surgeon should address both the scapho-trapezoid and the scapho-trapezoid joints during the procedure.

Release of the first dorsal compartment would address de Quervain tenosynovitis, which could present with pain over the anatomic snuffbox. On examination, however, the patient would typically demonstrate pain with the "resisted Hitchhiker" maneuver (resisted extensor pollicis brevis function at the metacarpophalangeal level). Given the negative findings on examination and the STT arthritis noted on imaging, this patient would not likely respond to treatment directed at the first dorsal compartment.

Second dorsal compartment tenosynovitis can present with distal forearm and wrist pain. The location of the pain is typically more proximal in the forearm and localized to the intersection between the muscle bellies of the first compartment tendons and the radial wrist extensors. This patient's pain is localized to the STT region rather than the second dorsal compartment.

Hemiresection of the distal trapezium and tendon interposition has been used successfully in the management of trapezio-metacarpal arthritis (basal joint arthritis). In this patient, the location of the pain, absence of pain with a "grinding" type maneuver, and the imaging showing preservation of the basal joint argue against directing treatment at the basal joint itself.

For the same reasons that hemiresection of the distal trapezium is a poor choice for this patient, arthrodesis of the basal joint addresses the wrong site of arthritis. X-ray study and physical examination both indicate STT arthritis as the etiology of the patient's pain.

## REFERENCES:

1. Garcia-Elias M. Excisional arthroplasty for scaphotrapeziotrapezoidal osteoarthritis. *J Hand Surg Am.* 2011 Mar;36(3):516-520.

2. Andrachuk J, Yang SS. Modified total trapezial and partial trapezoidal excision and ligament reconstruction tendon interposition reduces symptoms in isolated scaphotrapezial-trapezoid arthritis of the wrist. *J Hand Surg Eur* Vol. 2012 Sep;37(7):637-641. Epub 2012 May 8.
3. Wolf JM. Treatment of scaphotrapezio-trapezoid arthritis. *Hand Clin.* 2008 Aug;24(3):301-306.



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

91. A 21-year-old man is evaluated for loss of shoulder abduction and extension, and loss of sensation in the left lateral upper arm sustained in a motorcycle accident 8 months ago. A photograph is shown. Physical examination shows atrophy of the deltoid and weakness with shoulder abduction and external rotation. The patient has intact elbow flexion and extension, and motor function distal to the elbow is preserved. Which of the following is the most appropriate management?
- A) Exploration of the left brachial plexus with nerve graft repair
  - B) Latissimus dorsi to deltoid muscle transfer
  - C) Shoulder arthrodesis
  - D) Triceps branch of radial nerve to axillary nerve transfer
  - E) Observation and follow-up examination in 3 months

The correct response is Option D.

This patient has an axillary nerve injury of one of the terminal branches of the brachial plexus.

Absence of any recovery by 6 months following an injury to the brachial plexus is an indication for surgical reconstruction. Continued observation would be unlikely to lead to any further recovery.

Exploration of the brachial plexus and nerve grafting for acute injuries is controversial, and not indicated in the subacute setting (8 months). The distance required to recover motor function, from site of injury to motor end plate, is too great for any meaningful recovery at 8 months. Even in the acute setting, nerve graft reconstruction of the brachial plexus has not demonstrated predictable outcomes.

Shoulder arthrodesis is an acceptable salvage procedure for patients with shoulder pain resulting from paralysis of the shoulder girdle following brachial plexus injury. The resulting limited mobility, however, is fairly severe and this procedure should only be used if attempts at restoration of function via other modalities have failed.

The standard reconstruction for this injury is transfer of a triceps branch of the radial nerve to the axillary nerve.

Although latissimus muscle transfer for restoration of elbow flexion can play a role in the treatment of brachial plexus injuries, it is not used for shoulder reconstruction. The trapezius is traditionally used for late reconstruction of shoulder abduction.

## REFERENCES:

1. Lee SK, Wolfe SW. Nerve transfers for the upper extremity: new horizons in nerve reconstruction. *J Am Acad Orthop Surg*. 2012 Aug;20(8):506-517.
2. Kostas-Agnantis I, Korompilias A, Vekris M, et al. Shoulder abduction and external rotation restoration with nerve transfer. *Injury*. 2013 Mar;44(3):299-304. Epub 2013 Jan 18.

92. A 42-year-old man comes to the emergency department after sustaining an injury to the right hand when he caught his thumb in a table saw. Physical examination and x-ray studies show a 1.5-cm defect of the distal and volar aspect of the thumb with exposed bone. Which of the following flap and blood supply classifications is most appropriate for coverage of this defect?

|   | <b>Flap</b>  | <b>Blood Supply</b> |
|---|--------------|---------------------|
| A | Cross-finger | axial               |
| B | Cross-finger | random              |
| C | Moberg       | axial               |
| D | Moberg       | random              |
| E | VY           | axial               |
| F | VY           | random              |

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

The correct response is Option C.

The most appropriate coverage option for this 1.5-cm defect of the thumb is a Moberg flap. The Moberg flap has an axial pattern blood supply. It is indicated for defects as great as 1.5 cm on the volar surface of the thumb. It provides sensate soft-tissue coverage of thumb tip wounds.

The VY advancement flap will not cover defects as large as 1.5 cm; and the cross-finger flap, although it will cover defects as large as 1.5 cm, is inferior to the Moberg flap for defects of this type. It also does not carry innervated tissue, making the Moberg flap the most appropriate flap option for this defect.

## REFERENCES:

1. Baumeister S, Menke H, Wittemann M, et al. Functional outcome after the Moberg advancement flap in the thumb. *J Hand Surg Am*. 2002 Jan;27(1):105-114.
2. Chung KC. Flap reconstruction of the traumatized upper extremity. *Hand Clin*. 2014 May;30(2):109-258. Epub 2014 Jan 14.

93. A 27-year-old man is brought to the emergency department because of compartment syndrome of the lower left leg. Release of the deep posterior compartment includes decompression of which of the following muscles?
- A) Flexor hallucis longus
  - B) Peroneus brevis
  - C) Plantaris
  - D) Soleus
  - E) Tibialis anterior

The correct response is Option A.

The flexor hallucis longus flexes the great toe and is located in the deep posterior compartment. The soleus and plantaris muscles are located in the superficial posterior compartment, just deep to the gastrocnemius muscles. The peroneus brevis is located in the lateral compartment. The tibialis anterior is located in the anterior compartment.

#### **REFERENCES:**

1. Netter FH. *Atlas of Human Anatomy*. 3rd ed. Philadelphia: Elsevier-Saunders; 2003:Plates 499, 500, 523.
2. Winkes MB, Hoogeveen AR, Scheltinga MR. Is surgery effective for deep posterior compartment syndrome of the leg? A systematic review. *Br J Sports Med*. 2014 Dec;48(22):1592-1598. Epub 2013 Sep 24.

94. A 3-month-old boy is brought for evaluation because of bilateral simple syndactylies between the long and ring fingers. During which gestational age range did this developmental anomaly most likely occur?
- A) Days 0-15
  - B) Days 20-35
  - C) Days 40-55
  - D) Days 65-80
  - E) Days 85-100

The correct response is Option C.

Syndactyly is the most common congenital limb malformation. Digital separation is the result of distal to proximal apoptosis, likely mediated by bone morphogenic proteins (BMP) signaling TGF-beta. Overexpression of BMP inhibitors and persistent fibroblast growth factor (FGF) function have been found to lead to syndactyly.

The exact dates of digital separation vary by publication, but occur approximately between days 44 and 54. Limb buds appear by day 26, and a hand paddle by day 33. By day 56, the phalangeal tips are ossified.

## REFERENCES:

1. Al-Qattan MM, Yang Y, Kozin SH. Embryology of the upper limb. *J Hand Surg Am.* 2009 Sep;34(7):1340-1350.
2. Oberg KC, Feenstra JM, Manske PR, et al. Developmental biology and classification of congenital anomalies fo the hand and upper extremity. *J Hand Surg Am.* 2010 Dec;35(12):2066-2076.
3. Bates SJ, Hansen SL, Jones NF. Reconstruction of congenital differences of the hand. *Plast Reconstr Surg.* 2009 Jul;124(1 Suppl):128e-143e.



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

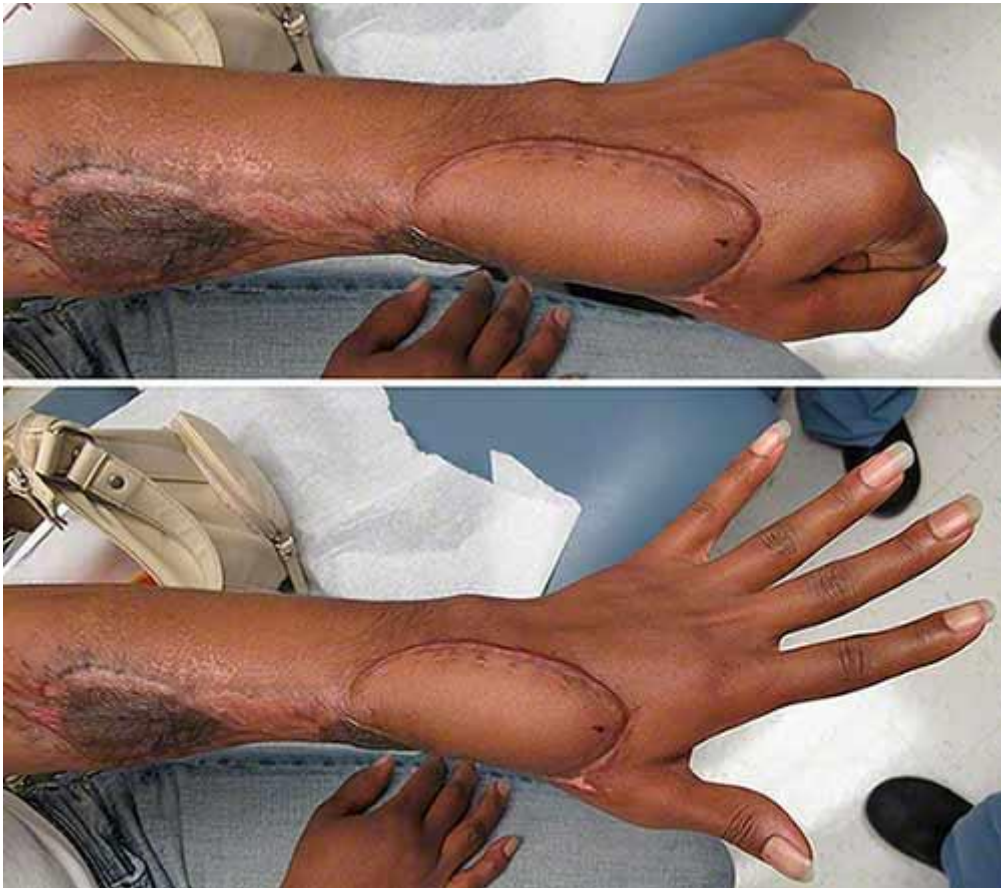
95. A 28-year-old woman is brought to the emergency department after sustaining an injury to the arm during a motor vehicle collision. A photograph is shown. Physical examination shows inability to extend the index or long fingers, and a rent in the dorsal wrist capsule. Which of the following extensor zones is most likely involved?
- A) II
  - B) III
  - C) IV
  - D) V
  - E) VI

The correct response is Option E.

The patient described sustained a dorsal wrist injury involving extensors of the wrist and fingers, with the injury at the base of the hand and over the carpus. Typically this is considered zones VI and VII. The other zones represent the following areas with

some common conditions listed for each zone. Knowing and reporting zones of injury are helpful not just for descriptive purposes, but also for communicating with other doctors and therapists. Common therapy protocols are based on which zone or zones are involved in the injury.

- Zone I: over the distal interphalangeal joint (mallet finger)
- Zone II: over the middle phalanx
- Zone III: over the proximal interphalangeal joint (boutonnière deformity)
- Zone IV: over the proximal phalanx
- Zone V: over the metacarpophalangeal joint (fight bite)
- Zone VI: over the metacarpal bones
- Zone VII: over the dorsal wrist retinaculum



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

## REFERENCES:

1. Moore KL, Dalley AF. *Clinically Oriented Anatomy*. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2005:725-884.
2. Strauch RJ. Extensor Tendon Injury. In: Wolfe SW, Pederson WC, Hotchkiss RN, et al, eds. *Green's Operative Hand Surgery*. Vol 1. 6th ed. Philadelphia: Churchill Livingstone; 2010:159-188.

96. A 48-year-old right-hand–dominant man is referred for treatment of a biopsy-proven subungual malignant melanoma in situ of the right thumb. Which of the following is the most appropriate treatment?
- A) Amputation to the interphalangeal joint with no reconstruction
  - B) Amputation to the metacarpophalangeal joint with toe-to-thumb transfer
  - C) Chemotherapy
  - D) Radiation therapy
  - E) Wide local excision with split-thickness skin grafting

The correct response is Option E.

While the literature lacks randomized control data, there is mounting evidence that melanoma in situ can be appropriately treated with wide local excision alone. This is associated with considerably less morbidity than amputation with or without reconstruction. Radiation therapy or chemotherapy are not appropriate treatment options for malignant melanoma in this setting.

## REFERENCES:

1. Chow WT, Bhat W, Magdub S, et al. In situ subungual melanoma: digit salvaging clearance. *J Plast Reconstr Aesthet Surg*. 2013 Feb;66(2):274-276. Epub 2012 Jul 17.
2. Haddock NT, Wilson SC, Shapiro RL, et al. Wide local en bloc excision of subungual melanoma in situ. *Ann Plast Surg*. 2014 dec;73(6):640-644.
3. Cochran AM, Buchanan PJ, Bueno RA Jr, et al. Subungual melanoma: a review of current treatment. *Plast Reconstr Surg*. 2014 Aug;134(2):259-273.

97. A 24-year-old man is brought by ambulance to the emergency department after sustaining a tibial fracture in a motorcycle collision. On physical examination, there is an open, segmental fracture with a 4-cm wound and a large avulsion flap, but adequate soft-tissue coverage. Which of the following Gustilo-Anderson fracture classifications best describes this injury?

- A) Type I
- B) Type II
- C) Type IIIA
- D) Type IIIB
- E) Type IIIC

The correct response is Option C.

The Gustilo-Anderson classification of open fractures is a primary method of classification and communication in orthopedic surgery and plastic surgery when limb injury and reconstruction are required. The types are as follows:

- Type I – an open fracture with a wound less than 1 cm long and clean
- Type II – an open fracture with a laceration more than 1 cm long without extensive soft-tissue damage, flaps, or avulsions
- Type III – either an open segmental fracture, an open fracture with extensive soft-tissue damage, or a traumatic amputation

Type III was later subclassified as follows:

- IIIA – adequate soft-tissue coverage of a fractured bone despite extensive soft-tissue lacerations or flaps, or high energy trauma irrespective of the size of the wound
- IIIB – extensive soft-tissue injury with periosteal stripping and bone exposure; there is usually associated massive contamination
- IIIC – open fractures associated with arterial injury requiring repair

## REFERENCES:

1. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. *J Bone Joint Surg Am.* 1976 Jun;58(4):453-458.

2. Gustilo RB, Mendoza RM, Williams DN. Problems in the management of type III (severe) open fractures: a new classification of type III open fractures. *J Trauma*. 1984 Aug;24(8):742-746.
3. Chummun S, Wigglesworth TA, Young K, et al. Does vascular injury affect the outcome of open tibial fractures? *Plast Reconstr Surg*. 2013 Feb;131(2):303-309.

98. A 30-year-old man who works as a carpenter comes for evaluation because of a full-length longitudinal ridge over the nail of his left index finger. He recalls hitting it with a hammer 6 months ago and saw "blue under the nail" at that time. He has not sought medical attention until now. An x-ray study shows no abnormalities. Which of the following is the most appropriate management?

- A) Observation
- B) Excision of scar and ablation of the nail matrix
- C) Excision of scar and primary repair of the nail matrix
- D) Excision of scar and wrapped second toe procedure
- E) Trephination of the nail plate

The correct response is Option C.

The correct treatment for this deformity would be excision of scar and repair of the nail germinal and sterile matrices, which had not been done initially. Usually, removal of scar tissue and undermining will allow for delayed primary closure. Grafting of the nail bed should not be necessary.

Trephination is done only in the acute setting to evacuate hematoma, if the subungual hematoma is symptomatic.

The nail plate grows at 3 mm per month; therefore, full-length nail growth would require 3 to 4 months. Because this deformity has occurred 6 months after the injury, the nail plate has completed a full growth cycle. Nonsurgical treatment would therefore be incorrect.

Nail bed ablation, also called matricectomy, is complete chemical or surgical ablation of the nail matrix and is used for recalcitrant and recurrent fungal infections. Matricectomy is also used in painful post traumatic conditions such as pincer or split nail deformities.

A wrapped toe procedure is a microsurgical replacement of soft tissue to an amputated finger, and can include nail matrix and surrounding soft tissue replacement, but is not indicated in this setting where only the nail matrix is involved.

## REFERENCES:

1. Ashbell TS, Kleinert HE, Putcha SM, et al. The deformed finger nail, a frequent result of failure to repair nail bed injuries. *J Trauma*. 1967 Mar;7(2):177-190.
2. Bharathi RR, Bajantri B. Nail bed injuries and deformities of nail. *Indian J Plast Surg*. 2011 May;44(2):197-202.
3. Zook EG, Brown RE. The perionychium. In: Green DP, Hotchkiss RN, eds. *Operative Hand Surgery*. 3rd ed. Vol 2. Edinburgh: Churchill Livingstone; 1993:1283-1297.
4. Tos P, Titolo P, Chirila NL, et al. Surgical treatment of acute fingernail injuries. *J Orthop Traumatol*. 2012 Jun;13(2):57-62. Epub 2011 Oct 8.
5. Ceilley RI, Collision DW. Matricectomy. *J Dermatol Surg Oncol*. 1992 Aug;18(8):728-734.

99. A 30-year-old man comes to the emergency department after falling on his outstretched left hand 6 hours ago. He injured the same hand 3 years ago and underwent open reduction and internal fixation and distal radius bone grafting to repair a metacarpal fracture of the index finger. Physical examination and x-ray study obtained today show an exposed, fractured plate. He undergoes hardware removal and multiple washouts, resulting in a 1-cm bone defect. Reconstruction of the defect is planned using bone graft from Gerdy's tubercle of the tibia. The cortical window should be made just proximal and medial to which of the following muscles?

- A) Extensor digitorum longus
- B) Extensor hallucis longus
- C) Peroneus longus
- D) Popliteus
- E) Tibialis anterior

The correct response is Option E.

The lateral tibial tubercle (Gerdy's tubercle), on the proximal lateral tibia, is an excellent source of cancellous bone graft and would provide ample graft for use in this patient. In the patient described, the ipsilateral distal radius was harvested in the original surgery and is not available. Patient factors including obesity may make other bone graft donor sites such as the iliac crest less appealing.

Gerdy's tubercle is located between the tibial tubercle and patellar tendon insertion to the medial side and the head of the fibula to the lateral side. Bone can be harvested through a 3- to 4-cm oblique incision, and the cortical window is made just proximal and medial to the tibialis anterior origin.

The popliteus muscle is posterior to the knee. The extensor hallucis longus and extensor digitorum longus muscles originate more distally on the tibia. The peroneus longus originates from the fibula, not the tibia.

## REFERENCES:

1. Brutus JP, Loftus JB. Gerdy's tubercle as a source of cancellous bone graft for surgery of the upper extremity: description of technique. *J Hand Surg Am*. 2006 Jan;31(1):147-149.

2. Mauffrey CP, Seligson D, Krikler S. Surgical techniques: How I do it? Bone graft harvest from the proximal lateral tibia. *Injury*. 2010 Feb;41(2):242-244.

100. A 24-year-old male figure skater comes to the emergency department because of dorsal metacarpophalangeal dislocation of the right thumb. The emergency department staff is unable to reduce the dislocation. Which of the following structures is most likely preventing reduction in this patient's injury?

- A) Extensor pollicis longus tendon
- B) Flexor pollicis brevis tendon
- C) Opponens pollicis
- D) Sesamoid bone
- E) Ulnar neurovascular bundle

The correct response is Option D.

The thumb metacarpophalangeal (MCP) sesamoid bone(s) may be associated with an irreducible dorsal dislocation.

Dorsal dislocation of the thumb at the MCP joint typically occurs with forced hyperextension with resultant volar plate and collateral ligament rupture. Irreducibility usually occurs through interposition of the volar plate in the joint. Extensor expansion interposition, collateral ligaments, bony fragments, sesamoids, and flexor pollicis longus entrapment have also been associated with irreducibility. In these circumstances, open reduction is often necessary.

The ulnar neurovascular bundle, extensor pollicis longus, opponens pollicis, and flexor pollicis brevis are not typically associated with an irreducible dislocation.

## REFERENCES:

1. Izadpanah A, Wanzel K. Late presentation of a complete complex thumb metacarpophalangeal joint dislocation: A case report. *Can J Plast Surg*. 2011 Winter;19(4):139-142.
2. Hughes LA, Freiberg A. Irreducible MP joint dislocation due to entrapment of FPL. *J Hand Surg Br*. 1993 Dec;18(6):708-709.

## Section 3: Craniomaxillofacial

101. A 2-month-old male infant is evaluated for cleft lip and lower lip pits. Medical history shows his father also had a cleft lip at birth. Which of the following is the most likely genetic defect in this patient?
- A) *FGFR1*
  - B) *IRF6*
  - C) *PTCH1*
  - D) Trisomy 13
  - E) 22q11.2

The correct response is Option B.

van der Woude syndrome is an autosomal dominant condition affecting 1:40,000 to 1:100,000 live births. It involves lower lip pits or mounds, and cleft lip and/or palate. Fifteen percent do not have the associated pits, so genetic associations are useful in diagnosis and counseling.

*IRF6* is the mutation associated with van der Woude syndrome as well as popliteal pterygium syndrome (webbing behind the knee, lower lip pits, cleft lip and/or palate, and genital hypoplasia).

*PTCH1* is found in Gorlin syndrome, also known as basal cell nevus syndrome.

*FGFR1* is associated with Kallmann syndrome (hypogonadotrophic hypogonadism with anosmia, cleft lip and/or palate, renal aplasia/agenesis, dental defects).

The majority of orofacial clefts are nonsyndromic (70% of all cleft lip/palate; 50% of all cleft palate only). Cleft lip/palate is more common in males (2:1) and cleft palate only is more common in females (1:2).

22q11.2 deletion is associated with DiGeorge sequence or velocardiofacial syndrome (cardiac anomalies, abnormal facies, thymic aplasia, cleft palate, hypocalcemia/hypoparathyroidism—CATCH).

Trisomy 13 is associated with Patau syndrome (cleft palate, CNS disorders,

microcephaly, polydactyly, rocker bottom foot, urogenital defects, and cardiac anomalies.

## REFERENCES:

1. Friedman O, Wang TD, Milczuk HA. Cleft Lip and Palate. In: Flint PW, Haughey BH, Lund VJ, et al, eds. *Cummings Otolaryngology - Head and Neck Surgery*. 5th ed. Maryland Heights, MO: Mosby; 2010:2659-2675.
2. Leslie EJ, Marazita ML. Genetics of cleft lip and cleft palate. *Am J Med Genet C Semin Med Genet*. 2013 Nov;163C(4):246-258. Epub 2013 Oct 4.

102. A 42-year-old man is evaluated because of a 2-cm mass in the anterior floor of the mouth. Examination shows no palpable masses in the neck. In addition to surgical tumor removal, which of the following is the most appropriate additional step in management?

- A) Radiation only
- B) Radical neck dissection
- C) Radical neck dissection and radiation
- D) Selective neck dissection
- E) Observation

The correct response is Option D.

A 2-cm mass with a clinically negative neck, pT2cN0, merits a supraomohyoid neck dissection because of the high risk of occult spread in this zone. A supraomohyoid dissection removes the lymph nodes in zones I, II, III; a modified neck dissection covers I-IV.

A smaller tumor, pT1N0, can be managed with a "tight 'wait and watch'" strategy.

A radical neck dissection includes the sternocleidomastoid muscle and is not necessary for a clinically negative neck. Adding radiation therapy to a reflex neurovascular dystrophy is also not necessary for an N0 neck.

## REFERENCES:

1. Künzel J, Psychogios G, Koch M, et al. Results of treatment for pT1/pT2 carcinomas of the floor of mouth. *Acta Otolaryngol*. 2013 Sep;133(9):1000-1005. Epub 2013 Jul 22.
2. Wein R, Malone J, Weber R. Malignant Neoplasms of the Oral Cavity. In: *Cummings Otolaryngology - Head and Neck Surgery*. 5th ed. Maryland Heights, MO: Mosby;1293-1318.

103. A 3-month-old male infant is evaluated because of bilateral preauricular pits and small ears. Physical examination is otherwise unremarkable. The patient failed the newborn hearing test; the parents have not repeated the test. They are not very concerned, because the father is also hearing impaired. Which of the following is the most appropriate next step in management?

- A) Echocardiography
- B) MRI of the brain
- C) Renal ultrasound
- D) Repeat hearing test
- E) Surgical treatment of the preauricular pits

The correct response is Option C.

This child most likely has branchio-oto-renal (BOR) syndrome, an autosomal dominant syndrome. Two genetic mutations (*EYAI* and *SIX1*) have been identified. The clinical findings include auricular malformations, preauricular skin pits, hearing loss, branchial fistulae, external auditory canal stenosis, and renal anomalies. Renal ultrasound should be performed to rule out renal anomalies. Family history of hearing loss should also raise suspicion.

Ear anomalies can also be associated with the oculo-auriculo-vertebral spectrum (OAV), within which hemifacial microsomia falls. OAV spectrum may have associated mandibular, facial nerve, and ocular findings (e.g., epibulbar dermoid, coloboma). Other possible associations include congenital heart defects, such as ventricular septal defect or tetralogy of Fallot. This child does not have other craniofacial findings of hemifacial microsomia, thus cardiac echocardiography is not indicated.

Internal cerebral arterial anomalies may be associated with PHACE syndrome (P, posterior fossa; H, hemangioma; A, arterial anomalies; C, cardiac defects; E, eye anomalies). Investigation of cerebral circulation by MRI of the brain would be prompted by a facial hemangioma, which is absent in this child.

While resection of the preauricular pits may be offered, it does not aid in ruling out other findings and there is no urgency to perform surgical resections in this child at 3 months of age.

Repeating a hearing test will not confirm or rule out OAV or BOR syndrome.

## REFERENCES:

1. Kochhar A, Fischer SM, Kimberling WJ, et al. Branchio-oto-renal syndrome. *Am J Med Genet A*. 2007 Jul 15;143A(14):1671-1678.
2. Strömmland K, Miller M, Sjögreen L, et al. Oculo-auriculo-vertebral spectrum: associated anomalies, functional deficits and possible developmental risk factors. *Am J Med Genet A*. 2007 Jun 15;143A(12):1317-1325.
3. Bayer ML, Frommelt PC, Blei F, et al. Congenital cardiac, aortic arch, and vascular bed anomalies in PHACE syndrome (from the International PHACE Syndrome Registry). *Am J Cardiol*. 2013 Dec 15;112(12):1948-1952. Epub 2013 Sep 28.

104. Which of the following is the primary treatment for keratocystic odontogenic tumor?

- A) Curettage only
- B) Enucleation and chemoablation
- C) Enucleation only
- D) Marginal mandibulectomy
- E) Segmental mandibulectomy

The correct response is Option B.

The most common benign tumors of the jaw are ameloblastoma (37%) and keratocystic odontogenic tumor (KCOT) (14%). Ameloblastomas are slow growing, occur in the 4th to 5th decades of life, and arise from odontogenic epithelium. KCOTs are locally aggressive, occur earlier in life, and also arise from odontogenic epithelium.

Curettage or enucleation results in higher recurrence rates. Addition of Carnoy's solution (absolute alcohol, chloroform, glacial acetic acid, and ferric chloride) to the enucleated site for 3 minutes addresses the most common issue of local recurrence.

Segmental or marginal resection of the mandible is reserved for recurrence after resection locally.

## REFERENCES:

1. Johnson NR, Gannon OM, Savage NW, et al. Frequency of odontogenic cysts and tumors: a systematic review. *J Investig Clin Dent*. 2014 Feb;5(1):9-14. Epub 2013 Jun 14.
2. Johnson NR, Batstone MD, Savage NW. Management and recurrence of keratocystic odontogenic tumor: a systematic review. *Oral Surg Oral Med Oral Pathol Oral Radiol*. 2013 Oct;116(4):e271-e276. Epub 2012 Jul 6.



105. In the panoramic x-ray study (Panorex) shown, which of the following is the most likely diagnosis of the bilateral expansile lesions?

- A) Ameloblastoma
- B) Central giant cell granulomas (CGCG)
- C) Neurofibromas
- D) Odontogenic keratocysts
- E) Osteosarcoma

The correct response is Option C.

Bilateral expansile lesions of the inferior alveolar nerve canal is pathognomonic of neurofibroma. The lesions on the Panorex are both expansile and not locally destructive of bone, as is common in ameloblastoma and odontogenic keratocysts. Central giant granulomas are most often multilocular, with cortical rupture and root atrophy. Osteosarcoma always has cortical destruction.

## REFERENCES:

1. De Lange J, Van den Akker HP. Clinical and radiological features of central giant-cell lesions of the jaw. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2005 Apr;99(4):464-470.

2. Harmon M, Arigan M, Toner M, et al. A radiological approach to benign and malignant lesions of the mandible. *Clin Radiol*. 2015 Apr;70(4):335-350. Epub 2015 Jan 2.

106. Which of the following is the most common origin of the superior thyroid artery?

- A) Bifurcation of the carotid artery
- B) Common carotid artery
- C) External carotid artery
- D) Internal carotid artery

The correct response is Option C.

The origin of the superior thyroid artery is predictable and most commonly it arises from the external carotid artery. It has, however, been described to arise from all three of the other options, just less frequently.

## REFERENCES:

1. Gupta P, Bhalla AS, Thulkar S, et al. Variations in superior thyroid artery: A selective angiographic study. *Indian J Radiol Imaging*. 2014 Jan;24(1):66-71.
2. Ozgur Z, Govsa F, Celik S, et al. Clinically relevant variations of the superior thyroid artery: an anatomic guide for surgical neck dissection. *Surg Radiol Anat*. 2009 Mar;31(3):151-159. Epub 2008 Aug 27.
3. Anagnostopoulou S, Mavridis I. Emerging patterns of the human superior thyroid artery and review of its clinical anatomy. *Surg Radiol Anat*. 2014 Jan;36(1):33-38. Epub 2013 Jun 20.
4. Vázquez T, Cobiella R, Maranillo E, et al. Anatomical variations of the superior thyroid and superior laryngeal arteries. *Head Neck*. 2009 Aug;31(8):1078-1085.

107. A 3-year-old boy is evaluated for unilateral cleft lip and palate. Tympanogram shows bilateral noncompliance. Which of the following muscles is most likely responsible for this finding?
- A) Levator veli palatini
  - B) Palatoglossus
  - C) Palatopharyngeus
  - D) Superior constrictor
  - E) Tensor veli palatini

The correct response is Option E.

Flat tympanograms indicate the eustachian tubes are not draining properly. The action of the tensor veli palatini is key in the equalization of pressure between the middle ear and nasopharynx. In a child with a cleft palate, the tensor is abnormally inserted into the levator palatini, and as a result, there is an increased incidence of ear eustachian tube dysfunction. The primary function of the levator veli palatini is velopharyngeal closure by velar elevation and retrodisplacement. The palatopharyngeus is responsible for controlling the velopharyngeal sphincter by controlling velar size, shape, and position. The palatoglossus works to modulate speech by velar depression and tongue elevation. The superior constrictor is important for pharyngeal closure during swallowing and speech.

## REFERENCES:

1. Huang MH, Lee ST, Rajendran K. Anatomic basis of cleft palate and velopharyngeal surgery: implications from a fresh cadaveric study. *Plast Reconstr Surg*. 1998 Mar;101(3):613-627.
2. Fára M, Dvorák J. Abnormal anatomy of the muscles of palatopharyngeal closure in the cleft palates: anatomical and surgical considerations based on the autopsies of 18 unoperated cleft palates. *Plast Reconstr Surg*. 1970 Nov;46(5):488-497.
3. Shprintzen RJ, Croft CB. Abnormalities of the Eustachian tube orifice in individuals with cleft palate. *Int J Pediatr Otorhinolaryngol*. 1981 Jan;3(1):15-23.
4. Sheer FJ, Swarts JD, Ghadiali SN. Three-dimensional finite element analysis of Eustachian tube function under normal and pathological conditions. *Med Eng Phys*. 2012 Jun;34(5):605-616. Epub 2011 Oct 12.

108. A 6-year-old girl with cerebral palsy is evaluated for sialorrhea. Medical treatment has been unsuccessful. Surgical intervention for drooling control is planned. Which of the following glands contributes the most to basal salivary production?

- A) Lacrimal
- B) Minor salivary
- C) Parotid
- D) Sublingual
- E) Submandibular

The correct response is Option E.

Daily saliva production is on the scale of 500 to 2000 mL per day. Excessive drooling in patients with cerebral palsy or other severe neurologic impairment is caused by inefficient swallowing. The submandibular glands contribute the most to basal salivary production, approximately 60%. The parotid gland contributes approximately 20% to basal salivary production. Sublingual glands and minor salivary glands each contribute 10%. The lacrimal gland is responsible for production of the aqueous layer of the tear film.

## REFERENCES:

1. Greensmith AL, Johnstone BR, Reid SM, et al. Prospective analysis of the outcome of surgical management of drooling in the pediatric population: a 10-year experience. *Plast Reconstr Surg*. 2005 Oct;116(5):1233-1242.
2. Holsinger, F.C.; Bui, D.T. Anatomy, function, and evaluation of the salivary glands. *Salivary Glands Disorders*. 2007: 1-16.

109. Which of the following tooth types is most commonly the last one to erupt when the primary teeth are replaced by permanent teeth?
- A) Maxillary canine
  - B) Maxillary central incisor
  - C) Maxillary first molar
  - D) Maxillary first premolar
  - E) Maxillary lateral incisor

The correct response is Option A.

Aside from the third molars, the maxillary canines are typically the last teeth to erupt of the available options (around 11 to 12 years of age). It is important to give the tooth a large area of viable bone to traverse and become supported by, and alveolar bone grafting is typically performed well in advance of the eruption of the maxillary canine in order to preserve the native tooth.

The maxillary central incisor is often the second permanent tooth a child will erupt, typically at age 7 to 8 years.

The maxillary lateral incisor is often the third permanent tooth a child will erupt, typically at age 8 to 9 years.

The maxillary first premolar is often the fourth permanent tooth a child will erupt, typically at age 10 to 12 years.

The maxillary first molar is often the first permanent tooth a child will erupt, typically at age 6 to 7 years.

## REFERENCES:

1. The American Dental Association. Eruption Charts. Available at: <http://www.mouthhealthy.org/en/az-topics/e/eruption-charts>. Accessed February 12, 2015.
2. Jones MC, Jones KL. Pediatric Dentistry. In: Losee JE, Kirschner RE, eds. *Comprehensive Cleft Care*. New York: McGraw-Hill; 2009:681-691.

110. A 12-hour-old male newborn is evaluated in the neonatal intensive care unit. A diagnosis of CHARGE syndrome is suspected. Review of the medical record and physical examination show congenital heart defect, eyelid colobomas, microtia, hypogonadism, and growth retardation. Which of the following additional conditions is/are most likely in this patient?

- A) Craniosynostosis
- B) Intrahepatic hemangiomas
- C) Lower lip pits
- D) Orofacial cleft
- E) Syndactyly

The correct response is Option D.

Cleft lip and/or palate is found in up to 20% of patients with CHARGE (coloboma of the eye, heart defects, atresia of the nasal choanae, retardation of growth and/or development, genital and/or urinary abnormalities, and ear abnormalities and deafness) syndrome. It is the second most common syndrome associated with cleft lip and palate, following van der Woude syndrome. CHARGE syndrome is believed to be caused by a microdeletion or mutation in the *CHD7* (chromodomain helicase DNA-binding protein 7) gene. Over the years, there have been other conditions found to be associated with this syndrome, including limb anomalies, renal anomalies, omphalocele, cranial nerve anomalies, and tracheoesophageal fistula.

Syndactyly is not typically associated with CHARGE syndrome.

Intrahepatic hemangiomas are not typically associated with CHARGE syndrome.

Craniosynostosis is not typically associated with CHARGE syndrome.

Lip pits are commonly found in patients with van der Woude syndrome.

## REFERENCES:

1. The Charge Syndrome Foundation. About CHARGE. Available at: <http://www.chargesyndrome.org/about-charge.asp>. Accessed February 12, 2015.

2. Jones MC, Jones KL. Syndromes of Orofacial Clefting. In: Losee JE, Kirschner RE, eds. *Comprehensive Cleft Care*. New York: McGraw-Hill; 2009:107-127.

111. A 50-year-old woman is evaluated after undergoing Mohs micrographic surgery of the lower eyelid to remove a basal cell carcinoma 2 days ago. On examination, a 65% defect of the lower eyelid involving both the anterior and posterior lamellae is noted. Neither canthi are involved. Which of the following is the most appropriate reconstructive option for this patient?
- A) Hughes tarsoconjunctival flap and Tripier lid switch flap
  - B) Local cheek V-Y advancement flap and buccal mucosal graft
  - C) Mustardé flap and hard palate mucosal graft
  - D) Tenzel semicircular flap and periosteal flap
  - E) Upper eyelid Cutler-Beard flap and buccal mucosal graft

The correct response is Option A.

Eyelid reconstruction is often a challenging endeavor, and depends upon thorough knowledge of the local anatomy, reconstructive options, and extent of resection. Eyelid defects are commonly classified into three categories—less than 25%, 25 to 50%, and greater than 50%—in order to help the surgeon choose the best reconstructive options. Whenever reconstructing an eyelid defect, it is important to identify the structures involved and be sure to reconstruct the lamellae that have been resected. In this patient, there is a defect that involves both the anterior (skin and orbicularis) and posterior (conjunctiva and tarsus) lamellae, and both must be addressed. Of the available options, the only one that appropriately provides the correct amount and quality of anterior and posterior lamellae for a greater than 50% defect is a Hughes tarsoconjunctival flap and Tripier lid switch flap.

A Tenzel semicircular flap would be appropriate for a 50% or less defect of the lower eyelid, but would not be the best option for a 65% defect.

Although a local cheek V-Y advancement flap and a buccal mucosal graft provides both anterior and posterior lamellar reconstruction, a local V-Y advancement flap of the appropriate size would likely create a cosmetically unappealing contour, and using buccal mucosa for the posterior lamella would not provide the amount of support needed for the lower eyelid to prevent ectropion postoperatively.

Although the combination of a Mustardé flap and a hard palate mucosal graft is a possibility because it provides both anterior and posterior lamellar reconstruction, the use of a hard palate mucosal graft would incorporate keratinized epithelium into the

reconstruction, and, therefore, would be less desirable than the use of conjunctiva because it can cause corneal irritation.

The Cutler-Beard flap provides both anterior and posterior lamellar reconstruction and, therefore, the buccal mucosal graft is redundant and unnecessary.

## **REFERENCES:**

1. Alghoul M, Pacella SJ, McClellan WT, et al. Eyelid reconstruction. *Plast Reconstr Surg*. 2013 Aug;132(2):288e-302e.
2. McCord CD, Codner MA. Lower Eyelid Reconstruction. In: *Eyelid and Periorbital Surgery*. Boca Raton: CRC Press; 2008:543-575.

112. A 55-year-old woman is evaluated because of a 2-year history of an enlarging right-sided facial mass. Examination shows a roughly 4-cm firm mass in the right parotid region and a firm lymph node in zone III of the ipsilateral neck. Imaging does not show metastatic disease. Fine-needle aspiration of the mass suggests high-grade mucoepidermoid carcinoma of the parotid gland. Which of the following is the most appropriate treatment in this patient?
- A) Neoadjuvant chemoradiation and reassessment of tumor response before additional treatment
  - B) Superficial parotidectomy with ipsilateral cervical lymph node dissection
  - C) Superficial parotidectomy with ipsilateral cervical lymph node dissection and postoperative adjuvant radiotherapy
  - D) Total parotidectomy with ipsilateral cervical lymph node dissection
  - E) Total parotidectomy with ipsilateral cervical lymph node dissection and postoperative adjuvant radiotherapy

The correct response is Option E.

This patient has T2N1M0 (Stage II) high-grade mucoepidermoid carcinoma, and total parotidectomy with ipsilateral cervical dissection is the appropriate treatment. Because the patient is lymph node positive, both an ipsilateral cervical lymph node dissection and postoperative adjuvant radiotherapy are indicated.

A superficial parotidectomy would perhaps be indicated in a low-grade mucoepidermoid carcinoma, but in a high grade lesion, total parotidectomy is more appropriate. Ipsilateral cervical lymph node dissection and postoperative adjuvant radiotherapy would be indicated in this patient, however.

Although total parotidectomy and ipsilateral cervical lymph node dissection are appropriate, two factors make postoperative adjuvant radiotherapy an important component of treatment: the node positive status of the neck, and the high grade of the tumor.

Chemotherapy remains somewhat controversial in the treatment of mucoepidermoid carcinoma, and, to date, is not a part of standardized therapy.

## REFERENCES:

1. Ariyan S, Narayan D, Ariyan C. Salivary Gland Tumors. In: Neligan PC, Gurtner GC, eds. *Plastic Surgery*. Philadelphia: Elsevier-Saunders; 2013:360-379.
2. Oh YS, Russell MS, Eisele DW. Salivary Gland Neoplasms. In: Johnson JT, Rosen CA, eds. *Bailey's Head & Neck Surgery: Otolaryngology*. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2013:1760-1787.

113. A 45-year-old man with a 10-year history of unilateral facial palsy is evaluated for dynamic reanimation of the lower face. Single-stage free gracilis transfer to restore smiling function is planned. The proximal stump of the ipsilateral facial nerve is not available as a donor nerve. Which of the following options is most appropriate for this patient because it is associated with the lowest donor site morbidity/loss of function?

- A) Cross-facial nerve transfer
- B) Ipsilateral glossopharyngeal nerve
- C) Ipsilateral hypoglossal nerve
- D) Ipsilateral masseteric nerve
- E) Ipsilateral spinal accessory nerve

The correct response is Option D.

In cases of unilateral facial palsy in which the ipsilateral facial nerve is unavailable for use as a donor nerve, nerve transfers are the best option. Of the local options, the ipsilateral masseteric nerve provides the best and most commonly used transfer due to its proximity and relatively low morbidity when harvested. In one study, spontaneous smiling was achieved routinely in 59% of patients and occasionally in 29% of patients by using this technique.

Although the hypoglossal nerve is sometimes used as a donor nerve for ipsilateral facial reanimation, its harvest can be associated with considerable oropharyngeal morbidity due to ipsilateral tongue atrophy.

A cross-facial nerve transfer does not provide for single-stage reconstruction. In many cases where there are sufficient contralateral branches of the facial nerve for cross-facial transfer, this option can provide optimal function, but its use requires a staged approach.

Use of the ipsilateral glossopharyngeal nerve as a donor in this situation would also create significant oropharyngeal function morbidity, and is therefore not commonly used.

Use of the ipsilateral spinal accessory nerve as a donor nerve is rarely used due to the fact that its use often requires uncoordinated movements for function. Ipsilateral masseteric nerve is a significantly better choice.

## REFERENCES:

1. Fattah A, Borschel GH, Manktelow RT, et al. Facial palsy and reconstruction. *Plast Reconstr Surg*. 2012 Feb;129(2):340e-352e.
2. Manktelow RT, Tomat LR, Zuker RM, et al. Smile reconstruction in adults with free muscle transfer innervated by the masseter motor nerve: effectiveness and cerebral adaptation. *Plast Reconstr Surg*. 2006 Sep 15;118(4):885-899.
3. Zuker RM, Gur E, Hussain G, et al. Facial Paralysis. In: Rodriguez ED, Losee JE, Neligan PC, eds. *Plastic Surgery*. Philadelphia: Elsevier-Saunders; 2012:278-306.

114. A 21-year-old man undergoes repair of the parotid gland and Stensen duct after sustaining an injury while being assaulted with a glass bottle. Ten days later, salivary leakage from the wound is noted. Which of the following is the most appropriate next step in management?
- A) Pressure dressings and limited oral intake
  - B) Radiation therapy
  - C) Re-exploration of the wound and repair of the duct injury
  - D) Tympanic neurectomy
  - E) Observation only

The correct response is Option A.

Sialocele and cutaneous fistula may occur as a complication of a major salivary gland injury or after attempted parotid gland or duct repair. Prior to intervention, the surgeon should confirm the presence of salivary fluid in the aspirate by evaluating for amylase ( $>1000$  U/L). This helps to rule out hematoma vs. infection. At this time, the accepted initial treatment of sialocele and cutaneous fistula is conservative management. This includes pressure dressings, repeated aspirations, limited intake by mouth, and the use of antisialagogues to decrease salivary flow. Most studies have shown that most sialoceles and fistulas will resolve within 2 to 3 weeks with this approach.

Secondary repair of the duct is generally difficult because of granulation and scar tissue. This runs the risk for delayed or poor wound healing as well as facial nerve injury. Radiation therapy has been used in the past but has been found to have a high failure rate in ductal injuries. More than 6 weeks is needed for gland atrophy to occur after radiation. There is also the risk of inducing malignancy, which has led to the abandonment of radiation for the treatment of sialoceles and cutaneous fistulas. Antisialagogues primarily have a role as an adjunct therapy to decrease salivary flow. Alone, they have had mixed reviews in the literature and have been found generally ineffective in major salivary duct injuries. Tympanic neurectomy has a high failure rate and does not speed recovery. Internalization of salivary flow could be considered for failures of conservative management. It has lower surgical risk than wound exploration and duct repair.

## REFERENCES:

1. Lewis G, Knottenbelt JD. Parotid duct injury: is immediate surgical repair necessary? *Injury*. 1991 Sep;22(5):407-409.
2. Betts NJ, Cotrell KR. Diagnosis and Management of Traumatic Salivary Gland Injuries. In: Fonseca RJ, Walker RV, Betts NJ, et al, eds. *Oral and Maxillofacial Trauma*. Vol 2. Philadelphia: Elsevier-Saunders; 2005:873-875.

115. Which of the following surgeries addresses the most common anatomic site of obstruction in patients with obstructive sleep apnea?
- A) Bilateral sagittal split osteotomy
  - B) Geniohyoid advancement
  - C) Septoplasty
  - D) Tracheostomy
  - E) Uvulopalatopharyngoplasty

The correct response is Option E.

The answer is uvulopalatopharyngoplasty (UP3). The mainstay of UP3 surgery is to remove the uvula and lateral oropharyngeal tissues. The most common site of obstruction in obstructive sleep apnea (OSA) patients is the retropalatal area, including the lateral pharyngeal walls. This latter anatomic area is even more important if the patient has never had a tonsillectomy; in this case, the tonsils are removed in continuity with UP3. UP3 generally decreases the various indexes documented during a sleep study, such as the apnea-hypopnea index, by about 50%. Thus, those at the border of severe and moderate sleep apnea can see their reported indexes go to a level that can be managed by lifestyle changes without the need for a continuous positive airway pressure (CPAP) machine. On the other hand, in patients with very high indexes, these procedures merely make the disease less severe and may allow for a lower setting on the CPAP machine. Although the CPAP machine which applies positive pressure transnasally to patients can “cure” OSA, their compliance rates are low.

There are other procedures that can help with OSA, such as a septoplasty or those that deal with the tongue base (e.g., geniohyoid advancement), but neither directly treats the most common site of obstruction. A tracheostomy is a curative treatment for OSA, but it completely bypasses all of the obstructive points without addressing them. A tracheostomy has much morbidity, including a measurable mortality rate, and is reserved for life-threatening cases of OSA. A sagittal split operation of the mandible is used for occlusion, not OSA.

## REFERENCES:

1. Vroegop AV, Vanderveken OM, Boudewyns AN, et al. Drug-induced sleep endoscopy in sleep-disordered breathing: report on 1,249 cases. *Laryngoscope*. 2014 Mar;124(3):797-802. Epub 2013 Dec 11.
2. Koo SK, Choi JW, Myung NS, et al. Analysis of obstruction site in obstructive sleep apnea syndrome patients by drug induced sleep endoscopy. *Am J Otolaryngol*. 2013 Nov-Dec;34(6):626-630. Epub 2013 Sep 5.
3. Xiong YP, Yi HL, Yin SK, et al. Predictors of surgical outcomes of uvulopalatopharyngoplasty for obstructive sleep apnea hypopnea syndrome. *Otolaryngol Head Neck Surg*. 2011 Dec;145(6):1049-1054. Epub 2011 Sep 7.



116. A 55-year-old man is evaluated because of right-sided jaw pain, speech problems, and oral dysphagia 5 years after successfully completing a chemoradiation protocol for base-of-tongue cancer. CT imaging shows no signs of recurrence or distant metastatic disease. A panoramic x-ray study (Panorex) is shown. Which of the following is the most appropriate management of this constellation of symptoms?

- A) Debridement of mandible
- B) Hyperbaric oxygen therapy
- C) Open reduction and internal fixation
- D) Osteocutaneous fibular free tissue transfer
- E) Rib graft

The correct response is Option D.



It is important to note that any patient experiencing pain like this should be worked up for recurrent disease. Nevertheless, this question addresses two issues in head and neck reconstruction. First, most non-oral cavity head and neck cancers are now treated primarily with chemoradiation protocols. This leaves surgery for salvage or for dealing with the morbidities of the therapy. In this case, the patient is now experiencing bilateral osteoradionecrosis with a pathologic fracture on the right. Had

this problem stopped with the left side, debridement and letting the mandible sway to the ipsilateral side would be a form of management, although it can be disfiguring.

Secondly, from a reconstructive standpoint, this is a challenging case; but advances in flaps and preoperative modeling allow for managing such situations in one procedure. Given how long the fibular free flap can be fashioned and the ability to remove large central pieces of bone, surgeons can create two osseous segments vascularized off the same pedicle. Since many of these patients have difficult necks from a recipient vessel standpoint, decreasing the number of needed anastomoses is beneficial. Two free flaps can be performed at the same time or sequentially, but this adds increasing morbidity and complexity to the situation. In this case, a single fibular free flap with plates designed using stereolithographic modeling was adequate to restore the patient's ability to eat and articulate. It also improved his occlusion, and, with debridement, stopped his pain. Postreconstructive imaging is shown.

Now that the right side is involved, simple debridement only would leave the patient potentially an oral cripple. By definition, the bone is of poor quality and simple open reduction and internal fixation will not restore the patient's function or promote proper healing. Hyperbaric oxygen is used for osteoradionecrosis, but numerous studies now question its benefit in craniofacial bone, and it would not address the pathologic fracture on the right. Hyperbaric oxygen was shown to positively influence the osteoradionecrotic tissues prior to and post-free tissue reconstruction. Finally, a free bone graft in this situation, even with additional soft tissue coverage, would not address the major issue of hypoperfusion to the affected bone.

## REFERENCES:

1. Chopra K, Folstein MK, Manson PN, et al. Complex craniofacial reconstruction using stereolithographic modeling. *Ann Plast Surg.* 2014 Jan;72(1):59-63.
2. Jacobson AS, Buchbinder D, Urken ML. Reconstruction of bilateral osteoradionecrosis of the mandible using a single fibular free flap. *Laryngoscope.* 2010 Feb;120(2):273-275.
3. Ang E, Black C, Irish J, et al. Reconstructive options in the treatment of osteoradionecrosis of the craniomaxillofacial skeleton. *Br J Plast Surg.* 2003 Mar;56(2):92-9.

117. A 10-year-old boy who previously underwent palatoplasty for cleft palate is evaluated because of velopharyngeal insufficiency associated with minimal palatal elevation and coronal closure pattern. The most appropriate procedure to treat this patient targets which of the following muscles?

- A) Hyoglossus
- B) Levator veli palatini
- C) Palatopharyngeus
- D) Pharyngeal constrictor
- E) Stylohyoid

The correct response is Option C.

The palatopharyngeus muscle is one of the two structures (arches) that surround the oropharyngeal tonsils. Its action is to pull the pharynx upward during swallow to help separate the oropharynx from the nasopharynx. A sphincter pharyngoplasty transposes bilaterally the palatopharyngeal muscles to create an even greater barrier from the oropharynx to the nasopharynx to decrease velopharyngeal insufficiency (VPI).

The hyoglossus muscle is an extrinsic tongue muscle and, like the stylohyoid muscle, has one of its attachments to the hyoid bone. Neither of these muscles is commonly used to treat VPI. The levator veli palatini is an important muscle to mobilize in primary hard palate reconstruction in cleft cases, but not in secondary situations where the muscle is not functional. The pharyngeal constrictors are used in pharyngeal flaps and are primarily employed in secondary situations with a sagittal closure pattern.

## REFERENCES:

1. Collins J, Cheung K, Farrokhyar F, et al. Pharyngeal flap versus sphincter pharyngoplasty for the treatment of velopharyngeal insufficiency: a meta-analysis. *J Plast Reconstr Aesthet Surg*. 2012 Jul;65(7):864-868. Epub 2012 Mar 28.
2. Gart MS, Gosain AK. Surgical management of velopharyngeal insufficiency. *Clin Plast Surg*. 2014 Apr;41(2):253-270.

118. A 6-year-old girl with 22q11.2 deletion syndrome is brought to the office by her parents. The parents report trouble understanding the child when she speaks. An incompetent velopharyngeal port is suspected. Which of the following is the most likely indication of this malfunction?

- A) Consonant omission
- B) Glottal stop
- C) Hyponasality
- D) Nasal air emission
- E) Sibilant lateralization

The correct response is Option D.

Nasal air emission, along with hypernasality and facial grimacing, are all findings that are commonly observed in patients with an incompetent velopharyngeal port or velopharyngeal dysfunction (VPD). Consonant omissions and glottal stops are two common pathologic compensatory speech patterns that such patients exhibit but are not directly caused by VPD. Instead, they are maladaptive compensatory speech patterns often present in patients with VPD. Although some patients with VPD can have hyponasality or sibilant lateralization, these are unrelated to VPD or an attempt to compensate for VPD.

## REFERENCES:

1. Fisher DM, Sommerlad BC. Cleft lip, cleft palate, and velopharyngeal insufficiency. *Plast Reconstr Surg*. 2011 Oct;128(4):342e-360e.
2. Dudas JR, Deleyiannis FW, Ford MD, et al. Diagnosis and treatment of velopharyngeal insufficiency: clinical utility of speech evaluation and videofluoroscopy. *Ann Plast Surg*. 2006 May;56(5):511-517.

119. A 16-year-old boy is evaluated for multiple fractures to the mandible after crashing his ATV into a tree. Which of the following modalities best takes advantage of load-bearing osteosynthesis in the management of this patient's fractures?
- A) Bicortical border plate for a mandibular parasymphiseal fracture
  - B) Champy plate fixation for a mandibular angle fracture
  - C) Lag screw fixation for a displaced fracture of the mandibular symphysis
  - D) Locking reconstruction plate for a comminuted mandibular body fracture
  - E) Maxillomandibular fixation for a minimally displaced mandibular subcondylar fracture

The correct response is Option D.

Load-bearing osteosynthesis differs from load-sharing osteosynthesis in that the fracture plate assumes all of the load of the given bone rather than distributing the load among the plate and the bone. Examples of load-sharing osteosynthesis include lag screw fixation, maxillomandibular fixation, nonlocking mandibular border plate, and monocortical miniplate (Champy principle) fixation. An example of load-bearing fixation is a mandibular locking reconstruction plate for a comminuted fracture.

## REFERENCES:

1. Champy M, Loddé JP, Schmitt R, et al. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. *J Maxillofac Surg*. 1978 Feb;6(1):14-21.
2. Ellis E. Selection of internal fixation devices for mandibular fractures: How much fixation is enough? *Semin Plastic Surg*. 2002;16:229-240.
3. Ellis E 3rd, Graham J. Use of a 2.0-mm locking plate/screw system for mandibular fracture surgery. *J Oral Maxillofac Surg*. 2002 Jun;60(6):642-645.
4. Madsen MJ, McDaniel CA, Haug RH. A biomechanical evaluation of plating techniques used for reconstructing mandibular symphysis/parasymphysis fractures. *J Oral Maxillofac Surg*. 2008 Oct;66(10):2012-2019.
5. Rudderman RH, Mullen RL, Phillips JH. The biophysics of mandibular fractures: an evolution toward understanding. *Plast Reconstr Surg*. 2008 Feb;121(2):596-607.

120. A 17-year-old boy is evaluated for Le Fort I advancement and lengthening procedure. Medical history shows repair of bilateral cleft lip and palate in infancy. Postoperatively, which of the following facial changes is most likely in this patient?
- A) Decreased nasolabial angle
  - B) Decreased tooth show in repose
  - C) Increased alar base
  - D) Increased depth of nasolabial folds
  - E) Increased length of upper lip

The correct response is Option C.

Le Fort I advancement and lengthening can result in dramatic changes to facial appearance. These include increased midfacial projection and fullness, increased upper lip vermilion fullness, decreased upper lip height, decreased depth of the nasolabial folds, and increased tooth show in repose and smile. Additionally, as the bony platform of the caudal piriform region is advanced, the alar base widens, and the tip rotates cephalad, increasing the nasolabial angle. It is important to counsel patients on this expected outcome preoperatively so that they are fully informed of the facial changes they will experience.

## REFERENCES:

1. Honrado CP, Lee S, Bloomquist DS, et al. Quantitative assessment of nasal changes after maxillomandibular surgery using a 3-dimensional digital imaging system. *Arch Facial Plast Surg*. 2006 Jan-Feb;8(1):26-35.
2. McCance AM, Moss JP, Wright WR, et al. A three-dimensional soft tissue analysis of 16 skeletal class III patients following bimaxillary surgery. *Br J Oral Maxillofac Surg*. 1992 Aug;30(4):221-232.
3. Dann JJ 3rd, Fonseca RJ, Bell WH. Soft tissue changes associated with total maxillary advancement: a preliminary study. *J Oral Surg*. 1976 Jan;34(1):19-23.

121. A 14-year-old girl is evaluated for a dog bite injury to the left nasal alar rim that she sustained 6 months ago. Physical examination shows full-thickness loss of the left alar and soft triangle subunits of her nose. Which of the following treatment options best addresses all missing components?
- A) Composite helical root graft
  - B) Conchal cartilage graft and bilobed flap for coverage
  - C) Forehead flap and skin graft for lining with septal cartilage graft
  - D) Forehead flap with nasolabial flap for lining
  - E) Nasolabial flap with full-thickness skin graft for lining

The correct response is Option C.

Full-thickness nasal alar defects must be reconstructed with all missing lamellae including lining, support, and coverage in addition to all subunits that are missing. Although many reconstructive options exist, each with their respective benefits and drawbacks, only those options which provide lining, support, and coverage will successfully address the defect in question. Of the options listed, only a forehead flap and skin graft for lining with septal cartilage reconstructs all missing lamellae. Although a composite helical root graft comprises all three nasal lamellae, it is not big enough to address both the alar and the soft triangle nasal subunits.

## REFERENCES:

1. Menick FJ. Practical details of nasal reconstruction. *Plast Reconstr Surg.* 2013 Apr;131(4):613e-630e.
2. Menick FJ. The evolution of lining in nasal reconstruction. *Clin Plast Surg.* 2009 Jul;36(3):421-441.
3. Konofaos P, Alvarez S, McKinnie JE, et al. Nasal Reconstruction: A Simplified Approach Based on 419 Operated Cases. *Aesthetic Plast Surg.* 2014 Nov 21. [Epub ahead of print]

122. A 45-year-old woman with a history of metastatic breast cancer previously treated with zoledronate is evaluated because of an area of exposed necrotic mandibular bone measuring  $1 \times 1$  cm. She has no pain, and there is no clinical evidence of infection. Panoramic x-ray study (Panorex) shows no evidence of fracture. Which of the following is the most appropriate next step in management?
- A) Aggressive debridement and prophylactic titanium plate placement
  - B) Antiseptic mouth rinses and observation
  - C) Dental extraction and intravenous antibiotics
  - D) Segmental mandibulectomy and osteocutaneous free flap reconstruction
  - E) Superficial debridement and oral antibiotics

The correct response is Option B.

This patient has osteonecrosis of the jaw secondary to bisphosphonate medication used to treat her bony cancer metastases. The mandible is more commonly affected than the maxilla. The appropriate next step in management is to begin antiseptic mouth rinses in addition to stressing good dental hygiene. Asymptomatic bone exposure can be followed for progression, and early cases appear to often resolve spontaneously when the bisphosphonates are discontinued.

Ruggiero et al. proposed a three-stage classification system and treatment algorithm for bisphosphonate-related osteonecrosis of the jaw based on clinical features. In Stage 1, there is exposed and necrotic bone that is otherwise asymptomatic, as in the patient described above. In Stage 2, there is exposed and necrotic bone with pain and clinical evidence of infection. Antiseptic mouth rinses, oral antibiotics, and superficial debridement are recommended for this stage. Stage 3 includes all the features of Stage 2 and one or more of the following: pathologic fracture, extraoral fistula, and osteolysis extending to the inferior mandibular border. Stage 3 patients require surgical debridement or resection in addition to antiseptic mouth rinses and oral antibiotics. Dental extraction of infected, unsalvageable teeth should be performed, but extractions may also result in further nonhealing wounds and bone exposure. Segmental mandibulectomy is usually followed by immediate reconstruction with osseous or osteocutaneous free flap reconstruction. The role for prophylactic titanium plating of the jaws to prevent pathologic fracture has not been studied.

## REFERENCES:

1. Ruggiero SL, Mehrotra B, Rosenberg TG, et al. Osteonecrosis of the jaws associated with the use of bisphosphonates: a review of 63 cases. *J Oral Maxillofac Surg* 2004 May;62(5):527-534.
2. Chiu CT, Chiang WF, Chuang CY, et al. Resolution of oral bisphosphonate and steroid-related osteonecrosis of the jaw--a serial case analysis. *J Oral Maxillofac Surg*. 2010 May;68(5):1055-1063.
3. Hanasono MM, Militsakh ON, Richmon JD, et al. Mandibulectomy and free flap reconstruction for bisphosphonate-related osteonecrosis of the jaws. *JAMA Otolaryngol Head Neck Surg*. 2013 Nov;139(11):1135-1142.

123. A 3-month-old female infant is brought to the office for evaluation of head shape. Examination shows brachycephaly and abnormal orbits. Genetic testing is negative for fibroblast growth factor receptor (FGFR) mutation. Which of the following is the most likely diagnosis?
- A) Antley-Bixler syndrome
  - B) Apert syndrome
  - C) Crouzon syndrome
  - D) Pfeiffer syndrome
  - E) Saethre-Chotzen syndrome

The correct response is Option E.

Only Saethre-Chotzen syndrome is not associated with a fibroblast growth factor receptor (FGFR) mutation, but it is instead associated with a mutation of the *TWIST* gene. It is characterized by brachycephaly with maxillary hypoplasia, a prominent ear crus, and syndactyly. Pfeiffer syndrome (characterized by brachycephaly, mild syndactyly, and broad toes and thumbs) is associated with mutations of both *FGFR1* and *FGFR2*. Apert syndrome (characterized by brachycephaly, syndactyly, and cognitive delay) is autosomal dominant and associated with mutations of *FGFR2*. Crouzon syndrome is also autosomal dominant and characterized by shallow orbits, craniosynostosis, and maxillary hypoplasia. Antley-Bixler syndrome has four phenotypes, some of which are associated with FGFR mutations and characterized by craniosynostosis, choanal atresia, and radiohumeral synostosis.

## REFERENCES:

1. Ciurea AV, Toader C. Genetics of craniosynostosis: review of the literature. *J Med Life*. 2009 Jan-Mar;2(1):5-17.
2. Kress W, Schropp C, Lieb G, et al. Saethre-Chotzen syndrome caused by TWIST 1 gene mutations: functional differentiation from Muenke coronal synostosis syndrome. *Eur J Hum Genet*. 2006 Jan;14(1):39-48.
3. Chun K, Teebi AS, Jung JH, et al. Genetic analysis of patients with the Saethre-Chotzen phenotype. *Am J Med Genet*. 2002 Jun 15;110(2):136-143.

124. A 50-year-old man with a long-term history of sun exposure is evaluated because of a 2.5-cm biopsy-proven squamous cell carcinoma of the central lower lip. Physical examination shows no enlarged cervical lymph nodes. Which of the following is the most appropriate treatment for this cancer?
- A) Combined surgery and radiation
  - B) Curettage and electrodesiccation
  - C) Photodynamic therapy
  - D) Surgical excision
  - E) Treatment with 5-fluorouracil for 3 months

The correct response is Option D.

Oral cavity cancers are staged based on the following criteria set forth by the American Joint Committee on Cancer (AJCC):

Primary tumor staging for oral cavity cancers (T)

- TX Primary tumor cannot be assessed
- T0 No evidence of primary tumor
- Tis Carcinoma in situ
- T1 Tumor = 2 cm in greatest dimension
- T2 Tumor > 2 cm but not more than 4 cm in greatest dimension
- T3 Tumor > 4 cm in greatest dimension
- T4a Moderately advanced, local disease
  - Lip – Tumor invades through cortical bone, inferior alveolar nerve, floor of mouth, or skin of face
  - Oral cavity – Tumor invades adjacent structures (e.g., through cortical bone, into deep extrinsic muscle of the tongue, maxillary sinus, or skin of face)
- T4b Very advanced, local disease
  - Tumor invades masticator space, pterygoid plates, or skull base and/or encases internal carotid artery

The cancer described in the scenario is a stage T2N0M0 cancer of the lip. Surgical excision with margin control is the most appropriate and probably the most common treatment for this lesion, although Mohs micrographic surgery may also be an option for surgical removal. Reconstruction would be performed after attaining adequate

surgical margins and can be performed utilizing local tissue flaps in most patients.

5-Fluorouracil cream can be used in the treatment of actinic keratosis and superficial basal cell cancers. It is also used in the treatment of some squamous cell cancers, but its efficacy is lower and would not be indicated for a T2 cancer. In curettage and electrodesiccation, small tumors are scraped off with a curette and electrocautery destroys residual tumor and controls bleeding. It is used for superficial squamous cell cancers without high-risk characteristics in noncosmetically sensitive sites and would not be appropriate for this lesion. Also, surgical margins cannot be evaluated with this technique. Photodynamic therapy involves application of a photosensitizing agent, such as 5-aminolevulinic acid (5-ALA), that is taken up by the cancer cells. The next day, the medicated areas are activated by a strong light. The treatment selectively destroys cancer cells while causing minimal damage to the surrounding tissue. It is used to treat actinic keratosis and is not approved by the Food and Drug Administration for treatment of squamous cell carcinoma, although experience suggests that it is effective for small, superficial cancers. Radiation therapy alone can be used in cosmetically and functionally important sites such as the lip or in patients who are poor candidates for surgery because of medial comorbidities. Given the good functional and cosmetic prognosis of surgical resection and reconstruction in this patient, irradiation would likely be reserved for a recurrent cancer. Combined surgery and irradiation is usually reserved for T4-stage cancers or those with nodal metastases.

## REFERENCES:

1. Patel SG, Shah JP. TNM staging of cancers of the head and neck: striving for uniformity among diversity. *CA Cancer J Clin*. 2005 Jul-Aug;55(4):242-258.
2. Lai SY, Weber RS. High-risk non-melanoma skin cancer of the head and neck. *Curr Oncol Rep*. 2005 Mar;7(2):154-158.
3. Ruldolph R, Zelac DE. Squamous cell carcinoma of the skin. *Plast Reconstr Surg*. 2004 Nov;114(5):82e-94e.

125. A 3-month-old male infant is brought to the office by his parents for evaluation of skull asymmetry that has worsened since birth. Birth history includes prolonged labor that required cesarean delivery. Physical examination shows flattening of the right posterior occiput with ipsilateral forehead bossing. From a superior view, the right ear is 1 cm more anterior than the left ear, and the anterior fontanelle is open without any bulging. The child's head tilts to the right and has decreased range of motion when looking to the left. The left side of his neck feels tighter and more rigid compared with the right side. Which of the following is the most appropriate initial management of this child?
- A) Cerebral palsy evaluation
  - B) Occupational therapy of the neck
  - C) Posterior cranial vault expansion
  - D) Passive molding helmet therapy
  - E) Sternocleidomastoid muscle release

The correct response is Option B.

This child demonstrates the classic presentation of deformation plagiocephaly with his posterior occiput flattening and compensatory ipsilateral forehead bossing with anterior shifting of his ear on the same side. There are many reasons for deformational plagiocephaly, especially with the current practice of "back to sleep." Treatment of this focuses on removing the pressure on the affected side. His head tilt and decreased motion are consistent with torticollis. Initial treatment is stretching and occupational therapy to restore usage and balance of his neck muscles. Although helmet therapy can help alleviate pressure on this side, it is not addressing the issue. Further studies have demonstrated that deformational plagiocephaly can be treated with positional changes and behavior modification up until 7 to 8 months of age without difference in head asymmetry compared with those children who began helmet therapy at a younger age. There is no difference in children who fail positional changes compared with those who initiate helmet therapy immediately. At this child's age of 3 months and with obvious torticollis, the most appropriate initial therapy should be focused on resolving his torticollis and giving him a trial of non-helmet therapy.

## REFERENCES:

1. van Wijk RM, van Vlimmeren LA, Groothuis-Oudshoorn CG, et al. Helmet therapy in infants with positional skull deformation: randomised controlled trial. *BMJ*. 2014 May 1;348:g2741.
2. Steinberg JP, Rawlani R, Humphries LS, et al. Effectiveness of conservative and helmet therapy for positional cranial reformation. *Plast Reconstr Surg*. 2014 Nov 20. [Epub ahead of print]

126. A 58-year-old man is evaluated because of floor-of-mouth cancer that is invading the mandible. A segmental mandibulectomy and reconstruction with an osteocutaneous free flap that includes bone from the lateral border of the scapula are planned. The vascular pedicle supplying this flap is based on which of the following arteries?

- A) Circumflex scapular
- B) Dorsal scapular
- C) Lateral thoracic
- D) Thoracoacromial
- E) Transverse cervical

The correct response is Option A.

The circumflex scapular artery, which is a branch of the subscapular artery, supplies blood to the lateral and medial borders of the scapular bone. The scapula free flap was first described in 1978 by Saijo. It can be harvested as part of a chimeric flap that includes other tissues supplied by the subscapular arterial system, such as the latissimus dorsi muscle, serratus anterior muscle, and scapular or parascapular skin. The tip of the scapula receives its blood supply from the angular branch of the thoracodorsal artery and has also been utilized as a pedicle for the inferior portion of the scapula. While the scapular bone is not as thick as the fibula bone, it provides adequate stability for mandibular reconstruction. Cutaneous branches of the circumflex scapular artery supply the scapular and parascapular skin and, therefore, a skin flap can be harvested simultaneously to close soft-tissue defects.

The transverse cervical artery and the dorsal scapular artery primarily supply the trapezius muscle and overlying skin. The thoracoacromial artery supplies the pectoralis major muscle and overlying skin. The lateral thoracic artery supplies both the lateral portion of the pectoralis major muscle and the skin in the axillary region.

## REFERENCES:

1. Saijo M. The vascular territories of the dorsal trunk: a reappraisal for potential flap donor sites. *Br J Plast Surg*. 1978 Jul;31(3):200-204.
2. Hanasono MM, Skoracki RJ. The scapular tip osseous free flap as an alternative for anterior mandibular reconstruction. *Plast Reconstr Surg*. 2010 Apr;125(4):164e-166e.

3. Hasan Z, Gore SM, Ch'ng S, et al. Options for configuring the scapular free flap in maxillary, mandibular, and calvarial reconstruction. *Plast Reconstr Surg*. 2013 Sep;132(3):645-655.

127. A 3-year-old girl with craniofrontonasal dysplasia presents to the craniofacial team because of moderate exorbitism, severe central sleep apnea, and severe hypertelorism (interocular distance of 40 mm). Which of the following is the most appropriate management plan for this patient?
- A) Continuous positive airway pressure until 6 or 8 years of age
  - B) Facial bipartition surgery within the next year
  - C) Immediate tracheostomy and assisted ventilation
  - D) Monobloc advancement surgery within the next year
  - E) Orbital box osteotomy surgery within the next year

The correct response is Option C.

Tracheostomy and assisted ventilation is the most appropriate management. The patient described demonstrates a significant number of central and mixed apneas, indicating that the initiation of breathing by central drive is diminished and that tracheostomy with assisted ventilation set at a base ventilation rate, such as synchronized intermittent mandatory ventilation (SIMV), would be optimal to ensure adequate minute ventilation.

Continuous positive airway pressure (CPAP) until 6 to 8 years of age and then a facial advancement is incorrect. CPAP will assist with obstructive apnea, but will not treat central apnea because no baseline ventilation rate is set using CPAP mode.

Hypertelorism surgery within the next year is incorrect because hypertelorism surgery will not treat sleep apnea without facial advancement. Only the wide orbit position would be treated with an orbital box osteotomy or facial bipartition without advancement.

Facial advancement surgery within the next year is incorrect because advancement will correct the obstructive apnea and a portion of the mixed apneas, but will not address the central sleep apnea. Observation with tracheotomy and assisted ventilation will be more prudent until the central apnea rate improves, usually after time with maturation. The patient described will still have persistent central apnea and is at higher risk for relapse of the face due to the age of under 6 years.

## REFERENCES:

1. Driessen C, Joosten KF, Bannink N, et al. How does obstructive sleep apnoea evolve in syndromic craniosynostosis? A prospective cohort study. *Arch Dis Child*. 2013 Jul;98(7):538-543. Epub 2013 May 23.
2. Zandieh SO, Padwa BL, Katz ES. Adenotonsillectomy for obstructive sleep apnea in children with syndromic craniosynostosis. *Plast Reconstr Surg*. 2013 Apr;131(4):847-852.

128. Which of the following arteries is most likely to be injured in a patient undergoing Le Fort I osteotomy?

- A) Descending palatine
- B) External carotid
- C) Greater palatine
- D) Internal carotid
- E) Internal maxillary

The correct response is Option A.

Descending palatine artery is the correct response since it is at greatest risk after pterygoid osteotomy and down fracture. It is easily visible after down fracture and mobilization of the Le Fort I segment. It is typically injured during osteotomy prior to its division into the greater and lesser palatine arteries.

External carotid artery is incorrect because it is within the neck. Its branches ascend in the face and end in the sphenopalatine artery as it enters the pterygoid foramen.

Internal maxillary artery is incorrect because it is the larger artery prior to division into multiple smaller branches including the middle meningeal, sphenopalatine, and descending palatine arteries.

Greater palatine artery is incorrect because the greater and lesser palatine arteries are below the level of the pterygoid osteotomy. The descending palatine is more proximal and is at greater risk for injury.

## REFERENCES:

1. Li KK, Meara JG, Alexander A Jr. Location of the descending palatine artery in relation to the LeFort I osteotomy. *J Oral Maxillofac Surg.* 1996 Jul;54(7):822-825.
2. Dodson TB, Bays RA, Neuenschwander MC. Maxillary perfusion during LeFort I osteotomy after ligation of the descending palatine artery. *J Oral Maxillofac Surg.* 1997 Jan;55(1):51-55.

129. In a patient undergoing orthognathic surgery with preoperative class III malocclusion, which of the following anatomic relationships must be retained in order to optimize postoperative occlusion?
- A) Centric relation and centric occlusion
  - B) Condylar seating
  - C) Maximal intercuspation
  - D) 2 mm of overbite
  - E) 2 mm of overbite and 2 mm of overjet

The correct response is Option A.

Centric occlusion is incorrect because centric occlusion (maximal intercuspation) without centric relation (condylar seating within the glenoid fossa) will not lead to reliable postoperative occlusion.

Maxillary occlusion plane angle is incorrect because the maxillary plane angle affects open bite tendency and is not a reliable measure of occlusion.

Gonial angle is incorrect because the gonial angle along with the mandible occlusal plane are better predictors of prognathism and open bite tendency and are not a reliable measure of occlusion.

Centric relation is incorrect because centric relation without centric occlusion will not lead to reliable postoperative occlusion.

Centric occlusion and centric relation is the correct response because maximal intercuspation (centric occlusion) coupled with proper mandible condylar position within the glenoid fossa (centric relation) is most likely to result in optimal occlusion after orthognathic surgery.

## REFERENCES:

1. Polley JW, Figueroa AA. Orthognathic positioning system: intraoperative system to transfer virtual surgical plan to operating field during orthognathic surgery. *J Oral Maxillofac Surg*. 2013 May;71(5):911-920. Epub 2013 Jan 10.

2. Borba AM, Ribeiro-Junior O, Brozoski MA, et al. Accuracy of perioperative mandibular positions in orthognathic surgery. *Int J Oral Maxillofac Surg*. 2014 Aug;43(8):972-979. Epub 2014 May 28.

130. In the pediatric population, which of the following mandibular fracture patterns most commonly results in future growth complications?
- A) Displaced bilateral parasymphiseal fractures
  - B) Displaced mandibular body fractures
  - C) Nondisplaced bilateral condylar fractures
  - D) Nondisplaced bilateral parasymphiseal fractures
  - E) Nondisplaced mandibular symphyseal fractures

The correct response is Option C.

Nondisplaced mandibular symphyseal fracture is incorrect as the mandible growth centers are located in the condyle and posterior aspect of the ascending ramus of the mandible.

Displaced bilateral parasymphiseal fractures is incorrect.

Nondisplaced bilateral condyle fractures is correct because the growth centers are located in the mandible condyle regions and a significant amount of trauma resulting in displaced factors of the condyles has occurred.

Displaced mandible body fractures is incorrect.

## REFERENCES:

1. Morrow BT, Samson TD, Schubert W, et al. Evidence-based medicine: Mandible fractures. *Plast Reconstr Surg*. 2014 Dec;134(6):1381-1390.
2. Ferreira PC, Barbosa J, Braga JM, et al. Pediatric Facial Fractures: A Review of 2071 Fractures. *Ann Plast Surg*. 2014 Sep 30. [Epub ahead of print]

131. A 40-year-old man is evaluated for orbital fractures from a direct blow to the right eye. A swinging flashlight test is performed to evaluate a suspected afferent pupillary defect. Which of the following is the most appropriate description of this procedure?
- A) The flashlight shone into the left eye causes both eyes to constrict; then when the light is shone in the right eye, the right eye constricts but the left eye does not
  - B) The flashlight shone into the left eye causes consensual constriction, and then both eyes dilate when the light is shone in the right eye
  - C) The flashlight shone into the left eye causes consensual constriction; then when the light is shone in the right eye, the right eye dilates while the left eye constricts
  - D) The flashlight shone into the left eye causes consensual dilation followed by paradoxical constriction when swung to the right eye
  - E) The flashlight shone into the left eye causes the left eye to constrict while the right eye remains dilated; both eyes are constricted when the light is shone in the right eye

The correct response is Option B.

A relative afferent pupillary defect, or Marcus Gunn pupil, results from an optic nerve dysfunction. The physical examination maneuver used to evaluate the optic nerve for a relative afferent pupillary defect is the swinging flashlight test described above. The most common cause of Marcus Gunn pupil is a lesion on the optic nerve, optic neuritis, or severe retinal disease but can also be caused by trauma. The normal response to light in one eye is constriction of both pupils and when the light is taken away both eyes dilate (consensual light reflex). In an abnormal exam the normal eye/optic nerve will cause a normal constriction of both pupils but the light shone in the affected eye will not have normal light perception (minimal pupillary constriction). The afferent pathway refers to the nerve impulse sent from the pupil to the brain via the optic nerve of one eye. The efferent pathway is the impulse sent back to both pupils via CN III and ciliary ganglia, causing both pupils to constrict.

## REFERENCES:

1. Soparkar CN, Patrinely JR. The eye examination in facial trauma for the plastic surgeon. *Plast Reconstr Surg*. 2007 Dec;120(7 Suppl 2):49S-56S.

2. Neuhaus RW, Shore JW, Shepler TR, et al. Blindness after reduction of facial fractures. *Plast Reconstr Surg.* 1999 Sep;104(3):875-876

132. A 30-month-old female infant is evaluated for unilateral complete cleft lip and palate. She was adopted from China, where her lip was previously repaired. Her parents are concerned about her palate, which has not been repaired, and the appearance of her lip and nose. Which of the following is the most appropriate next step in management?
- A) Repair the palate and perform a rhinoplasty
  - B) Repair the palate first and revise the lip at a later time
  - C) Revise the lip and repair the palate simultaneously with a gingivoperiosteoplasty
  - D) Revise the lip now and repair the palate at a later time
  - E) Wait one year until more English vocabulary is acquired, and then undergo speech evaluation before palate repair

The correct response is Option B.

The child has already had a lip repair and although she may require revision in the future, the primary goal at this age is palate repair. A repair after age 18 months is considered a late palate repair. The literature supports that late palate repairs have worse speech outcomes. Additionally, internationally adopted children with late palate repairs have higher fistula rates, more hypernasality and velopharyngeal insufficiency, and are more likely to require speech surgery.

## REFERENCES:

1. Goldstein JA, Brown BJ, Mason P, et al. Cleft care in international adoption. *Plast Reconstr Surg*. 2014 Dec;134(6):1279-1284.
2. Sullivan SR, Jung YS, Mulliken JB. Outcomes of cleft palatal repair for internationally adopted children. *Plast Reconstr Surg*. 2014 Jun;133(6):1445-1452.
3. Swanson JW, Smartt JM Jr, Saltzman BS, et al. Adopted children with cleft lip and/or palate: a unique and growing population. *Plast Reconstr Surg*. 2014 Aug;134(2):283e-293e.

133. After schwannoma resection with facial nerve sacrifice, which of the following reconstructions provides the quickest restoration of natural reflexive dynamic blink?
- A) Cross-facial nerve grafting
  - B) Functional muscle transfer
  - C) Gold weight insertion
  - D) Ipsilateral nerve grafting
  - E) Nerve transposition

The correct response is Option E.

All of the choices are suitable options for reanimation of the eyelid; however, transfer of a regional nerve, such as the motor nerve to the masseter, will result in the quickest reinnervation of the orbicularis oculi muscle. Nerve grafts may be used to overcome a wide neural gap; however, nerve regeneration proceeds slowly at only 1 mm per day. Cross-facial nerve grafts take an extended period of time to regenerate due to the long distance from the contralateral side. While gold weights are immediately effective, they are static procedures. Restoration of a reflexive blink requires neural input from the zygomatic branch of the facial nerve or direct neurotization of the orbicularis oculi muscle. Functional muscle transfers used for eyelid reanimation include the frontalis and temporalis; however, because they are innervated by nerves other than the facial, coordinated movements are not present.

## REFERENCES:

1. Terzis JK, Anesti K. Facial Paralysis. In: Thorne CH, Chung KC, Gosain AK, et al, eds. *Grabb and Smith's Plastic Surgery*. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2014:399-409.
2. Borschel GH, Kawamura DH, Kasukurthi R, et al. The motor nerve to the masseter muscle: an anatomic and histomorphometric study to facilitate its use in facial reanimation. *J Plast Reconstr Aesthet Surg*. 2012 Mar;65(3):363-366. Epub 2011 Oct 10.

134. A 21-year-old man is evaluated because of pain and double vision 2 weeks after being punched in the face. An orbital fracture is suspected. Which of the following characteristics of an orbital floor fracture is the most common indication for surgical repair?

- A) Concomitant naso-orbito-ethmoid fracture
- B) Contralateral zygomaticomaxillary complex fracture
- C) Herniation of orbital contents with diplopia
- D) Medial wall fracture without additional symptoms
- E) Nondisplacement

The correct response is Option C.

The facial skeleton acts as a buffer and barrier against injury to the brain and deep structures. Reconstruction of the buttress system is integral to reforming the form and function of the facial skeleton.

Zygomaticomaxillary complex (ZMC) fractures, sometimes referred to as tripod fractures, may involve fractures of the following: zygomaticotemporal suture, maxillary sinus, and occasionally sphenoid bone. Correction involves reduction of the fracture, commonly with miniplate fixation or with 2-point wire fixation. These fractures can also involve the orbital floor and maxillary wall.

Symptoms may include numbness in the maxillary nerve (V2 of trigeminal (V) nerve), subconjunctival hemorrhage, diplopia, and enophthalmos. Orbital floor fractures can be isolated, as in a blowout, or involve other structures (e.g., orbital rim, orbital medial/lateral walls, orbital apex). Additional fractures are typically associated with higher-force injury and may require more extensive surgical repair.

Diagnostic study typically includes CT scan of the facial bones to assess the fractures and to delineate the extent of the facial trauma.

There are three main indications to treat isolated orbital fractures:

1. Entrapment of the extraocular muscles: this may cause injury and permanent dysfunction of the globe if not reduced.
2. Prevention of globe malposition: malposition of the globe may occur leading to diplopia or enophthalmos. This may not be apparent immediately after the

injury because of soft-tissue edema. Reduction is indicated if there are signs of early enophthalmos, displacement of more than 50% of the orbital floor, or significant soft-tissue displacement.

3. Lateral orbital wall displacement: when the injury is more severe, the lateral orbital bone (sphenoid bone) may impact the orbital apex or even the mid-cranial fossa.

The CT scan should be examined for muscle entrapment, herniation of orbital contents, and associated fractures (naso-orbito-ethmoid, zygomaticomaxillary, Le Fort). Open reduction and internal fixation can be performed emergently or after edema has subsided, and usually after the orbit has been examined by an ophthalmologist for ocular injury.

Repair of the orbital floor can be done using several different types of materials—alloplastic and autologous. This is usually dictated by the surgeon's preference and the extent of the injury.

## REFERENCES:

1. Fraioli RE, Branstetter BF 4th, Deleyiannis FW. Facial fractures: beyond Le Fort. *Otolaryngol Clin N Am*. 2008 Feb;41(1):51-76.
2. Kellman RM. Maxillofacial Trauma. In: Thomas JR, ed. *Cummings Otolaryngology – Head and Neck Surgery*. Vol 1. Philadelphia: Elsevier-Mosby; 2010:318-341.

135. A 50-year-old man who underwent superficial parotidectomy for a benign tumor 9 months ago comes to the office because of a 6-month history of gustatory sweating. Which of the following nerves carries the parasympathetic postganglionic nerve fibers to the parotid gland in a healthy patient?

- A) Auriculotemporal
- B) External carotid plexus
- C) Facial (VII)
- D) Great auricular
- E) Marginal mandibular

The correct response is Option A.

The preganglionic parasympathetic innervation of the parotid gland originates in the inferior salivatory nucleus located in the brainstem, and travels within the glossopharyngeal nerve. Shortly thereafter, these fibers then travel within the tympanic and lesser petrosal branches to the otic ganglion. Within the otic ganglion, these fibers then synapse with the postganglionic cells, whose axons then travel within the auriculotemporal nerve to reach the parotid gland.

The great auricular nerve is incorrect because there are no preganglionic or postganglionic parasympathetic fibers to the parotid gland carried within the great auricular nerve.

The facial (VII) nerve is incorrect because there are preganglionic parasympathetic nerve fibers that are in close proximity to the facial nerve, and these are carried within the tympanic and lesser petrosal branches of the glossopharyngeal nerve. There are no preganglionic or postganglionic parasympathetic nerve fibers to the parotid gland carried within the facial nerve.

The marginal mandibular nerve is incorrect because there are no preganglionic or postganglionic parasympathetic fibers to the parotid gland carried within the marginal mandibular nerve.

The external carotid nerve plexus is incorrect because this option describes the location of the postganglionic sympathetic nerve fibers to the parotid gland. Sympathetic innervation of the parotid gland originates within the spinal cord, and the preganglionic axons then travel to the superior cervical ganglion, where they

synapse with the postganglionic cells, and then travel along the external carotid arterial plexus to reach the parotid gland.

## REFERENCES:

1. Walvekar RR, Loehn BC, Wilson MN. Anatomy and Physiology of the Salivary Glands. In: Johnson JT, Rosen CA, eds. *Bailey's Head & Neck Surgery: Otolaryngology*. 5th ed. Philadelphia: Lippincott Williams & Wilkins; 2013:691-701.
2. Rustemeyer J, Eufinger H, Bremerich A. The incidence of Frey's syndrome. *J Craniomaxillofac Surg*. 2008 Jan;36(1):34-37. Epub 2007 Nov 19.

136. A 60-year-old man is evaluated for a painful unilateral facial rash with blisters, intense ear pain, and complete ipsilateral facial nerve paralysis. Which of the following is the most likely diagnosis?
- A) Cholesteatoma
  - B) Facial myokymia
  - C) Lyme disease
  - D) Möbius syndrome
  - E) Ramsay Hunt syndrome

The correct response is Option E.

This is a case of Ramsay Hunt syndrome, also known as herpes zoster oticus. It is a variant of typical herpes zoster, in that in its reactivation, it affects both afferent neurons as well as motor axons of the facial nerve. A combination of corticosteroids, narcotics, and acyclovir is the standard of care.

Facial myokymia is mainly associated with multiple sclerosis and causes a wormlike motion in the facial muscles.

Möbius syndrome is a congenital condition characterized by, among other nerve conditions, facial paralysis.

Cholesteatoma is a benign growth in the middle or external ear formed from desquamated keratin. It can act locally and be very aggressive, so much so, that if left untreated, it could cause destruction of the facial nerve.

This is not a typical presentation of Lyme disease.

## REFERENCES:

1. Kosins AM, Hurvitz KA, Evans GR, et al. Facial paralysis for the plastic surgeon. *Can J Plast Surg*. 2007 Summer;15(2):77-82.
2. Kim YH, Chang MY, Jung HH, et al. Prognosis of Ramsay Hunt syndrome presenting as cranial polyneuropathy. *Laryngoscope*. 2010 Nov;120(11):2270-2276.

3. Hohman MH, Hadlock TA. Etiology, diagnosis, and management of facial palsy: 2000 patients at a facial nerve center. *Laryngoscope*. 2013 Nov 27. [Epub ahead of print]



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

137. A 7-year-old girl is evaluated because of the ear anomaly shown. CT scan of the temporal bone of the affected ear shows an absent stapes and incus. Construction using autogenous rib cartilage is planned. The girl's family inquires about options for improving hearing to the affected ear. Which of the following is the most appropriate response?
- A) Atresia repair should be performed after auricular reconstruction
  - B) Atresia repair should be performed before auricular reconstruction
  - C) A bone-anchored hearing aid should be placed after auricular reconstruction
  - D) A bone-anchored hearing aid should be placed before auricular reconstruction
  - E) Hearing cannot be improved in this patient

The correct response is Option C.



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

Staged autogenous cartilage reconstruction remains the gold standard to correct microtia. The urgency and method of treatment for associated hearing loss depends on whether the problem is unilateral or bilateral, whether external ear construction is planned, and the condition of the middle ear structures. Bilateral hearing loss can result in problems with language development and learning and requires early intervention to improve or restore hearing. This is usually done with external hearing aids in early childhood followed by atresia repair or a bone-anchored hearing aid (BAHA) later in life. Historically, most authorities have concluded that patients with congenital unilateral hearing loss naturally adjust and experience few functional implications. Consequently, most do not routinely recommend operative correction for unilateral hearing loss. There are some recent reports of improved language

development after early binaural hearing restoration, and some clinicians now support early treatment. If correction is considered, the two primary options are atresia repair, wherein the canal is opened and the middle ear is reconstructed, or use of a hearing aid. Atresia repair is usually deferred until the external ear framework is placed or the reconstruction is complete. The success depends on the presence and normalcy of the middle ear structures. Jahrsdoerfer's 10-point scoring system (10 being most suitable for reconstruction) grades the anatomic appearance and relationship of the middle ear structures by temporal CT scan. Middle ear reconstruction is contraindicated for a score of 5 or less. Based on the information provided, this patient with anotia (-1 point), absence of the stapes (-2 points) and absence of the incus (-2 points), has a maximum score of 5 and would not be a good candidate for middle ear reconstruction. Certainly, this procedure would not improve hearing as well as a hearing aid such as the BAHA. BAHA uses osseointegrated implants to affix a hearing aid. This provides excellent correction of conductive hearing loss and is widely used. BAHA is the best surgical option to restore hearing in this patient if so desired. However, placement should be deferred until after the autologous ear reconstruction is completed.

## REFERENCES:

1. Lipan MJ, Eshraghi AA. Otologic and audiology aspects of microtia repair. *Semin Plast Surg.* 2011 Nov;25(4):273-278.
2. Bouhabel S, Arcand P, Saliba I. Congenital aural atresia: bone-anchored hearing aid vs. external auditory canal reconstruction. *Int J Pediatr Otorhinolaryngol.* 2012 Feb;76(2):272-277.
3. Cho BC, Lee SH. Surgical results of two-stage reconstruction of the auricle in congenital microtia using an autogenous costal cartilage alone or in combination with canalplasty. *Plast Reconstr Surg.* 2006 Mar;117(3):936-947.

138. A 25-year-old woman is evaluated because of facial swelling around the jaw and loosening teeth. The swelling has worsened progressively. Physical examination shows unilateral right facial swelling around the third molar. CT scan of the mandible shows a radiolucent, multicystic, unilocular lesion in the right mandibular angle and confirmed root resorption. Which of the following series of treatments is most appropriate for this patient?
- A) Local curettage of the lesion followed by cancellous bone graft reconstruction
  - B) Neo-adjuvant radiation therapy, segmental mandibulectomy, and reconstruction
  - C) Segmental mandibulectomy and reconstruction
  - D) Segmental mandibulectomy, reconstruction, and postoperative chemotherapy after adjuvant therapy
  - E) Segmental mandibulectomy, reconstruction, dental rehabilitation, and sentinel node biopsy

The correct response is Option C.

The patient described has an ameloblastoma. Ameloblastomas are benign tumors of odontogenic origin. Treatment is surgical. Conservative management, such as local curettage, is associated with high recurrence rate. The most appropriate treatment is segmental mandibulectomy, reconstruction, and dental rehabilitation. Because ameloblastoma is benign, neither adjuvant therapy nor neoadjuvant therapy is indicated.

## REFERENCES:

1. Ooi A, Feng J, Tan HK, et al. Primary treatment of mandibular ameloblastoma with segmental resection and free fibula reconstruction: Achieving satisfactory outcomes with low implant-prosthetic rehabilitation uptake. *J Plast Reconstr Aesthet Surg*. 2014 Apr;67(4):498-505. Epub 2014 Jan 15.
2. Vayvada H, Mola F, Menderes A, et al. Surgical management of ameloblastoma in the mandible: Segmental mandibulectomy and immediate reconstruction with free fibula or deep circumflex iliac artery flap (evaluation of the long-term esthetic and functional results). *J Oral Maxillofac Surg*. 2006 Oct;64(10):1532-1539.

3. Stoelinga PJ. The management of aggressive cysts of the jaws. *J Maxillofac Oral Surg.* 2012 Mar;11(1):2-12.

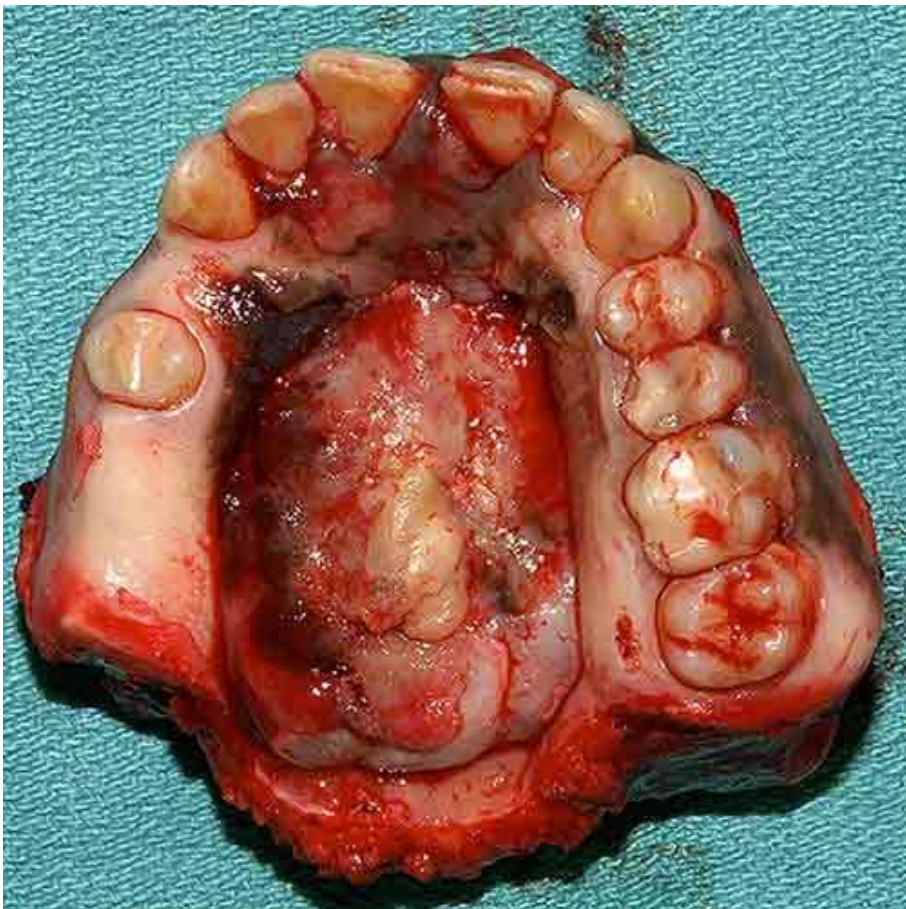
139. Which of the following is the best dental reference to use for determining the timing for secondary alveolar bone grafting in a patient with a unilateral complete cleft lip/palate?
- A) Complete eruption of the central incisor next to the cleft
  - B) Complete eruption of the permanent canine into the cleft
  - C) Crowning of the permanent canine
  - D) Loss of the primary canine adjacent to the cleft
  - E) Loss of the primary ipsilateral central incisor

The correct response is Option C.

Secondary alveolar bone grafting is performed in mixed dentition. The goals of alveolar bone grafting are to stabilize the alveolus and allow adequate bone stock to support tooth health for the permanent canine (if that is the tooth erupting into the cleft). Generally, the timing of bone grafting is done before the canine has fully erupted. If it has fully erupted, the root may be exposed in the cleft and not well surrounded by bone. It is preferable to perform the bone graft after the deciduous teeth are gone, but before the tooth is fully erupted. An appropriate time to perform the bone graft is when the canine is crowning. Early grafting may be detrimental to midface growth. Orthodontic preparation may be required before performing secondary bone grafting, and there must be enough permanent dentition to support this.

## REFERENCES:

1. Freihofer HP, Borstlap WA, Kuijpers-Jagtman AM, et al. Timing and transplant materials for closure of alveolar clefts. A clinical comparison of 296 cases. *J Craniomaxillofac Surg*. 1993 Jun;21(4):143-148.
2. Bajaj AK, Wongworawat AA, Punjabi A. Management of alveolar clefts. *J Craniofac Surg*. 2003 Nov;14(6):840-846.



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

140. A 50-year-old woman with hypertension and diabetes comes to the office because of a large mid-palatal cancer. She undergoes a total palatotomy. A photograph is shown. Which of the following is the most appropriate method of reconstruction?
- A) Anterolateral thigh free flap
  - B) Bilateral temporalis muscle flaps
  - C) Fibula osteocutaneous free flap
  - D) Iliac crest bone grafting
  - E) Rehabilitation with a palatal obturator

The correct response is Option C.

This patient has a bilateral maxillectomy defect following resection via a Le Fort I osteotomy. While small defects can be successfully addressed with prosthetic palatal obturators that fit through the wound margins and clasp to the remaining teeth, larger defects can rarely be obturated because of their weight and instability due to lack of dentition and an alveolar ridge. Bone grafting is also not an option for such a large defect, particularly one resulting from a malignancy where postoperative radiation therapy is likely. In general, bone grafts are only indicated in benign conditions with bone loss less than 5 cm in length. Even when these conditions are met, they require coverage with well-vascularized tissue. Temporalis muscle flaps can be used to reconstruct palatal defects, but in this case, the skeletal elements of the mid face have been removed. Temporalis muscle flaps alone will result in loss of mid face projection. Similarly, the anterolateral thigh free and rectus abdominis myocutaneous free flaps are frequently used to reconstruct posterior maxillary defects but, though bulkier than temporalis muscle flaps, will not maintain midfacial projection in this patient with loss of the entire palate and premaxilla.

The most appropriate reconstruction for this patient is the fibula osteocutaneous free flap. This flap will restore midfacial height, width, and projection. It has adequate bone stock for osseointegrated implant placement dental restoration as well. The skin paddle is used to close the palatal defect, separating the oral cavity from the nasal cavity.



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

Several other osteocutaneous free flaps, including the iliac crest and scapular osteocutaneous free flaps, have also been used for similar reconstructions.

## REFERENCES:

1. Cordeiro PG, Santamaria E. A classification system and algorithm for reconstruction of the maxillectomy and midfacial defects. *Plast Reconstr Surg*. 2000 Jun;105(7):2331-2346; discussion 2347-2348.
2. Hanasono MM, Silva AK, Yu P, et al. A comprehensive algorithm for oncologic maxillary reconstruction. *Plast Reconstr Surg*. 2013 Jan;131(1):47-60.
3. Okay DJ, Genden E, Buchbinder D, et al. Prosthodontic guidelines for surgical reconstruction of the maxilla: a classification system of defects. *J Prosthet Dent*. 2001 Oct;86(4):352-363.

141. A 7-year-old Asian American boy is brought to the office because of congenital cryptotia. Which of the following is the most likely pathophysiologic explanation for his condition?
- A) Abnormal distribution of the intrinsic transverse and oblique auricular muscles
  - B) Failure of the antihelix to furl during weeks 12 to 16 of gestation
  - C) Failure of hillocks 3 and 4 to arise from the first and second branchial arches
  - D) Incomplete fusion of the six hillocks
  - E) Malformation of the conchal bowl

The correct response is Option A.

Cryptotia is a congenital ear deformity in which the upper pole appears buried beneath the mastoid skin. It is a common auricular malformation in Asians. Children with this condition often present when they are in elementary school, and are unable to wear eyeglasses. The cause of this condition is the abnormal distribution of the intrinsic auricular muscle. Malformation of the conchal bowl results in prominence of the pinna from the head. Incomplete fusion of the six hillocks does not result in cryptotia, nor does it result from failure of the two superior hillocks (3 and 4) to arise from the branchial arches. Failure of the antihelix to furl during weeks 12 to 16 results in a protruding scapha.

## REFERENCES:

1. Hirose T, Tomono T, Matsuo K, et al. Cryptotia: our classification and treatment. *Br J Plast Surg*. 1985 Jul;38(3):352-360.
2. Hayashi R, Matsuo K, Hirose T. Familial cryptotia. *Plast Reconstr Surg*. 1993 Jun;91(7):1337-1339.

142. A 60-year-old woman with a history of squamous cell carcinoma of the scalp treated with resection, skin grafting, and total scalp radiation therapy is evaluated for osteoradionecrosis of the cranial vertex. After full-thickness debridement, which of the following is the most appropriate method for soft-tissue reconstruction?

- A) Coverage with a free latissimus dorsi musculocutaneous flap
- B) Coverage with a pedicled trapezius musculocutaneous flap
- C) Coverage with a scalp rotation flap
- D) Negative pressure wound therapy
- E) Skin grafting

The correct response is Option A.

In the patient described, with a history of previous radiation therapy and a full-thickness defect, a free latissimus dorsi musculocutaneous flap would be the best choice for soft-tissue reconstruction.

Skin grafting over an implant cranioplasty would not be a suitable option in this setting. Skin grafts could be considered in nonradiated, partial-thickness defects of the scalp or for coverage of scalp rotation flap donor sites.

A pedicled trapezius musculocutaneous flap would not reach the cranial vertex without undue tension and is better suited for full-thickness occipital defects.

Scalp rotation flaps are ideal for defects up to 8 cm in diameter in a nonradiated scalp. The patient's history of previous radiation therapy would likely compromise the viability of a large rotation flap in this setting.

Negative pressure wound therapy over an implant cranioplasty in a radiated field would not allow for soft-tissue healing and coverage.

## REFERENCES:

1. Fowler NM, Futran ND. Achievements in scalp reconstruction. *Curr Opin Otolaryngol Head Neck Surg*. 2014 Apr;22(2):127-130.
2. Lin SJ, Hanasono MM, Skoracki RJ. Scalp and calvarial reconstruction. *Semin Plast Surg*. 2008 Nov;22(4):291-293.

143. An 8-year-old boy with a history of submucous cleft palate presents with persistent velopharyngeal insufficiency. Surgical history includes a Furlow palatoplasty 3 years ago, with subsequent revision to a superiorly based pharyngeal flap for persistent hypernasality 1 year ago. He had no improvement after the second surgery and speech therapy. Physical examination shows an intact, high and wide pharyngeal flap. Nasoendoscopy shows patent lateral oronasal ports and poor palatal and lateral pharyngeal wall motion. Which of the following treatments is most appropriate in this patient?

- A) Fabrication of a custom palatal elevator
- B) Pharyngeal flap port revision
- C) Posterior wall augmentation with fat grafting
- D) Speech therapy with retraining
- E) Sphincter pharyngoplasty

The correct response is Option A.

The most likely cause of this child's persistent hypernasality is hypotonia of the muscles involved in speech. Because this is neurogenic, it will be difficult to correct with surgery, so the best option becomes a palatal elevator used when talking to close off the nose posteriorly by pushing up the posterior soft palate. Posterior augmentation with fat grafting would decrease the size of the posterior gap but without adequate closure would still not correct the problem. The child has been in therapy and has failed to show improvement so additional therapy especially in light of the neurologic problem is unlikely to do anything but frustrate the child. A sphincter pharyngoplasty is not a viable option because a pharyngeal flap has been done and without adequate muscle function would fail.

## REFERENCES:

1. Elkadi H. Cleft palate repair: functional anatomy of the velopharynx. In: Salyer KE, Bardach J, eds. *Atlas of Craniofacial & Cleft Surgery*. Philadelphia, PA: Lippincott Williams & Wilkins;2000:679-782.
2. Sloan GM, Zajac D. Velopharyngeal dysfunction. In: Mathes SJ, Hentz VR, eds. *Plastic Surgery*. 2nd ed. Philadelphia, PA: Saunders;2006:311-337.

3. Witt PD. Velopharyngeal Insufficiency. In: Achauer BM, Eriksson E, Guyuron B, Coleman JJ III, Russell RC, Vander Kolk CA, eds. *Plastic Surgery: Indications, Operations, and Outcomes*. 1st ed. Maryland Heights, MO: Mosby; 2000:819-833.

144. A 50-year-old man is evaluated for facial trauma sustained after falling off a bicycle 5 days ago. The patient reports mid-facial pain and resolved swelling. Physical examination of the face shows no signs of trauma. Intraoral examination shows traumatic loss of tooth No. 8. He has no cervical spine tenderness or pain to active range motion. Which of the following is the most appropriate next step in management?
- A) Obtain cervical spine MRI
  - B) Obtain maxillofacial CT scan to evaluate for facial fracture
  - C) Recommend elevation of the head of the bed and ice pack to the face
  - D) Recommend soft diet and referral to a dentist
  - E) No further management is necessary

The correct response is Option B.

The patient described most likely has a facial fracture and, thus, the most appropriate next step in management is to obtain a maxillofacial CT scan. A retrospective analysis of patients with facial trauma who had maxillofacial CT scan for the evaluation of facial fractures identified five independent criteria highly predictive of facial fracture. Any of the following five physical examination criteria – the Wisconsin criteria – were predictive of facial fracture: bony step-off or instability, periorbital swelling or contusion, Glasgow Coma Scale score less than 14, malocclusion, or tooth absence (sensitivity, 98.2%). Because the patient has a missing tooth, he should be evaluated with a maxillofacial CT scan. Although soft diet and eventual referral to a dentist as well as elevation of the head of bed with cool compress are reasonable recommendations, the first important step is obtaining a diagnosis.

Because the patient does not have tenderness of the cervical spine, there is no indication for obtaining cervical spine x-ray studies.

Systematic and efficient decision instruments in the management of multisystem trauma patients are critical in identifying all injuries including those of the maxillofacial skeleton and the cervical spine. The accurate use of systematic decision instruments could potentially result in a dramatic decrease in the number of CT scans and x-ray studies performed annually in the United States.

## REFERENCES:

1. Sitzman TJ, Hanson SE, Alsheik NH, et al. Clinical criteria for obtaining maxillofacial computed tomographic scans in trauma patients. *Plast Reconstr Surg*. 2011 Mar;127(3):1270-1280.
2. Hoffman JR, Mower WR, Wolfson AB, et al. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. *N Engl J Med*. 2000 Jul 13;343(2):94-99.

145. An 18-year-old woman is evaluated for persistent fullness of the left cheek 3 months after undergoing open reduction and internal fixation of a left zygomaticomaxillary complex fracture. She has no pain. The fracture was fixated at the inferior orbital rim (1.3-mm-thick titanium plate), the frontozygomatic suture (1.3-mm-thick titanium plate), and the lateral buttress (2.4-mm-thick titanium plate). On physical examination, the incisions are well healed. Which of the following is the most likely cause of this patient's cheek fullness?
- A) Excessive profile of the lateral buttress and orbital rim plate fixation
  - B) Malreduction of the fracture
  - C) Mucocele from the maxillary sinus
  - D) Residual soft-tissue edema
  - E) Subclinical hardware infection

The correct response is Option D.

Fullness of the soft-tissue envelope is expected after any severe trauma, regardless of location. This is further compounded by operative dissection to effect open reduction and internal fixation. Although most soft-tissue swelling around a fracture site dissipates in several weeks, there will be persistent thickening of the soft tissue in the area for many months after the trauma.

It is nearly impossible to "over-reduce" a zygomaticomaxillary (ZMC) fracture in the sagittal plane. Malreduction of these injuries characteristically results in flattening of the cheek (not fullness), vertical dystopia, or enophthalmos. Prominent hardware can create contour irregularities, but this would be localized and would not lead to global cheek fullness. Furthermore, the plate choices in areas where they could potentially be visible (i.e., the orbital rims) here are quite low profile and would be very unlikely to create excessive soft-tissue fullness. Hardware infection can rarely occur and lead to fullness of the cheek. Nevertheless, the absence of pain and the presence of healed wounds make this improbable. Mucocele from the maxillary sinus after repair of ZMC fracture is a rare but described entity and can result in localized soft-tissue fullness. These often occur in the context of a concurrent sinus infection and present many months to years after the injury. Soft-tissue swelling is usually accompanied by pressure and/or pain, and the symptoms can wax and wane. External drainage is not uncommon.

## REFERENCES:

1. Kaufman Y, Stal D, Cole P, et al. Orbitozygomatic fracture management. *Plast Reconstr Surg*. 2008 Apr;121(4):1370-1374.
2. Kim DH, Kim RH, Lee J, et al. Evaluation of soft tissue asymmetry using cone-beam computed tomography after open reduction and internal fixation of zygomaticomaxillary complex fracture. *J Korean Assoc Oral Maxillofac Surg*. 2014 Jun;40(3):103-110. Epub 2014 Jun 27.

146. A 6-month-old male infant is evaluated for facial asymmetry noted at birth. Physical examination shows symmetry of the upper one-third of the face, but the right cheek is less prominent than the left. The occlusal plane is canted upward to the right, and the chin point is deviated to the right. In addition, the right ear is small and constricted, and an adjacent preauricular soft-tissue appendage is noted. He has a palsy of the right marginal mandibular nerve. He is otherwise healthy. The parents should be informed that the asymmetry was most likely caused by which of the following?
- A) Autosomal dominant mutation
  - B) Disruption of normal developmental sequence
  - C) Maternal smoking
  - D) Omega oil ingestion during pregnancy
  - E) Uterine deformation

The correct response is Option B.

This patient has hemifacial microsomia (also referred to as craniofacial microsomia, Goldenhar syndrome, or oculoauriculovertebral spectrum), the second most common congenital facial malformation after cleft lip/palate. It is estimated to occur in 1:5600 to 1:20,000 live births. Unilateral (or less commonly, bilateral) facial hypoplasia is the primary manifestation, and it can involve ocular structures (orbital size, position, globe development, coloboma, epibulbar dermoids), mandibular structures, auricular structures (preauricular tags and sinuses, microtia or anotia, hearing loss), cranial nerve palsies (cranial facial nerve [VII] is most common); and soft-tissue underdevelopment (including facial clefts). In addition, patients can have cardiac, musculoskeletal, central nervous system, and renal manifestations.

The etiology of hemifacial microsomia (HFM) appears to be heterogeneous. Early investigators using animal models of the condition believed that this was the result of an isolated vascular event in the stapedia artery. While this mechanism cannot be completely dismissed and may have a role in some cases, the prevalence of extracranial findings strongly suggests a more sublime pathogenesis: faulty neural crest cell (NCC) migration. Both genetic and environmental factors have been demonstrated to alter or impair NCC activity. Recent studies have implicated genetic factors in the development of this disorder. Nevertheless, the majority of patients with HFM have no family history and less than 2% of cases arise from autosomal dominant inheritance. Certain vasoactive and nonsteroidal anti-inflammatory drug

(NSAID) medications can increase the risk of HFM; maternal ingestion of omega oils has not been associated. Maternal smoking can increase the risk of having a child with HFM, but the association is weak and this is not causative in the vast majority of patients. Uterine deformation can lead to facial asymmetry; however, this typically improves with growth and does not lead to the ear and jaw anomalies in the patient described.

## REFERENCES:

1. Online Mendelian Inheritance in Man. Hemifacial Microsomia; HFM. Available at: <http://omim.org/clinicalSynopsis/164210>. Accessed December 21, 2014.
2. Horgan JE Padwa BL, LaBrie RA, et al. OMENS-Plus: analysis of craniofacial and extracraniofacial anomalies in hemifacial microsomia. *Cleft Palate Craniofac J*. 1995 Sep;32(5):405-412.
3. Werler MM, Starr JR, Cloonan YK, et al. Hemifacial microsomia: from gestation to childhood. *J Craniofac Surg*. 2009 Mar;20 Suppl 1:664-669.

147. A 30-year-old primigravid woman is referred to the office because ultrasonography showed polyhydramnios at 22 weeks' gestation. Additionally, the fetus was observed to have macrosomia, omphalocele, macroglossia, and microtia. There is no evidence of nephromegaly or hepatomegaly. A groove between the lobule and antitragus is noted. Chromosomal analysis indicates rearrangements on chromosome 11p15. Which of the following is the most likely diagnosis?
- A) Beckwith-Wiedemann syndrome
  - B) Binder syndrome
  - C) Diabetic fetopathy
  - D) Down syndrome
  - E) van der Woude syndrome

The correct response is Option A.

This is a rare overgrowth disorder involving genetic defect of chromosome 11, commonly characterized by the presence of macrosomia, omphalocele, and macroglossia. These symptoms typically present after 22 weeks' gestation. Additionally, infants with Beckwith-Wiedemann syndrome often display auricular abnormalities, including characteristic ear folds.

While a common symptom of diabetic fetopathy is macrosomia, a diagnosis of diabetic fetopathy would be incorrect. Common symptoms of diabetic fetopathy include congenital anomalies of the internal organs, such as nephromegaly or hepatomegaly; no such symptoms are detected in this fetus.

The absence of cleft lip and/or cleft palate nephromegaly also precludes the diagnosis of van der Woude syndrome. Additionally, the genetic abnormality responsible for van der Woude syndrome involves chromosome 1, not chromosome 11. Likewise, trisomy 21 (Down syndrome) is not the correct diagnosis, as the chromosomal abnormality responsible for this disease involves chromosome 21, not chromosome 11.

Finally, Binder syndrome is a congenital facial malformation most commonly characterized by a flat nose and retrusion of the midface, neither of which are observed in this fetus. Therefore, Beckwith-Wiedemann syndrome is the correct answer.

## REFERENCES:

1. Cohen MM Jr. Beckwith-Wiedemann syndrome: historical, clinicopathological, and etiopathogenic perspectives. *Pediatr Dev Pathol.* 2005 May-Jun;8(3):287-304. Epub 2005 Jul 14.
2. Demars J, Gicquel C. Epigenetic and genetic disturbance of the imprinted 11p15 region in Beckwith-Wiedemann and Silver Russell syndromes. *Clin Genet.* 2012 Apr;81(4):350-361. Epub 2012 Jan 16.
3. Weksberg R, Shuman C, Smith AC. Beckwith-Wiedemann syndrome. *Am J Med Genet C Semin Med Genet.* 2005 Aug 15;137C(1):12-23.

148. A 50-year-old man is evaluated for progressive growth of his nose. He desires improvement of the appearance of the nose, which is causing him distress. On examination, the nose has thickened skin and glands in the nasal tip and a bulbous appearance. Tangential excision of the nose is planned. This patient most likely has a history of which of the following risk factors?

- A) Alcohol abuse
- B) Excessive sun exposure
- C) Psoriasis
- D) Radiation treatment for teenage acne
- E) Rosacea

The correct response is Option E.

This patient has rhinophyma, characterized by progressive hypertrophy of the sebaceous glands in the nose resulting in a bulbous appearance that can be deforming. This can cause significant emotional distress. This is considered an end-stage presentation of rosacea.

Treatment consists of topical and oral antibiotics (for mild cases, and for treating rosacea), and surgical excision (tangential excision) and laser therapy.

Alcohol abuse was thought to be associated with this condition, as the facial appearance can be ruddy/red/flushed, but there is no scientific study that demonstrates any association of alcohol use with development of rhinophyma.

Rhinophyma is not associated with exposure to radiation. There is no evidence that sun exposure causes rhinophyma, although malignant lesions have been coincidentally found within rhinophyma tissues. There is no association between psoriasis and rosacea or rhinophyma.

## REFERENCES:

1. Lazzeri D, Larcher L, Huemer GM, et al. Surgical correction of rhinophyma: comparison of two methods in a 15-year-long experience. *J Craniomaxillofac Surg.* 2013 Jul;41(5):429-436. Epub 2012 Dec 8.
2. Curnier A, Choudhary S. Rhinophyma: dispelling the myths. *Plast Reconstr Surg.* 2004 Aug;114(2):351-354.

149. Which of the following stigmata is most common after a rotation-advancement repair of a unilateral cleft lip?

- A) Blunting of Cupid's bow
- B) Elongated lip
- C) Short lip
- D) Triangular scar across the philtrum
- E) Widened philtrum

The correct response is Option C.

If there is inadequate rotation, the rotation-advancement repair can result in a short lip (white upper lip).

A Tension, or triangular, flap repair can result in an elongated lip and a visible scar across the lower philtrum. The advantage of the rotation-advancement flap is that the design places the scar along the philtral ridge.

Straight-line repairs have been shown to result in blunting of Cupid's bow.

An overly wide philtrum is a surgical stigma of a repaired bilateral cleft lip.

## REFERENCES:

1. Cohen M. Residual deformities after repair of clefts of the lip and palate. *Clin Plast Surg*. 2004 Apr;31(2):331-345.
2. Demke JC, Tatum SA. Analysis and evolution of rotation principles in unilateral cleft lip repair. *J Plast Reconstr Aesthet Surg*. 2011 Mar;64(3):313-318. Epub 2010 May 24.

150. A 60-year-old man presents with a 7-mm basal cell carcinoma on the ear. Which of the following is the most appropriate management?
- A) Wedge excision with wide 3-mm margins and bilobed flap closure
  - B) Wedge excision with wide 3-mm margins and chondrocutaneous advancement flap closure
  - C) Wedge excision with wide 3-mm margins and primary closure
  - D) Wedge excision with wide 10-mm margins and chondrocutaneous advancement flap closure
  - E) Wedge excision with wide 10-mm margins and primary closure

The correct response is Option B.

A bilobed flap is usually used for nasal reconstruction. A 3-mm margin is adequate for most basal cell carcinoma 2 cm or smaller. This will result in an almost 13-mm helical rim defect, slightly too large for primary closure. At this defect size, ear cupping from primary closure can result in a less pleasing final aesthetic result.

## REFERENCES:

1. Gulleth Y, Goldberg N, Silverman RP, et al. What is the best surgical margin for a Basal cell carcinoma: a meta-analysis of the literature. *Plast Reconstr Surg*. 2010 Oct;126(4):1222-1231.
2. Valesky EM, Kaufmann R, Meissner M. Chondrocutaneous helix rim advancement flap: two classical and two new modifications for very large defects of the ear. *J Eur Acad Dermatol Venereol*. 2014 Oct 22. [Epub ahead of print]

## Section 4: Breast and Cosmetic

151. A 48-year-old man with HIV infection comes to the office requesting facial rejuvenation because of the accelerated changes he has seen since his HIV-positive status was identified. He is receiving antiretroviral therapy, has a nondetectable viral load, and normal T-cell count. Physical examination shows significant facial lipoatrophy despite the patient appearing somewhat overweight with a BMI of 27 kg/m<sup>2</sup>. The patient desires fat transfer to correct this deformity. Which of the following best describes this patient's risk evaluation when compared with HIV-negative patients?

- A) Decreased satisfaction rate
- B) Higher risk of infection
- C) Increased bruising
- D) Increased fat graft resorption
- E) Similar risk profile

The correct response is Option E.

HIV-positive patients with nondetectable viral loads and normal T-cell counts are at no higher risk for infection with transdermal procedures than HIV-negative patients. While finding adequate subdermal fat for fat harvesting can be challenging in some HIV patients because of "wasting," or loss of fat, in patients with a normal or high BMI, fat for transfer is generally not an issue. No studies have shown higher rates of transferred fat reabsorption in HIV, while studies have shown long-term (12-month) retention using CT scans as an objective measure. Wasting is a hallmark of late-stage AIDS. Antiretroviral therapy is a mainstay of treatment for HIV-infected patients, generally improves wasting, and has dramatically improved the health and longevity of HIV-positive patients. Nonetheless, antiretrovirals are a major contributing factor to facial lipoatrophy even in stable HIV-positive patients with low or nondetectable viral loads and normal and near normal CD4 cell levels. While facial fat grafting in any patient is somewhat unpredictable, for healthy HIV-positive patients with adequate body fat, it is a reasonable approach to facial rejuvenation in patients with lipoatrophy.

Patient satisfaction and bruising should show the same variability as the HIV-negative patient.

## REFERENCES:

1. Reilly MJ, Burke KM, Davison SP. Wound infection rates in elective plastic surgery for HIV-positive patients. *Plast Reconstr Surg*. 2009 Jan;123(1):106-111.
2. Fontdevila J, Serra-Renom JM, Raigosa M, et al. Assessing the long-term viability of facial fat grafts: an objective measure using computed tomography. *Aesthet Surg J*. 2008 Jul-Aug;28(4):380-386.
3. McComsey GA, Ward DJ, Hesselthaler SM, et al. Improvement in lipoatrophy associated with highly active antiretroviral therapy in human immunodeficiency virus-infected patients switched from stavudine to abacavir or zidovudine: the results of the TARHEEL study. *Clin Infect Dis*. 2004 Jan 15;38(2):263-270. Epub 2003 Dec 18.

152. A 62-year-old woman undergoes breast reconstruction using autologous tissue from the abdomen. Intraoperatively, use of a perforator flap is found to be impossible because of multiple small nondominant perforators. Conversion to a delayed pedicled transverse rectus abdominis muscle flap is planned. Ligating which of the following vessels in this stage will best facilitate future viability of the tissue transferred in the next stage?

- A) Deep inferior epigastric
- B) Hypogastric
- C) Internal mammary
- D) Superficial inferior epigastric
- E) Superior epigastric

The correct response is Option A.

Pedicled transverse rectus abdominis muscle (TRAM) flaps are based on the superior epigastric system, which is often less robust than the deep inferior epigastric system. Therefore, surgical delay by ligation of the deep inferior epigastric system may facilitate overall viability of the transferred tissue. Ligation of the superior epigastric system would make a pedicled TRAM flap unlikely to survive. The internal mammary ligation may also interrupt blood supply to the superior epigastric system, and even if the tissue is fed through collaterals, it would not strengthen the flap. Division of the superficial inferior epigastric system might also help, but it is not as critical as ligation of the deep inferior epigastric system. The hypogastric system does not have a direct impact on the pedicled TRAM tissues.

## REFERENCES:

1. Aboutanos SZ, Spinos E, Blancet NP. Angiographic delay: a viable alternative to surgical delay. *Ann Plast Surg.* 2012 Jun;68(6):562-567.
2. Nair N, Dunya M, Streu R, et al. An innovative approach to the primary surgical delay procedure for pedicle TRAM flap breast reconstruction. *Plast Reconstr Surg.* 2010 Apr;125(4):173e-174e.
3. Atisha D, Alderman AK, Janiga T, et al. The efficacy of the surgical delay procedure in pedicle TRAM breast reconstruction. *Ann Plast Surg.* 2009 Oct;63(4):383-388.

153. For women undergoing abdominoplasty after massive weight loss, which of the following is the best position of the navel?
- A) Along the line drawn between the iliac crests
  - B) At the horizontal level of the tenth ribs
  - C) Between the first and second tendinous inscriptions
  - D) In the midline 10 cm above the vulvar commissure
  - E) One-third of the distance from the xiphoid to the pubis

The correct response is Option A.

As a result of the rapid increase in the number of bariatric surgical procedures performed each year, the frequency of body contouring procedures has risen concomitantly over the past decade. Among the most popular of these is abdominoplasty for resection of redundant skin on the torso. When designing the outline of skin to be resected, among the preeminent concerns is maximizing the aesthetic result of the procedure. Removal of the redundant panniculus may involve a low transverse incision only or a more extensive resection such as the fleur-de-lis or corset pattern incisions. The length of the navel stalk may limit any transposition of this structure. Accordingly, one must plan for siting the navel in an aesthetically pleasing location to complement the finished result. The umbilicus is typically inset along a horizontal line that spans the iliac crests. This will result in the most natural appearance for most individuals. A location 10 cm above the anterior vulvar commissure would result in a placement that is unnaturally low. The other options would yield a position of the umbilicus that is too high.

## REFERENCES:

1. Leahy PJ, Shorten SM, Lawrence WT. Maximizing the aesthetic result in panniculectomy after massive weight loss. *Plast Reconstr Surg*. 2008 Oct;122(4):1214-1224.
2. [No authors listed]. Safety considerations and avoiding complications in the massive weight loss patient. *Plast Reconstr Surg*. 2006 Jan;117(1 Suppl):74S-81S.
3. Moya AP, Sharma D. A modified technique combining vertical and high lateral incisions for abdominal-to-hip contouring following massive weight loss in persistently obese patients. *J Plast Reconstr Aesthet Surg*. 2009 jan; 62(1):56-64. Epub 2007 Nov 26.

154. A 35-year-old *BRCA*-positive woman undergoes bilateral prophylactic nipple-sparing mastectomy via lateral radial incisions with periareolar extensions. She undergoes direct-to-implant reconstruction with an acellular dermal matrix inferior lateral sling. Mastectomy specimens weigh 435 g each, and placement of 450 mL smooth, round, high-profile implants is performed. Postoperatively, 25% partial nipple areolar complex necrosis in both breasts is noted. Which of the following most likely contributed to the necrosis?

- A) Bilateral surgery
- B) Mastectomy incision
- C) Use of acellular dermal matrix
- D) Volume of the implants
- E) Weight of the mastectomy specimen

The correct response is Option B.

Nipple-sparing mastectomies are becoming more prevalent with the rise of prophylactic mastectomies and increased comfort with performing it in presence of in situ and invasive carcinoma. While universal standards for patient selection do not exist, there is consensus that general recommendations include no inflammatory breast cancers, no pathologic nipple discharge, no Paget's disease, and for many, a 2-cm distance from the tumor to the nipple. Nipple-sparing mastectomy incisions have been described as radial lateral, lateral inframammary fold, and peri-areolar. Because the entire skin envelope is preserved, direct-to-implant reconstruction is possible with inferolateral support from acellular dermal matrices or other scaffolds. Areolar involvement in mastectomy incisions is associated with increased rates of nipple necrosis. The weight of mastectomy specimen, volume of implants, use of acellular dermal matrices or laterality of surgery have not been shown to be associated with nipple necrosis.

## REFERENCES:

1. Colwell AS, Tessler O, Lin AM, et al. Breast reconstruction following nipple-sparing mastectomy: predictors of complications, reconstruction outcomes, and 5-year trends. *Plast Reconstr Surg*. 2014 Mar;133(3):496-506.
2. Adam H, Bygdeson M, de Boniface J. The oncological safety of nipple-sparing mastectomy - a Swedish matched cohort study. *Eur J Surg Oncol*. 2014 Oct;40(10):1209-1215. Epub 2014 Aug 20.

3. Salzberg CA, Ashikari AY, Koch RM, et al. An 8-year experience of direct-to-implant immediate breast reconstruction using human acellular dermal matrix (AlloDerm). *Plast Reconstr Surg*. 2011 Feb;127(2):514-524.

155. A 53-year-old woman is evaluated 6 weeks after undergoing blepharoplasty. Physical examination shows 1 mm of lagophthalmos with no dry-eye symptoms. The patient returns 8 months later for evaluation of dry eye, which began one month after undergoing laser-assisted in situ keratomileusis (LASIK) surgery. Which of the following is the most likely reason for this patient's dry-eye symptoms?
- A) Blunted blink reflex secondary to decreased corneal reflex arc
  - B) Chronic use of vasoconstrictive eyedrops
  - C) Transient decrease in functioning of the orbicular muscle of the eye secondary to stretching from lid traction during surgery
  - D) Transient decrease in tear production caused by lacrimal gland pressure injury
  - E) Transient hypersensitivity of the cornea

The correct response is Option A.

Minimal lagophthalmos in the postoperative period following blepharoplasty is not uncommon and generally self-correcting. Minimal lagophthalmos may persist but is often asymptomatic owing to compensatory blinking and increased tear production, both of which are the result of the mild exposure and resulting corneal stimulation.

Laser-assisted in situ keratomileusis (LASIK) procedure involves creation of a corneal flap that interrupts the long ciliary nerves of the ophthalmic division of the trigeminal nerve. The interruption of these nerves results in decreased sensation to the cornea and a decreased corneal reflex arc. Patients with compensated exposure from blepharoplasty may lose the compensatory blink in reaction to corneal irritation following LASIK. This may cause dry-eye symptoms. With time, the corneal reflex arc improves, and the transient neurotrophic keratopathy and dry-eye symptoms improve. The other options are unlikely to cause her symptoms of dry eyes.

## REFERENCES:

1. Korn BS, Kikkawa DO, Schanzlin DJ. Blepharoplasty in the post-laser in situ keratomileusis patient: preoperative considerations to avoid dry eye syndrome. *Plast Reconstr Surg*. 2007 Jun;119(7):2232-2239.

2. Donnenfeld ED, Solomon K, Perry HD, et al. The effect of hinge position on corneal sensation and dry eye after LASIK. *Ophthalmology*. 2003 May;110(5):1023-1029.

156. A 51-year-old woman comes to the office for consultation for abdominal and lower extremity liposuction. The procedure is expected to last approximately 2.5 hours. BMI is 30 kg/m<sup>2</sup>. The patient takes an oral contraceptive. The patient reports having had a small venous thromboembolism (VTE) during lumpectomy for breast cancer that took place in her early 40s. Which of the following factors increases the risk of VTE and Caprini risk assessment score most significantly?

- A) Age
- B) History of malignancy
- C) History of VTE
- D) Length of surgery
- E) Use of an oral contraceptive

The correct response is Option C.

In this patient, the highest Caprini risk factor is the history of a VTE, which carries a score of 3. The length of surgery is greater than 45 minutes so it would be considered major and would carry a score of 2, as would her history of malignancy. Age, obesity, and contraceptive use all carry a score of 1. This gives the patient a Caprini score of 10.

## REFERENCES:

1. Matarasso A, Levine SM. Evidence-based medicine: liposuction. *Plast Reconstr Surg*. 2013 Dec;132(6):1697-1705.
2. Murphy RX Jr, Alderman A, Gutowski K, et al. Evidence-based practices for thromboembolism prevention: summary of the ASPS Venous Thromboembolism Task Force Report. *Plast Reconstr Surg*. 2012 Jul;130(1):168e-175e.

157. An otherwise healthy 38-year-old woman who is a smoker is considering implant-based breast reconstruction following mastectomy. She has been counseled about likely use of acellular dermal matrix when the intermediate tissue expander is placed and wants to further understand why the matrix will be used in her body. The patient should be advised that use of acellular dermal matrix is associated with a decreased risk for which of the following?

- A) Cancer recurrence
- B) Capsular contracture
- C) Seroma
- D) Skin flap necrosis
- E) Smoking-related complications

The correct response is Option B.

Acellular dermal matrix (ADM) use has been increasing over time with tissue expander or implant-based breast reconstruction following mastectomies. Many potential advantages and disadvantages have been studied, and some of the data are contradictory. However, the consensus of the literature indicates that ADMs are associated with decreased capsular contracture rates. There is literature to suggest that seroma rates are increased or remain stable, not decreased, with ADMs. ADMs have not been shown to decrease independent patient risk factors for complications such as tobacco use or to decrease cancer recurrence rates. ADMs also do not appear to improve vascularity of the tissue overlying them when initially placed.

## REFERENCES:

1. Schefflan M, Colwell AS. Tissue Reinforcement in Implant-based Breast Reconstruction. *Plast Reconstr Surg Glob Open*. 2014 Sep 8;2(8):e192. eCollection 2014.
2. Antony AK, McCarthy CM, Cordeiro PG, et al. Acellular human dermis implantation in 153 immediate two-stage tissue expander breast reconstructions: determining the incidence and significant predictors of complications. *Plast Reconstr Surg*. 2010 Jun;125(6):1606-1614.
3. Vardanian AJ, Clayton JL, Roostaieian J, et al. Comparison of implant-based immediate breast reconstruction with and without acellular dermal matrix. *Plast Reconstr Surg*. 2011 Nov;128(5):403e-410e.

158. Which of the following symptoms meet the current Medicare guidelines for approval of abdominal lipectomy/panniculectomy following massive weight loss?

- A) Neck and back pain
- B) Psychological distress
- C) Unsatisfactory appearance
- D) Diastasis recti
- E) Recurrent intertrigo

The correct response is Option E.

Medically necessary criteria for Medicare approval of abdominal lipectomy/panniculectomy include:

1. Inability to walk normally
2. Chronic pain and ulceration created by the abdominal skin fold
3. When the panniculus hangs below the level of the pubis
4. Intertrigo of the pannus that is persistent or recurrent over a 3-month period while receiving appropriate medical therapy
5. Stable weight for at least 6 months and 18 months after gastric bypass surgery

According to Medicare guidelines, the other four options listed are not considered reasons that make this procedure medically necessary:

1. Treatment of neck and back pain
2. Repairing abdominal wall laxity or diastasis recti
3. Improving appearance
4. Treating psychological symptomatology

## REFERENCES:

1. CMS (Centers for Medicare and Medicaid Services); Local coverage determination (LCD) for Cosmetic and Reconstructive Surgery; Abdominal Lipectomy/Panniculectomy

159. A healthy 26-year-old woman undergoes rhinoplasty using a spreader graft. Which of the following is the most likely cause of decreased airway resistance after placement of the spreader graft?
- A) Decreased angle at the external nasal valve
  - B) Decreased area of airway
  - C) Decreased radius at the internal nasal valve
  - D) Increased angle at the external nasal valve
  - E) Increased radius at the internal nasal valve

The correct response is Option E.

A spreader graft is placed between the septum and the upper lateral cartilages. Poiseuille law states that resistance = (viscosity  $\times$  length)/radius<sup>4</sup>. About half of nasal airway resistance occurs at the internal nasal valve. The internal nasal valve, formed at the junction of the septum (medially), the nasal floor (inferiorly), the inferior turbinate (laterally), and the caudal border of the upper lateral cartilages (superiorly), accounts for a significant amount of airway resistance. Maneuvers that increase the radius at the internal nasal valve will decrease resistance exponentially.

## REFERENCES:

- 1 Wittkopf M, Wittkopf J, Ries WR. The diagnosis and treatment of nasal valve collapse. *Curr Opin Otolaryngol Head Neck Surg*. 2008 Feb;16(1):10-13.
2. Bloching MB. Disorders of the nasal valve area. *GMS Curr Top Otorhinolaryngol Head Neck Surg*. 2007;6:Doc07. Epub 2008 Mar 14.

160. A 24-year-old man is evaluated because of a 15-month history of painful idiopathic gynecomastia. Which of the following is the most appropriate treatment?
- A) Anastrozole
  - B) Radiation therapy
  - C) Spironolactone
  - D) Surgical resection
  - E) Tamoxifen

The correct response is Option D.

Adult gynecomastia occurs because of drugs, unresolved pubertal gynecomastia, and unknown causes (idiopathic gynecomastia). Tamoxifen and raloxifene, both selective estrogen receptor modulators (SERMs), can be used for the treatment of male gynecomastia. Indeed, the use of SERMs is recommended to prevent gynecomastia as a result of antiandrogen monotherapy for treatment of prostate cancer. They are most effective, however, when used to treat gynecomastia that has been present for less than 1 year. Anastrozole, an aromatase inhibitor, is recommended for the treatment of breast cancer and as a preventative measure in high-risk women.

Surgical resection is the appropriate treatment for painful gynecomastia that has been present for greater than 1 year. Both open resection and liposuction are appropriate techniques.

Radiation therapy is indicated to prevent gynecomastia as a result of prostate cancer treatment.

Spironolactone is a cause of—not a treatment for—gynecomastia.

## REFERENCES:

1. Johnson RE, Murad MH. Gynecomastia: pathophysiology, evaluation, and management. *Mayo Clin Proc.* 2009 Nov;84(11):1010-1015.
2. Braunstein GD. Clinical practice. Gynecomastia. *N Engl J Med.* 2007 Sep 20;357(12):1229-1237.

161. A 48-year-old woman undergoes liposuction of the abdomen, flanks, and thighs. Liposuction is performed using 4 L of infiltration fluid. Each liter is mixed with 50 mL of 2% plain lidocaine and 1 mL of 1:1000 epinephrine. At which of the following times after infiltration are concentrations of lidocaine in the blood expected to be the highest in this patient?

- A) Immediately after injection
- B) 1 hour after surgery
- C) 2 to 4 hours after surgery
- D) 8 to 18 hours after surgery
- E) 24 to 48 hours after surgery

The correct response is Option D.

The safe dosage of lidocaine in liposuction is 35 to 55 mg/kg. Peak lidocaine levels are reported to be 8 to 18 hours after infiltration. Oftentimes, patients are discharged to home when peak levels occur. Surgeons should keep this in mind when calculating lidocaine dosage.

## REFERENCES:

1. Gutowski KA. Tumescant analgesia in plastic surgery. *Plast Reconstr Surg*. 2014 Oct;134(4 Suppl 2):50S-57S.
2. Swanson E. Prospective study of lidocaine, bupivacaine, and epinephrine levels and blood loss in patients undergoing liposuction and abdominoplasty. *Plast Reconstr Surg*. 2012 Sep;130(3):702-722.

162. A 13-year-old girl is evaluated for breast asymmetry. Examination shows total absence of the left mammary gland tissue, with normal areola and nipple. Pectoral muscles are normal. No hand, facial, or other body abnormalities are noted. Which of the following is the most likely diagnosis?

- A) Amastia
- B) Amazia
- C) Athelia
- D) Ectodermal dysplasia
- E) Poland sequence

The correct response is Option B.

There are a number of uncommon aplastic deformities of the breast. These include: total absence of the breast and nipple (amastia), absence of the nipple (athelia), and absence of the mammary gland (amazia), as described in this case. These anomalies may occur in isolation, or may be associated with various syndromes, such as Poland syndrome, where the absence of the breast is associated with absence of the pectoralis major muscle, rib cage and ipsilateral upper limb deformities. Ectodermal dysplasias can affect the breast, but two or more abnormalities of ectodermal structures – hair, teeth, nails, sweat glands, craniofacial structures – would be required to consider the diagnosis.

## REFERENCES:

1. Caouette-Laberge L, Borsuk D. Congenital anomalies of the breast. *Semin Plast Surg*. 2013 Feb;27(1):36-41.
2. Hatono A, Nagasao T, Sotome K, et al. A case of congenital unilateral amastia. *J Plast Reconstr Aesthet Surg*. 2012 May;65(5):671-674. Epub 2011 Nov 2.
3. van Aalst JA, Phillips JD, Sadove AM. Pediatric chest wall and breast deformities. *Plast Reconstr Surg*. 2009 Jul;124(1 Suppl):38e-49e.

163. A 23-year-old man is evaluated 1 day after undergoing a chemical peel to the face, entire back, arms, forearms, and hands, in a nonmedical setting. The patient reports nausea, disorientation, and ringing of the ears. Which of the following chemical peels was most likely used on this patient?
- A) Glycolic acid
  - B) Resorcinol
  - C) Salicylic acid
  - D) Solid carbon dioxide slush
  - E) Trichloroacetic acid

The correct response is Option C.

This patient is presenting with symptoms of salicylism or salicylic acid toxicity, a rare side effect of salicylic acid peels. Symptoms can include: rapid breathing, tinnitus, hearing loss, dizziness, abdominal cramps and central nervous system reactions. It is more likely to occur when large surface areas are peeled. It has been reported with 20% salicylic acid applied to 50% of the body surface, and lesser areas when stronger concentrations are used. Therefore, care should be taken when treating skin conditions that cover large surface areas, such as acne or psoriasis, with this peel. In general, however, salicylic acid peels are safe when used in more modestly sized areas (less than 20% TBSA) and have minimal complications. They can be used in darker skin types (IV-VI) successfully.

Salicylism has also been reported when large areas are peeled with Jessner's solution.

The other listed peels do not exhibit this type of toxic reaction.

## REFERENCES:

1. Singh-Behl D, Tung R. Chemical peels. In: Alam M, Gladstone HB, Tung R, eds. *Requisites in Dermatology: Cosmetic Dermatology*. Philadelphia: Elsevier-Saunders; 2008:81-102.
2. Grimes PE, Rendon MI, Pellerano J. Superficial Chemical Peels. In: Grimes PE, ed. *Aesthetics and Cosmetic Surgery for Darker Skin Types*. Philadelphia: Lippincott Williams & Wilkins; 2007:154-170.

164. A 48-year-old woman comes to the office because she is very unhappy with the appearance of her breasts following a bilateral mastopexy performed 1 year ago. Height is 5 ft 7 in (170 cm). BMI is 26 kg/m<sup>2</sup>. Which of the following findings on physical examination would be most difficult to correct?

- A) Asymmetrical breast size
- B) Dog ear of the inferior vertical scar
- C) Nipple to inframammary crease distance of 16 cm
- D) Nipple to sternal notch distance of 16 cm
- E) Widened circumareolar scar

The correct response is Option D.

A sternal notch to nipple distance of 16 cm represents a high-riding nipple. Revisional surgery for correction of a high-riding nipple is complex, and it is difficult to achieve a favorable result because of the surgeon's and patient's desire to avoid a scar extending superior to the nipple areola. Further, the paucity of excess skin between the nipple and clavicle limits the reconstructive options.

Suggested strategies include direct reposition of the nipple-areola complex, expansion of the skin between the nipple and clavicle, and repositioning of the breast parenchyma and inframammary crease.

Breast size asymmetry can be improved with either liposuction or revision mastopexy/reduction. The operation is usually performed using the previous incisions.

A dog ear of the inferior vertical scar is easily revised with a small transverse scar within the inframammary crease. The majority of these early postoperative deformities will resolve without surgery.

Recurrence of ptosis or an elongation of the nipple to inframammary crease distance occurs with all mastopexy operations. When performing secondary mastopexy, this can be improved with shortening the vertical scar with wedge resection at the inframammary crease. Knowledge of the location of the previous nipple areola pedicle is helpful in minimizing vascular complications.

Widened circumareolar scars can be revised with excellent results. Utilizing a permanent suture around the areola helps control size of the areola and tension on the suture line.

## **REFERENCES:**

1. Spear SL, Albino FP, Al-Attar A. Classification and management of the postoperative, high-riding nipple. *Plast Reconstr Surg*. 2013 Jun;131(6):1413-1421.
2. Colwell AS, May JW Jr, Slavin SA. Lowering the postoperative high-riding nipple. *Plast Reconstr Surg*. 2007 Sep;120(3):596-599.

165. A 35-year-old woman comes to the office for consultation regarding a tummy tuck. She wants the scar as low as possible, but she does not want a lower vertical midline scar. Physical examination shows mild upper and lower abdominal skin excess and rectus abdominis diastasis. BMI is 27 kg/m<sup>2</sup>. Abdominoplasty and repair of diastasis are planned. Intraoperatively, there is marked tension on the lower central abdominal flap closure. Which of the following is the most appropriate maneuver to decrease the tension on the repair?
- A) Creation of a 3-cm transverse umbilical opening
  - B) Liposuction of the upper abdomen
  - C) Relaxing incision of the external oblique fascia
  - D) Scoring of Scarpa fascia to the dermis
  - E) Use of progressive tension sutures

The correct response is Option E.

Progressive tension sutures are placed from Scarpa's fascia to the abdominal wall fascia. This helps close the dead space, minimize flap movement, and minimize seroma rate. When placing these sutures with progressive tension, final tension on the abdominal suture line can be lessened. In so doing, healing complications can be reduced.

The more common method for reducing tension on flap closure is to close the native umbilical skin opening in a vertical direction. This technique leaves a vertical incision in the midline of the abdominal flap. The need for revision of this scar is not infrequent. Further, most patients want to avoid this scar.

Creating a 3-cm transverse incision for the umbilicus would decrease the tension on the flap; however, the appearance of the umbilicus would be aesthetically unacceptable.

Relaxing incision of the external oblique fascia is used for closure of ventral herniorrhaphy and would not lessen skin flap tension.

Scoring Scarpa's fascia to the dermis would injure the subdermal vascular plexus, on which the vascularity of the abdominal flap depends.

Upper abdominal liposuction can be performed at the same time as abdominoplasty, provided care is taken to maximize preservation of the lateral rectus perforators. It would not be a solution to minimize skin tension.

## **REFERENCES:**

1. Hurvitz KA, Olaya WA, Nguyen A, et al. Evidence-based medicine: Abdominoplasty. *Plast Reconstr Surg*. 2014 May;133(5):1214-1221.
2. Pollock TA, Pollock H. Progressive tension sutures in abdominoplasty: a review of 597 consecutive cases. *Aesthet Surg J*. 2012 Aug;32(6):729-742. Epub 2012 Jun 29.

166. A 45-year-old woman comes to the office to discuss aesthetic improvement of the lower eyelids. Physical examination shows lower eyelid pseudoherniation of fat and fine skin wrinkles. A postseptal transconjunctival approach with skin pinch excision is considered. The most significant advantage of this approach compared with a transcutaneous skin-muscle flap is a lower risk of which of the following complications?

- A) Capsulopalpebral fascia injury
- B) Corneal injury
- C) Hematoma
- D) Infection
- E) Lid malposition

The correct response is Option E.

Transconjunctival blepharoplasty preserves the middle lamella, which includes the orbicularis oculi muscle. Preserving this layer significantly decreases the incidence of ectropion and lower eyelid malposition. Disadvantages of this technique include more difficulty with visualization and access. Many authors believe that a cutaneous skin muscle approach is more effective in blending the lid-cheek junction and transposing fat.

Some studies have shown minor reductions in hematoma and infection rates with the transconjunctival approach; however, the differences are small and not the most significant advantage.

The potential for corneal injury is greater with the transconjunctival approach. Most surgeons use corneal shields to prevent this complication.

The capsule palpebral fascia is routinely cut to access the fat compartments during a transconjunctival blepharoplasty.

## REFERENCES:

1. Pacella SJ, Nahai FR, Nahai F. Transconjunctival blepharoplasty for upper and lower eyelids. *Plast Reconstr Surg*. 2010 Jan;125(1):384-392.
2. Drolet BC, Sullivan PK. Evidence-based medicine: Blepharoplasty. *Plast Reconstr Surg*. 2014 May;133(5):1195-1205.

3. Sadove RC. Transconjunctival septal suture repair for lower lid blepharoplasty. *Plast Reconstr Surg.* 2007 Aug;120(2):521-529.
4. Lelli GJ Jr, Lisman RD. Blepharoplasty complications. *Plast Reconstr Surg.* 2010 Mar;125(3):1007-1017.

167. The mammary glands develop from which of the following embryologic structures?

- A) Bilateral mesenchymal condensations
- B) Ingrowths from the ectoderm
- C) Ingrowths from the mesoderm
- D) Proliferating masses of endoderm
- E) Proliferating masses of mesenchyme

The correct response is Option B.

The breasts, or mammary glands, are modified sweat glands. They are ingrowths from the ectoderm that form the lactiferous ducts and alveoli. They begin as linear mammary ridges with 15 to 20 buds. During the seventh week in utero, these buds undergo apoptosis, leaving a single pair of solid buds—the primary mammary buds—at the fourth or fifth intercostal space.

Proliferating masses of mesenchyme are at the center of each limb bud. The mesoderm gives rise to organs, musculature, vasculature, and connective tissues. The endoderm becomes the epithelial lining of the alimentary tract. Bilateral mesenchymatous condensations develop into the sternum.

## REFERENCES:

1. Lemaine V, Simmons PS. The adolescent female: breast and reproductive embryology and anatomy. *Clin Anat*. 2013 Jan;26(1):22-28.
2. Williams PL, Warwick R, Dyson M, et al. *Gray's Anatomy*. 37th ed. Edinburgh: Churchill Livingstone; 1989.

168. A 35-year-old woman is dissatisfied with the appearance of her nose. Physical examination shows parenthesis tip deformity with vertically oriented lower lateral cartilages. Which of the following grafts is most appropriate for correction of this deformity?

- A) Caudal septal extension
- B) Crural turnover
- C) Lateral crural strut
- D) Spreader
- E) Spring

The correct response is Option C.

This patient presents with a parenthesis deformity with vertically oriented lower lateral cartilages. To correct this deformity, the lower lateral cartilages must be rotated inferiorly. A lateral crural strut graft is a strip of cartilage 3 to 4 mm in width sutured to the deep surface of the lateral crura and then either buried or sutured to the soft tissue of the pyriform aperture. In this way, the native lower lateral cartilage can be rotated inferiorly and held in place.

A caudal septal extension graft is sutured to the caudal septum and is used to control nasal tip projection as well as lengthen an overly shortened nose.

A crural turnover graft is created by folding the cephalic portion of the upper lateral cartilage inferiorly onto itself. It thereby strengthens itself and is used to support weakened or collapsed lower lateral cartilages.

Spreader grafts are placed at the dorsal edge of the septum to correct internal nasal valve collapse and support the upper lateral cartilages.

A spring graft widens the middle vault by spanning between both upper lateral cartilages.

## REFERENCES:

1. Rohrich RJ, Lee MR. External approach for secondary rhinoplasty: advances over the past 25 years. *Plast Reconstr Surg*. 2013 Feb;131(2):404-416.

2. Losquadro WD, Toriumi DM. Tip Grafting for Nasal Contouring. In: Nahai F, ed. *The Art of Aesthetic Surgery: Principles and Techniques*. 2nd ed. Boca Raton, FL: CRC Press; 2011:1975-2022.

169. A 22-year-old nulliparous woman is evaluated for improvement of breast shape and size. Examination shows bilateral hypoplastic breasts with constricted bases and herniation of breast parenchyma in the areolae. Tuberous breast deformity is diagnosed. Bilateral breast augmentation with smooth, round gel implants via periareolar incisions is planned. Which of the following maneuvers is most likely to decrease the risk for a "double-bubble" deformity?

- A) Decreasing the areolar diameter
- B) Lowering of the inframammary fold
- C) Parenchymal scoring
- D) Periareolar incision
- E) Subpectoral placement of the implant

The correct response is Option C.

Common hallmarks of tuberous breast deformity include varying degrees of hypoplastic breast parenchyma, deficiencies of the inferior pole, herniation of the parenchyma in the areola, enlarged areolae, superior placement of the inframammary fold, and asymmetry. Surgical goals are to achieve symmetry, sufficient volume (especially in the hypoplastic areas), lowering of the inframammary fold, reduction of areolar tissue herniation, and correction of any ptosis. A double-bubble deformity can occur when the inframammary fold is not sufficiently obliterated. The risk for this is increased with superiorly displaced inframammary folds, as in tuberous breasts. Parenchymal scoring would both release any constricting bands to allow the lower pole tissue to spread over the implant as well as release the superiorly displaced inframammary fold. While decreasing the areolar diameter and lowering of the inframammary fold are goals for breast improvement, neither will treat a double-bubble deformity. A periareolar incision is often advocated in repair of tuberous breasts because of the ability to reduce the areola; it alone, however, will not prevent a double-bubble deformity. Subpectoral placement of implants increases the risk for double-bubble deformity while subglandular placement of implants decreases the risk. Many advocate a dual-plane approach to capitalize on increased upper pole coverage combined with the benefits of a subglandular relationship in the inferior pole.

## REFERENCES:

1. Kolker AR, Collins MS. Tuberous breast deformity: classification and treatment strategy for improving consistency in aesthetic correction. *Plast Reconstr Surg*. 2015 Jan;135(1):73-86.
2. Nahabedian MY. Breast deformities and mastopexy. *Plast Reconstr Surg*. 2011 Apr;127(4):91e-102e.
3. Handel N. The double-bubble deformity: cause, prevention, and treatment. *Plast Reconstr Surg*. 2013 Dec;132(6):1434-1443.

170. Compared with liposuction, which of the following is the greatest advantage of cryolipolysis?
- A) No procedural discomfort
  - B) No risk of bruising
  - C) No risk of posttreatment swelling
  - D) No surgical intervention
  - E) Shorter duration of treatment time

The correct response is Option D.

Nonsurgical fat freezing treatment (CoolSculpting) is a method of noninvasive fat reduction that occurs via the use of cryolipolysis. It is a noninvasive technique that takes place in an office setting and does not involve the use of surgery. Following CoolSculpting treatment, patients have some aspect of bruising and swelling, which can last for up to several weeks. Results of CoolSculpting treatments typically take 3 to 4 months to develop. Results are additive, however, with multiple treatments. CoolSculpting involves the utilization of different applicators that have been developed to treat various parts of the body effectively. Each actual treatment is for 1 hour; however, most areas of the body may require multiple treatments to be effectively managed. Treatment times for an abdomen can range from 2 to 6 hours alone, whereas outer thighs are treated for at least 2 hours per side and inner thighs at least 1 hour per side. Although not all of these treatments need to be performed in one sitting, the total time for CoolSculpting treatments for most areas of the body are much longer than it would take to surgically perform liposuction. In general, however, CoolSculpting is a less expensive treatment option compared with liposuction as there is no fee necessary for anesthesia or operating-room costs.

## REFERENCES:

1. Avram MM, Harry RS. Cryolipolysis for subcutaneous fat layer reduction. *Lasers Surg Med*. 2009 Dec;41(10):703-708.
2. Stevens WG, Pietrzak LK, Spring MA. Broad overview of a clinical and commercial experience with CoolSculpting. *Aesthet Surg J*. 2013 Aug 1;33(6):835-846. Epub 2013 Jul 15.

171. A 35-year-old woman, gravida 2, para 2, seeks implant-based augmentation mammoplasty. She breastfed both her children. Which of the following is the most common complication of this procedure?
- A) Early implant rupture
  - B) Hematoma
  - C) Infection
  - D) Lifetime need for reoperation
  - E) Seroma

The correct response is Option D.

Augmentation mammoplasty is known to have high rates of complications including reoperation. Infection, seroma, hematoma, and early implant rupture are rare in elective, cosmetic augmentation mammoplasty.

## REFERENCES:

1. Khavanin N, Jordan SW, Rambachan A, et al. A systematic review of single-stage augmentation-mastopexy. *Plast Reconstr Surg*. 2014 Nov;134(5):922-931.
2. Castello MF, Silvestri A, Nicoli F, et al. Augmentation mammoplasty/mastopexy: lessons learned from 107 aesthetic cases. *Aesthetic Plast Surg*. 2014 Oct;38(5):896-907. Epub 2014 Aug 7.
3. Swanson E. Prospective comparative clinical evaluation of 784 consecutive cases of breast augmentation and vertical mammoplasty, performed individually and in combination. *Plast Reconstr Surg*. 2013 Jul;132(1):30e-45e.

172. An otherwise healthy 46-year-old woman undergoes botulinum toxin type A (Botox) treatment for severe glabellar lines. Twelve units of Botox is administered into each corrugator muscle. Eight days later, the patient comes to the office because of ptosis of the right eyelid. Which of the following muscles is most likely inadvertently affected in this patient?

- A) Frontalis
- B) Levator palpebrae superioris
- C) Müller muscle
- D) Orbicular muscle of the eye
- E) Procerus

The correct response is Option B.

Ptosis following botulinum toxin type A (Botox) treatment to the glabellar area is most commonly associated with inadvertent exposure of the levator palpebrae superioris muscle to Botox. This muscle is the primary upper eyelid elevator and is innervated by the third cranial nerve. The muscle portion arises from the greater wing of the sphenoid and is typically 40 mm long. The tendinous distal portion is 14 to 20 mm long and is termed the levator aponeurosis. The transition from the muscular to the tendinous portion occurs in the region of Whitnall's ligament, a condensation of the superior sheath of the levator muscle.

Ptosis from Botox treatments most commonly occurs when the Botox spreads outside the intended target muscle. This is most commonly a technical error on the part of the injector by not staying high enough within the corrugator muscle and above the orbital rim. Ptosis from Botox injections cannot be reversed; however, the condition does completely resolve when the Botox effect wears off after several (3 to 4) months. Interval treatment to help improve, but not definitively treat, the ptosis consists of alpha-adrenergic eyedrops such as Iodipine or phenylephrine ophthalmic preparations, which cause stimulation of Müller's muscle to help improve the condition somewhat, but do not adequately resolve the ptosis. Müller's muscle is an accessory eyelid elevator and lies deep to the levator. It is innervated by the sympathetic nervous system. Contraction of this muscle (such as with pharmacologic stimulation) contributes about 2 mm to lid retraction.

## REFERENCES:

1. Parsa FD. How to avoid eyelid ptosis when injecting botulinum toxin into corrugators. *Plast Reconstr Surg*. 2000 Apr;105(4):1564-1565.
2. Carruthers J, Fagien S, Matarasso SL, et al. Consensus recommendations on the use of botulinum toxin type A in fat aesthetics. *Plast Reconstr Surg*. 2004 Nov;114(6 Suppl):1S-22S.

173. During routine brachioplasty, which of the following nerves is/are most likely at risk during typical dissection?
- A) Lateral antebrachial cutaneous nerve
  - B) Medial antebrachial cutaneous nerve
  - C) Sensory branches of the axillary nerve
  - D) Sensory branches of the radial nerve

The correct response is Option B.

The medial antebrachial nerve is most at risk for injury during routine brachioplasty surgery secondary to its superficial location within the subcutaneous tissue within the area of typical skin and soft-tissue excision. This nerve arises from the medial cord of the brachial plexus 78% of the time and from the lower trunk in 22%. After emerging from the axilla, the medial antebrachial cutaneous nerve travels medial to the brachial artery and lies adjacent to the basilic vein at the distal upper arm. In the distal or mid brachium, this nerve pierces the deep fascia to become very superficial running above the deep fascia at an average of 14 cm proximal to the medial epicondyle. Despite some minor anatomical variability, this nerve has been found to be consistently present in the deep plane of dissection for the standard brachioplasty technique.

## REFERENCES:

1. Knoetgen J 3rd, Moran SL. Long-term outcomes and complications associated with brachioplasty: a retrospective review and cadaveric study. *Plast Reconstr Surg*. 2006 Jun;117(7):2219-2223.
2. Gusenoff JA, Coon D, Rubin JP. Brachioplasty and concomitant procedures after massive weight loss: a statistical analysis from a prospective registry. *Plast Reconstr Surg*. 2008 Aug;122(2):595-603.

174. A healthy 64-year-old woman undergoes rhytidectomy with superficial musculoaponeurotic system (SMAS) plication and platysmaplasty. Preoperatively, 150 mL of tumescent solution is infiltrated into the face and neck. In the recovery room, the patient has buccal branch weakness of the right side. Overall facial swelling is noted, but the right side is slightly more swollen than the left side; the swelling and bruising are symmetric. Which of the following is the most appropriate next step in management of the right side of the face?

- A) Injection of corticosteroid
- B) Percutaneous aspiration
- C) Reexploration
- D) Release of potential nerve entrapment from sutures
- E) Observation only

The correct response is Option E.

The most common cause of postoperative facial nerve weakness following rhytidectomy is residual effect from local anesthesia. This effect can take several hours to wear off and the most reasonable course of management is to observe and reexamine the patient to ensure return of function. Corticosteroid injection is not indicated in this situation. Aspirating under the flap would not prove beneficial and is typically reserved for a small seroma that can develop within days following a rhytidectomy, not immediately following surgery. If there is cause for concern that a hematoma is present, then the patient should be returned to the operating room for evacuation of this and hemostasis. A hematoma would not, however, cause weakness of the facial nerve immediately postoperatively. Although nerve entrapment from sutures is a possible explanation for facial nerve weakness, it is much less likely a cause than a residual effect from the tumescent anesthesia.

## REFERENCES:

1. Chang S, Pusic A, Rohrich RJ. A systematic review of comparison of efficacy and complication rates among face-lift techniques. *Plast Reconstr Surg*. 2011 Jan;127(1):423-433.
2. Mustoe TA, Buck DW 2nd, Lalonde DH. The safe management of anesthesia, sedation, and pain in plastic surgery. *Plast Reconstr Surg*. 2010 Oct;126(4):165e-176e.

175. A healthy 27-year-old woman is evaluated 16 weeks after bilateral reduction mammoplasty with an inferior pedicle technique. Histologic examination of the resected tissue shows no malignancy. She reports a tender mass in the right breast that she noted 8 weeks after operation. She is now apprehensive because her mother had breast cancer at age 34. Physical examination of the affected breast shows a palpable, slightly tender, discrete, firm 2-cm subcutaneous mass beneath the upper areolar border. Examination shows no skin dimpling, nipple retraction, erythema, or edema. Which of the following is the most appropriate next step in management?
- A) Conduct needle aspiration of the lesion
  - B) Inject triamcinolone acetonide suspension 20 mg into the mass
  - C) Proceed to surgery for removal of the mass
  - D) Refer the patient for an oncology consultation
  - E) Schedule ultrasonography and mammography of the affected breast

The correct response is Option E.

Postsurgical changes in the breast after reduction mammoplasty encompass a variety of physical and radiographic manifestations. On presentation of a breast mass after reduction mammoplasty, a diagnostic protocol is used to determine whether operative intervention is appropriate, to avert unnecessary biopsy and to avoid overlooking breast malignancy. Fat necrosis, oil cysts, fibrosis, organizing hematoma, calcifications and, rarely, concurrent malignancy should be considered in this patient. In the absence of acute phenomena characteristic of a wound infection, work-up should consist of mammography and ultrasonography of the affected breast. Combining the radiographic findings with echographic appearance of the mass will help to differentiate fat necrosis and other benign conditions from the more ominous malignant etiology. The mammographic appearance of fat necrosis ranges from completely undetectable to a spiculated density and clustered microcalcifications. Many authors believe that the calcifications of fat necrosis can be distinguished from those seen with breast malignancies. Ultrasonographic findings include a solitary cyst, heterogenous echogenicity, and microcalcifications. Any remaining doubt as to the biologic nature of the mass should then be pursued with needle or open biopsy of the mass. Injection of any agent into the mass before it is definitively diagnosed is contraindicated, as is surgical removal or observation without obtaining a confident exclusion of malignancy. Referral to an oncologist would be premature in this instance and would provoke an unnecessary level of patient anxiety.

## REFERENCES:

1. O'Grady KF, Thoma A, Dal Cin A. A comparison of complication rates in large and small inferior pedicle reduction mammoplasty. *Plast Reconstr Surg*. 2005 Mar;115(3):736-742.
2. Hogge JP, Robinson RE, Magnant CM, et al. The mammographic spectrum of fat necrosis of the breast. *Radiographics*. 1995 Nov;15(6):1347-1356.
3. Mendelson EB. Evaluation of the postoperative breast. *Radiol Clin North Am*. 1992 Jan;30(1):107-138.
4. Rubin E. Breast imaging considerations in fat grafting to the breast. *Plast Reconstr Surg*. 2011 Nov;128(5):570e-571e.
5. Rao A, Saadeh PB. Defining fat necrosis in plastic surgery. *Plast Reconstr Surg*. 2014 Dec;134(6):1202-1212.

176. A 22-year-old woman is evaluated for revision rhinoplasty. A closed approach is planned. The alar margin is in an appropriate position. On lateral view, excessive columellar show is noted. Which of the following incisions is most appropriate for management of this deformity?

- A) Alar rim
- B) Intercartilaginous
- C) Intracartilaginous
- D) Killian
- E) Transfixion

The correct response is Option E.

On anterior/posterior view, the alar margin and columella have been described as ideally having the appearance of a gentle gull wing in flight. The columella represents the body of the gull and in this patient it is noted to be elongated with the wings (alar margin) appearing to be normal. On lateral view, the nostril should have an oval shape. A line drawn along the long axis should bisect it into equal halves with the alar rim being 1 to 2 mm above this line and the columella 1 to 2 mm below.

The patient described exhibits findings consistent with a hanging columella. The etiology of this problem is due to either a long caudal septum, long medial crura, or combination of the two. The transfixion incision is in the membranous septum at the border of the caudal septum. It is the only incision listed above that allows access to the caudal septum for excision and can also resect any redundant membranous septum that may develop as a result of the setback.

An intracartilaginous incision is made within the substance of the lateral crus of the lower lateral cartilage. It can be used in a closed approach to combine the incision for the access to the nose with the removal of the cartilage superior to the incision to accomplish a cephalic trim of the lower lateral cartilage.

A Killian incision is used for access to the septum. It is placed 1 to 2 cm posterior to the caudal border of the septal cartilage.

An alar rim incision is made in the vestibular skin just inside the border of the nostril. This incision can be used as an approach to create a pocket for a nonanatomical rim graft.

The intercartilaginous incision is made between the upper and lower lateral cartilages and would not improve columellar show.

## **REFERENCES:**

1. Kridel RW, Chiu RJ. The management of alar columellar disproportion in revision rhinoplasty. *Facial Plast Surg Clin North Am.* 2006 Nov;14(4):313-329.
2. Sajjadian A, Guyuron B. Primary rhinoplasty. *Aesthet Surg J.* 2010 Jul-Aug;30(4):527-539.
3. Rohrich RJ, Ahmad J. Open technique rhinoplasty. In: Neligan PC, Gurtner GC, eds. *Plastic Surgery*. 3rd ed. Philadelphia: Elsevier-Saunders; 2013:386-412.

177. A 34-year-old woman is evaluated for body contouring after Roux-en-y gastric bypass surgery 6 months ago. There is no evidence of malabsorption. BMI is 36.3 kg/m<sup>2</sup>. She had a 75-lb (34-kg) weight loss and is actively losing weight. The patient reports low back pain. Which of the following is the most appropriate next step in management?

- A) Liposuction
- B) Panniculectomy
- C) Revision of the gastric bypass surgery
- D) Upper GI series
- E) Observation

The correct response is Option E.

After bariatric surgery, patients can continue to lose weight as a result of the surgical procedure for approximately 2 years. Thus, most recommendations call for waiting until patients are 12 to 18 months out from their bariatric surgery and at a stable weight for 3 to 6 months. Ideally, patients should be within 10 to 15% of their goal weight.

In this case, the patient is still within the time frame of active weight loss, and notes that she is actively losing weight. Thus, the appropriate answer is to wait until weight loss has stabilized.

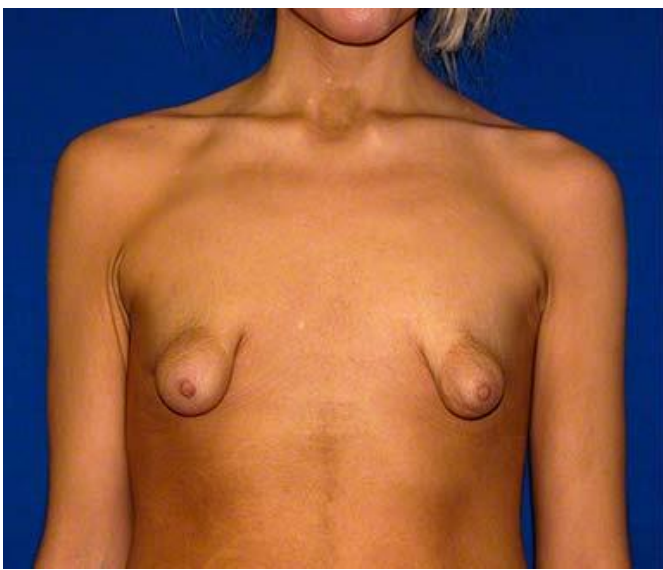
Because this patient is actively losing weight and there are no clinical findings of any issues such as malabsorption, there is no indication currently to evaluate her with an upper GI series or revise her bypass.

In addition, as noted above, the risks for surgery are increased at this patient's BMI. Thus, elective liposuction or panniculectomy is not appropriate at this time. Furthermore, because the patient is actively losing weight, the risk for revision surgery to address additional skin laxity that may develop with further weight loss makes undertaking these procedures not appropriate at this point in time.

## REFERENCES:

1. Hng KN, Ang YS. Overview of bariatric surgery for the physician. *Clin Med*. 2012 Oct;12(5):435-440.

2. Michaels J 5th, Coon D, Rupin JP. Complications in postbariatric body contouring: strategies for assessment and prevention. *Plast Reconstr Surg*. 2011 Mar;127(3):1352-1357.
3. Toy JW, Rubin JP. Post-bariatric reconstruction. In: Neligan PC, Gurtner GC, eds. *Plastic Surgery*. 3rd ed. Philadelphia: Elsevier-Saunders; 2013:634-654.
4. van der Beek ES, van der Molen AM, van Ramshorst B. Complications after body contouring surgery in post-bariatric patients: the importance of a stable weight close to normal. *Obes Facts*. 2011;4(1):61-66. Epub 2011 Feb 16.



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

178. An 18-year-old woman comes to the office for evaluation of her breasts. Photographs of the patient are shown. Which of the following statements most accurately describes the anatomy of this patient's breasts?
- A) The areola is normal size although the breast is small
  - B) The breast tissue is uniformly distributed throughout the breast pocket
  - C) The inframammary fold is elevated
  - D) The skin envelope has greater laxity than in a normal breast
  - E) The underlying musculature is underdeveloped

The correct response is Option C.

The tuberos breast deformity results in a protruding, oblong shape that resembles a tuberous root plant (Latin derivation tuber = to swell). The features noted in the tuberous breast deformity include a constricted breast base, decreased breast parenchyma, abnormal elevation of the inframammary fold, a decreased skin envelope, and herniation of the breast parenchyma through the central breast and into the areola. The areola is large and lacks firm underlying structure, thus allowing the breast tissue to protrude through this path of least resistance. The deformity is also often referred to as a tubular breast, constricted breast, doughnut breast, nipple breast, breast with narrow base, dome nipple, and snoopy dog breast.

The overall etiologic factors leading to the full expression of the constricted breast deformity are still largely unknown and likely involve a delicate balance of anatomic and endocrinologic forces. A constricting fibrous ring at the level of the areola periphery, representing probably a thickening of the superficial fascia coupled with the normally absent fascial layer in the NAC, has been proposed as a likely cause. The ring is composed of dense fibrous tissue made of large concentrations of collagen and elastic fibers arranged longitudinally. It is usually denser at the lower part of the breast and does not allow the developing breast parenchyma to expand during puberty. It has been suggested that a thickening of the superficial fascia combined with the absence of a superficial fascial layer under the NAC is the underlying anatomic/histopathologic cause of the deformity. The cause of the thickened fascia is unknown, although at least one study by Klinger, Caviggioli, et al. demonstrated altered collagen in both disposition and quantity. The same study excluded amyloid deposition as a component of the fibrosis.

The areola in the tuberous breast still contains the normal muscular structures that result in areolar changes with stimulation and temperature changes, although the tissue beneath the areola may be thinned.

## **REFERENCES:**

1. Pacifico MD, Kang NV. The tuberous breast revisited. *J Plast Reconstr Aesthet Surg*. 2007;60(5):455-464. Epub 2007 Feb 21.
2. Costagliola M, Atiyeh B, Rampillon F. Tuberous breast: revised classification and a new hypothesis for its development. *Aesthetic Plast Surg*. 2013 Oct;37(5):896-903. Epub 2013 Apr 30.

179. A 45-year-old woman undergoes mastectomy. Which of the following anatomical landmarks denotes a limit of the breast and, therefore, a limit to the extent of the mastectomy?
- A) Anterior border of latissimus dorsi muscle
  - B) Inferior origin of pectoralis major muscle
  - C) Lateral pectoralis minor muscle
  - D) Superficial fascia of the serratus anterior muscle
  - E) Supraclavicular lymph node basin

The correct response is Option A.

The borders of the breast and, therefore, the limits of the mastectomy are the sternum, clavicle, inframammary fold, and anterior border of the latissimus dorsi muscle. The other options are not designated as borders of the breast tissue.

## REFERENCES:

1. Kuwajerwala, NK. Modified Radical Mastectomy. Available at: <http://emedicine.medscape.com/article/1830105-overview>. Accessed May 13, 2015.
2. Baker M. Breast Cancer: Surgical Management In: Cameron JL, ed. *Current Surgical Therapy*. 11th ed. Philadelphia: Elsevier-Saunders; 2013:584-587.

180. Compared with standard suction-assisted lipectomy, laser-assisted liposuction has been shown to decrease which of the following?

- A) Contour irregularities
- B) Ecchymosis
- C) Postoperative pain
- D) Skin necrosis
- E) Swelling

The correct response is Option C.

A prospective, randomized, double-blind study involving human subjects compared the effects of laser-assisted lipoplasty with suction-assisted lipoplasty. No significant difference was noted between the two groups with respect to cosmetic outcome, ecchymosis, edema, skin retraction, or surgical time. The only measured potential benefit of the laser-assisted technique was an overall decrease in postoperative pain.

#### **REFERENCES:**

1. Prado A, Andrades P, Danilla S, et al. A prospective, randomized, double-blind, controlled clinical trial comparing laser-assisted lipoplasty with suction-assisted lipoplasty. *Plast Reconstr Surg*. 2006 Sep 15;118(4):1032-1045.
2. Gingrass MK. Liposuction. In: Thorne CH, Chung KC, Gosain AK, et al., eds. *Grabb and Smith's Plastic Surgery*. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2013:679-687.

181. A healthy 65-year-old woman is evaluated because of drooping of the upper eyelids. Examination shows high eyelid creases and 3 mm of ptosis. Levator excursion measures 10 mm. Which of the following is most likely to correct the blepharoptosis in this patient?

- A) Brow lift surgery
- B) Fasanella-Servat procedure
- C) Frontalis sling
- D) Levator advancement
- E) Upper eyelid blepharoplasty

The correct response is Option D.

The patient described has moderate acquired blepharoptosis characterized by a high eyelid crease and 3 mm of ptosis. Her levator palpebrae muscle excursion is excellent (10 mm). The most likely cause is disinsertion of the levator aponeurosis from the tarsal plate due to chronic stretching of the levator muscle or involutional changes associated with aging. Surgical treatment most commonly involves advancing and reattaching the levator muscle to the tarsal plate.

An upper eyelid blepharoplasty alone or with a browlift would not correct the underlying cause of the ptosis.

The Fasanella-Servat (tarsconjunctival mullerectomy) procedure classically excises a portion of mucosa, Müller's muscle, and superior tarsus, thereby shortening the posterior lamella. This can address mild ptosis (1 to 2 mm) in a patient with otherwise excellent levator function.

The frontalis sling procedure uses autologous or alloplastic material tunneled from the brow to upper tarsus to accomplish upper eyelid elevation when levator function is poor. The cause of ptosis in these cases is likely congenital.

## REFERENCES:

1. Newman MI, Spinelli HM. Reconstruction of the Eyelids, Correction of Ptosis, and Canthoplasty. In: Thorne CH, Bartlett SP, Beasley RW, et al, eds. *Grabb & Smith's Plastic Surgery*. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2006:397-416.

2. Jindal K, Sarcia M, Codner MA. Functional considerations in aesthetic eyelid surgery. *Plast Reconstr Surg*. 2014 Dec;134(6):1154-1170.
3. Pearl RM. Acquired ptosis: a reexamination of etiology and treatment. *Plast Reconstr Surg*. 1985 Jul;76(1):56-64.

182. A 56-year-old woman undergoes bilateral reduction mammoplasty. Eight hundred grams per breast is removed and sent to permanent pathology. Which of the following results most likely requires further discussion with a breast surgeon?
- A) Apocrine metaplasia
  - B) Atypical lobular hyperplasia
  - C) Fibroadenoma
  - D) Papillomatosis
  - E) Sclerosing adenosis

The correct response is Option B.

All of the answers are examples of benign breast disease. However, atypical lobular hyperplasia (ALH) is associated with an increased risk for breast cancer. Depending on other patient risk factors, chemoprevention with anti-estrogen medications and increased surveillance may be recommended.

#### REFERENCES:

1. Hartmann LC, Sellers TA, Frost MH, et al. Benign breast disease and the risk of breast cancer. *N Engl J Med*. 2005 Jul 21;353(3):229-237.
2. Tice JA, O'Meara ES, Weaver DL, et al. Benign breast disease, mammographic breast density, and the risk of breast cancer. *J Natl Cancer Inst*. 2013 Jul 17;105(14):1043-1049. Epub 2013 Jun 6.
3. Ambaye AB, MacLennan SE, Goodwin AJ, et al. Carcinoma and atypical hyperplasia in reduction mammoplasty: increased sampling leads to increased detection. A prospective study. *Plast Reconstr Surg*. 2009 Nov;124(5):1386-1392.
4. Pitanguy I, Torres E, Salgado F, Pires Viana GA. Breast pathology and reduction mammoplasty. *Plast Reconstr Surg*. 2005 Mar; 115(3):729-734.

183. A 28-year-old woman is evaluated for micromastia. During consultation, she reports that her best friend underwent breast augmentation that was complicated by painful capsular contracture. Which of the following measures is most likely to prevent this complication in this patient?

- A) Initiation of implant massage on postoperative day 5
- B) Placement of a closed suction drain for prevention of postoperative hematoma
- C) Use of a surgical support bra postoperatively for 2 weeks
- D) Use of a subglandular, smooth, round implant via periareolar incision
- E) Use of a subpectoral, textured implant via inframammary incision

The correct response is Option E.

Capsular contracture occurs when there is fibrosis of the peri-implant capsule. The severity is typically described by the Baker Grade classification.

Grade 1: the breast is soft and appears normal in size and shape

Grade 2: the breast is a little firm and appears normal

Grade 3: the breast is firm and appears abnormal

Grade 4: the breast is firm, appears abnormal, and is painful

Studies have shown a decreased relative risk for Baker grade 3-4 capsular contracture in primary breast augmentation associated with inframammary fold incision, textured implants, and subpectoral placement. The relative risk for capsular contracture was increased with periareolar or axillary incision, smooth implants, and subglandular placement. There is no evidence that wearing a support bra or implant massage will decrease the risk for capsular contracture. While hematoma is linked to capsular contracture, the presence of a drain does not prevent hematoma.

## REFERENCES:

1. Namnoum JD, Largent J, Kaplan HM, et al. Primary breast augmentation clinical trial outcomes stratified by surgical incision, anatomical placement and implant device type. *J Plast Reconstr Aesthet Surg*. 2013 Sep;66(9):1165-1172. Epub 2013 May 9.
2. Wong CH, Samuel M, Tan BK, et al. Capsular contracture in subglandular breast augmentation with textured versus smooth breast implants: a systematic review. *Plast Reconstr Surg*. 2006 Oct;118(5):1224-1236.

184. Accidental division of the great auricular nerve during rhytidectomy most commonly results in which of the following outcomes?

- A) Gustatory sweating
- B) Inability to elevate the brow
- C) Loss of sensation to the temporal scalp
- D) Numbness of the earlobe
- E) Paralysis of the posterior auricular muscle

The correct response is Option D.

While the overall incidence of nerve injury during rhytidectomy is low, consequences, depending on which nerve is involved, can range from minor annoyance to devastating aesthetic and functional sequelae. Identification of the location of nerves that are likely to be subject to sharp or blunt injury during rhytidectomy is key to prevention of injury. An intimate knowledge of the anatomy is imperative, particularly for the trunk and branches of cranial nerve VII, the auriculotemporal nerve, and the great auricular nerve (GAN). Cranial nerve VII branch laceration can result in deficits of brow elevation (frontal branch), paralysis of the orbicularis oculi (zygomatic branch), buccinator incompetence (buccal branch), asymmetry of the lip depressors (marginal mandibular branch), or loss of platysma tone (cervical branch). The auriculotemporal nerve innervates the external auditory meatus, upper helix, and temporal scalp. Gustatory sweating (Frey's syndrome) occurs due to aberrant reinnervation of cutaneous sweat glands after disruption of auriculotemporal nerve branches, more likely after parotidectomy. Motor function of the posterior auricular muscle is provided by the temporal branch of cranial nerve VII. Transection of the GAN would result in a sensory disturbance to the lobule of the ear and may elicit dysesthesia, cold intolerance, or focally painful neuroma. It is the most frequently injured nerve during rhytidectomy, with an incidence estimated at up to 2.6%. It may be repaired with epineural suture to help prevent neuroma. A recently described method to avoid injury to the GAN locates it within a triangle constructed using the anterior limb perpendicular to the Frankfort horizontal and the posterior limb angled 30 degrees behind the first limb and passing through the midpoint of the earlobe.

## REFERENCES:

1. Ozturk CN, Ozturk C, Huettner F, et al. A failsafe method to avoid injury to the great auricular nerve. *Aesthet Surg J*. 2014 Jan 1;34(1):16-21. Epub 2013 Dec 12.
2. Rohrich RJ, Taylor NS, Ahmad, et al. Great auricular nerve injury, the "subauricular band" phenomenon, and the periauricular adipose compartments. *Plast Reconstr Surg*. 2011 Feb;127(2):835-843.

185. A 57-year-old woman with a history of modified left radical mastectomy followed by adjuvant chemotherapy and radiation therapy is evaluated six months after her last radiation treatment for breast reconstruction. Physical examination shows slight skin redundancy of the chest wall and grade 2 ptosis of the contralateral breast. She wears a size 36D brassiere and does not want to undergo symmetry procedures on the contralateral breast. Which of the following reconstructive options is most likely to achieve breast symmetry in this patient?

- A) Deep inferior epigastric perforator flap
- B) Latissimus dorsi flap
- C) Thoracodorsal artery perforator flap
- D) Tissue expander with acellular dermal matrix and staged implant placement
- E) Total submuscular tissue expander and staged implant placement

The correct response is Option A.

Breast reconstruction requires reconstruction of both the soft-tissue envelope and volume. In the setting of radiated chest wall tissues, it would be difficult to recreate a breast envelope of sufficient size to match the contralateral breast with tissue expansion, even with acellular dermal matrix or total submuscular placement of a tissue expander. The history of radiation would likely cause an element of capsular contracture and decrease symmetry to the contralateral breast with grade 2 ptosis. Both the latissimus dorsi flap and the thoracodorsal artery perforator flap would recruit non-radiated skin to create an adequate envelope, but would not provide adequate volume alone. The deep inferior epigastric perforator (DIEP) flap would provide both envelope and volume.

## REFERENCES:

1. Weichman KE, Cemal Y, Albornoz CR, et al. Unilateral preoperative chest wall irradiation in bilateral tissue expander breast reconstruction with acellular dermal matrix: a prospective outcomes analysis. *Plast Reconstr Surg*. 2013 May;131(5):921-927.
2. Chevray PM. Update on Breast Reconstruction Using Free TRAM, DIEP, and SIEA Flaps. *Semin Plast Surg*. 2004 May;18(2):97-104.

186. A 47-year-old woman, gravida 3, para 3, is evaluated for improvement of breast appearance. She breast-fed all three of her children for 1 year each. Examination shows the distance from nipple to sternal notch is 27 cm bilaterally; decreased superior pole volume, and striae are also noted. There is Grade 3 ptosis bilaterally. The pinch of the superior pole soft tissue is 1 cm. Which of the following procedures is most likely to improve superior pole volume and breast shape in this patient?

- A) Dual-plane implant augmentation
- B) Mastopexy with dual-plane implant augmentation
- C) Mastopexy with subglandular implant augmentation
- D) Subglandular implant augmentation
- E) Vertical mastopexy

The correct response is Option B.

Goals of improvement would be upper pole fullness and a coned, rounded breast, with raising the nipple. Because the superior pole thickness is less than 2 cm, a subglandular implant is not recommended. A dual-plane implant would not address the ptosis and would likely leave persistent ptosis. Vertical mastopexy alone would require some modification to address the excess vertical skin with some element of horizontal inferior excision. This would not address the lack of upper pole volume in the long term. The striae indicate poor tissue strength. Staged implant placement would have the fewest risks.

## REFERENCES:

1. Tebbetts JB. Dual plane breast augmentation: optimizing implant-soft-tissue relationships in a wide range of breast types. *Plast Reconstr Surg*. 2006 Dec;118(7 Suppl):81S-98S.
2. Spear S. Augmentation/Mastopexy: "Surgeon, Beware". *Plast Reconstr Surg*. 2003 Sep;112(3):905-906.

187. An otherwise healthy 54-year-old woman with Fitzpatrick Type II skin undergoes full-face carbon dioxide laser resurfacing. She received acyclovir for 3 days before the procedure. She is treated with a closed dressing regimen. On postoperative day 2, the patient has onset of facial pain and pruritus. Physical examination shows marked diffuse erythema and edema. Which of the following is the most likely diagnosis?

- A) Allergic reaction
- B) Bacterial infection
- C) Fungal infection
- D) Herpes simplex virus
- E) Normal healing

The correct response is Option E.

Resurfacing causes complete ablation of the epidermis and superficial papillary dermis with thermal injury and coagulation through the papillary dermis. Wound healing occurs by re-epithelialization from the dermal appendages (hair follicles and sebaceous glands) and is complete within 7 to 10 days. The thermally damaged dermal layers are repaired by the stimulation of fibroblasts. This coagulated tissue is replaced by new bundles of tight collagen, a process that continues for up to 6 months. Thus, the result tends to improve over time.

During the initial period of healing and during the re-epithelialization, there is considerable edema and exudation of proteinaceous material, resulting in redness and crusting. Erythema is most intense during the first month after treatment but may persist for 6 months or more.

In addition to intense erythema, other expected adverse effects occurring in virtually all patients during the first postoperative week include marked edema, pain, and pruritus.

Allergic reactions, or contact dermatitis, occur most often in open postoperative dressing regimens where the patient has used topical products that contain irritants. Signs and symptoms suggestive of an allergic contact dermatitis include diffuse and intense facial erythema and/or pruritus.

Bacterial and fungal infections are often the result of prolonged (greater than 48 hours) wound occlusion in the postoperative period. Although the risk of bacterial infection is increased in the closed technique compared with the open, in this case, the dressing was changed at day 1 and it is therefore unlikely. Additional findings on examination suggestive of infection include lesions with skin invasion, focal areas of increased erythema, discoloration, purulent rather than serous discharge, and ulceration. The patient described did not exhibit any of these findings. The most common bacterial pathogen is *Staphylococcus aureus*, and the most common fungal pathogen is *Candida*.

Despite adequate antiviral prophylaxis, 2 to 7% of laser-treated patients have been shown to develop herpes simplex virus reactivation. An outbreak on laser-treated skin may have symptoms such as superficial erosions and irregular redness. These findings are not present in this case.

## REFERENCES:

1. Sandel HD 4th, Perkins SW. CO2 laser resurfacing: still a good treatment. *Aesthet Surg J*. 2008 Jul-Aug; 28(4): 456-462.
2. Alster TS, Lupton JR. Prevention and treatment of side effects and complications of cutaneous laser resurfacing. *Plast Reconstr Surg*. 2002 Jan; 109(1): 308-316; discussion 317-318.
3. Alster TS, Khoury RR. Treatment of laser complications. *Facial Plast Surg*. 2009 Dec; 25(5): 316-323. Epub 2009 Dec 18.

188. A 35-year-old woman comes to the office for lipodystrophy of the upper arms. Physical examination shows negligible skin laxity; pinch test shows a thickness of 3 cm of the entire upper arm and the chest wall. Which of the following is the most appropriate surgical intervention?

- A) Extended brachioplasty
- B) Limited medial brachioplasty
- C) Mini brachioplasty
- D) Suction-assisted lipectomy
- E) Traditional brachioplasty

The correct response is Option D.

Skin laxity is the single greatest determinant of whether liposuction is an appropriate modality in an algorithmic approach to upper arm lipodystrophy. The determination of excessive fat can be made by the pinch test, and patients with greater than 1.5 cm of fat on a pinch test may be candidates. The classification of lipodystrophy, described by Rohrich et al., includes skin excess, fat excess, and the location of skin excess.

Where there is skin excess, the skin must be excised for a favorable result. Liposuction alone can exacerbate the appearance and presence of excess skin. Similarly, skin laxity is a predictor of liposuction success. With marked laxity, the skin is unlikely to have enough elastic properties to retract. Although there are some papers that show increased retraction of skin with laser liposuction, this has not been shown to be a consistent result in large-scale studies.

## REFERENCES:

1. Appelt EA, Janis JE, Rohrich RJ. An algorithmic approach to upper arm contouring. *Plast Reconstr Surg*. 2006 Jul;118(1):237-246.
2. Rohrich RJ, Beran SJ, Kenkel JM. Back and Arms. In: Rohrich RJ, Beran SJ, Kenkel JM, eds. *Ultrasound-Assisted Liposuction*. St. Louis, MO: Quality Medical Publishing; 1998:231-252.

189. A 55-year-old postmenopausal woman desires improvement in the appearance of her breasts. Change in which of the following levels of hormones is most likely responsible for postmenopausal involution of breast tissue?
- A) Estrogen
  - B) Growth hormone
  - C) Oxytocin
  - D) Prolactin
  - E) Testosterone

The correct response is Option A.

Estrogen is the primary hormone in promoting the development of the breast epithelium and ductal tissue. Progesterone acts in combination with estrogen to regulate breast development. With the onset of menopause, there is a decrease in the secretion of estrogen and progesterone. As a result of the decrease in the circulating levels of these hormones, the breast undergoes regression and atrophy of the glandular elements.

Oxytocin and prolactin are hormones involved in the physiology of lactation. Growth hormone and testosterone may have an effect on breast tissue, but they are not primary factors in the physiology of the female breast.

## REFERENCES:

1. Hassiotou F, Geddes D. Anatomy of the human mammary gland: Current status of knowledge. *Clin Anat*. 2013 Jan; 26(1): 29-48. Epub 2012 Sep 19.
2. Hunt KK, Green MC, Buchholz TA. Diseases of the Breast. In: Townsend CM, Beauchamp RD, Evers BM, et al., eds. *Sabiston Textbook of Surgery: The biological Basis of Modern Surgical Practice*. 19th ed. Philadelphia: Saunders; 2012: 824-869.

190. A 55-year-old woman comes to the office to discuss a facelift. A rhytidectomy with SMASectomy (superficial musculoaponeurotic system) is planned. Compared with a skin-only facelift, a SMAS tightening procedure is associated with a decrease in which of the following?

- A) Facial nerve injury
- B) Hematoma formation
- C) Infection rate
- D) Longevity of result
- E) Tension on the skin closure

The correct response is Option E.

When superficial musculoaponeurotic system (SMAS) tightening procedures are performed, the tension of the facelift is secured at the SMAS level rather than the skin. With a skin-only facelift, the lift must depend solely on the skin sutures for support. The more tension on the skin, the more likely a spread or hypertrophic scar will occur.

SMAS procedures do not decrease the longevity of results. Many surgeons believe that a SMAS facelift will produce better results and longer lasting results. Despite these opinions, there are no conclusive evidence-based studies to prove an increase in longevity of results.

Hematoma formation is related to hypertension and extent of dissection, not whether a SMASectomy was performed.

SMAS procedures put the facial nerve at greater danger than skin-only facelifts. The incidence of facial nerve injury is low with both techniques.

Infection rates are low with both procedures.

## REFERENCES:

1. Stuzin JM. MOC-PSSM CME article: Face lifting. *Plast Reconstr Surg*. 2008 Jan;121(1 Suppl):1-19.
2. Mustoe TA, Park E. Evidence-based medicine: Face lift. *Plast Reconstr Surg*. 2014 May;133(5):1206-1213.

191. An otherwise healthy 25-year-old man comes to the office with concerns about recent enlargement of his breasts. BMI is 28 kg/m<sup>2</sup> and has not changed during the past year. He does not take any prescription or illicit drugs. He has no nipple discharge. Examination of which of the following is most appropriate?
- A) Cervical lymph nodes
  - B) Cranial nerves
  - C) Peripheral pulses
  - D) Prostate
  - E) Scrotum and testes

The correct response is Option E.

The patient described is likely to have gynecomastia, which can occur in up to 30% of men. In the younger, postpubertal patients, testicular cancer may be a cause. Examination of the scrotum and testes to rule out any testicular masses has to be included in the physical examination and documented. Measurement of beta-human chorionic gonadotropin concentration can also be effective.

The other examinations listed do not directly contribute to the assessment of gynecomastia.

## REFERENCES:

1. Petty PM, Solomon M, Buchel EW, et al. Gynecomastia: evolving paradigm of management and comparison of techniques. *Plast Reconstr Surg*. 2010 May;125(5):1301-1308.
2. Hammond DC. Surgical correction of gynecomastia. *Plast Reconstr Surg*. 2009 Jul;124(1 Suppl):61e-68e.

192. A 23-year-old woman comes to the office for consultation regarding rhinoplasty because she is dissatisfied with her smile. Physical examination shows a drooping nasal tip, shortened upper lip, and transverse upper lip crease when the patient smiles. Which of the following muscles is the most likely cause of these findings?

A) Depressor anguli oris

B) Depressor septi nasi

C) Levator anguli oris

D) Levator labii superioris

E) Nasalis

The correct response is Option B.

The depressor septi nasi muscle is a small, paired muscle located on both sides of the nasal septum, originating from the medial crural footplates. Its action pulls the nasal tip downward and shortens the upper lip. The overactive muscle can cause the “smiling deformity” in the patient described. It is important to evaluate the smile of the rhinoplasty patient to determine whether the depressor septi nasi muscle needs to be addressed during the procedure in order to optimize results. The depressor septi nasi muscle can be released from the medial crura through the trans-nasal approach. If the patient has tethering of the frenulum, a depressor septi nasi muscle dissection and transposition can be performed through the trans-oral approach.

The depressor anguli oris originates from the mandible and inserts into the angle of the mouth. It depresses the corner of the mouth and is associated with frowning, and does not affect the nasal tip or upper lip.

The nasalis consists of two parts: transverse and alar. The transverse part arises from the maxilla, above and lateral to the incisive fossa; its fibers proceed upward and medial, expanding into a thin aponeurosis which is continuous on the bridge of the nose with that of the muscle of the opposite side, and with the aponeurosis of the procerus. The alar part is attached by one end to the greater alar cartilage, and by the other to the integument at the point of the nose. The transverse part compresses the nostrils, drawing them toward the septum. The alar part dilates, or flares, the nostrils. While the nasalis is involved in nasal movement, it does not cause the smile deformity described.

The levator anguli oris arises from the canine fossa, located under the infraorbital foramen. The muscle's fibers insert at the mouth's angle, and it intermingles with the zygomaticus, triangularis, and orbicularis oris muscles. Although the muscle is involved in and helps form the smile, it elevates the angle of the mouth at the corner and is not involved in nasal tip drooping and shortened upper lip.

The levator labii superioris is a broad, flat, quadrangle muscle, and may be considered as three parts extending between the lateral side of the nose and the zygoma in the infraorbital area: angular (medial), infraorbital (intermediate), and zygomatic (lateral) head. The medial part of the angular head inserts into the greater part of the lower lateral cartilages and nasal skin, and helps dilate the nostrils. The lateral part of the angular head, infraorbital, and zygomatic head all insert by merging with fibers of the orbicularis oris, and serve to elevate and evert the upper lip, the primary function of the muscle. Although it may contribute to shortening the upper lip upon activation, it does not cause nasal tip droop.

## **REFERENCES:**

1. Kalantar-Hormozi A, Beiraghi-Toosi A. Smile analysis in rhinoplasty: a randomized study for comparing resection and transposition of the depressor septi nasi muscle. *Plast Reconstr Surg*. 2014 Feb;133(2):261-268.
2. Rohrich RJ, Huynh B, Muzaffar AR, et al. Importance of the depressor septi nasi muscle in rhinoplasty: anatomic study and clinical application. *Plast Reconstr Surg*. 2000 Jan;105(1):376-383; discussion 384-388.

193. A 53-year-old woman with a BMI of 27 kg/m<sup>2</sup>, gigantomastia, and grade III ptosis is considering unilateral mastectomy and autologous reconstruction with abdominal tissue. Which of the following is the most appropriate advice regarding the contralateral breast?
- A) A contralateral prophylactic mastectomy should be performed to maximize symmetry
  - B) Contralateral reduction should be accompanied by placement of an implant on that side to address upper pole symmetry with the autologous reconstruction
  - C) Simultaneous contralateral reduction may be performed with an acceptable risk profile
  - D) Symmetry is unlikely to be achieved, so a contralateral matching procedure would not be recommended
  - E) Symmetry with autologous tissue is likely to be achieved without the contralateral matching procedure

The correct response is Option C.

Studies have shown that contralateral symmetry procedures performed synchronously with unilateral autologous tissue reconstruction after mastectomy (including reconstructions with a free perforator flap) are acceptable. Situations requiring reduction rather than augmentation or mastopexy seem to be the most suited to this timing. A patient with a lower BMI and gigantomastia is unlikely to achieve symmetry without a contralateral procedure. Autologous tissue reconstruction likely would not need a contralateral implant for upper pole symmetry. An attempt at improvement in symmetry using contralateral surgery would be acceptable should the patient so choose, but recommending a prophylactic mastectomy on the contralateral side solely for symmetry and not for risk reduction may be overly aggressive when other methods such as reduction mammoplasty exist with a likelihood of acceptable postoperative symmetry.

## REFERENCES:

1. Inbal A, Gur E, Otremski E, et al. Simultaneous contralateral breast adjustment in unilateral deep inferior epigastric perforator breast reconstruction. *J Reconstr Microsurg*. 2012 Jun; 28(5): 285-292.

2. Chang EI, Lamaris G, Chang DW. Simultaneous contralateral reduction mammoplasty or mastopexy during unilateral free flap breast reconstruction. *Ann Plast Surg*. 2013 Aug; 71(2): 144-148.

194. A 37-year-old woman reports nontender swelling of the lumbar area after undergoing lower body lift following massive weight loss. Examination shows tense swelling and a positive fluid wave test. Percutaneous needle aspiration is performed on a weekly basis, and fluid is still present after three aspirations of 150 mL each of a clear, yellowish serum. Which of the following is the most appropriate next step in management?

- A) Compression
- B) Operative incision and drainage
- C) Placement of a closed suction drain tube
- D) Use of an ipsilateral gluteus maximus muscle advancement flap

The correct response is Option C.

Among the most common complications following body contouring for post-massive weight loss-induced skin laxity is seroma, occurring in up to 35 to 50% of patients. To minimize the risk for seroma, preoperative nutritional repletion, especially for protein, and intraoperative use of closed suction drains, aggressive minimization of dead space, limited degree of skin flap undermining, and use of well-fitted elastic compression garments are among the techniques that are commonly recommended. None of these, even in combination, can completely guarantee the elimination of this complication. After several ineffective aspirations, compression garments alone are not likely to eliminate a seroma for this patient. The most appropriate next management measure for this patient's seroma is ultrasound-directed percutaneous closed suction drain placement. Operative incision and drainage is not indicated unless the closed drain fails, following failed sclerosant therapy, or if the seroma is shown to be infected. A muscle flap is not indicated in this setting.

## REFERENCES:

1. Shermak MA, Rotellini-Coltvet LA, Chang D. Seroma development following body contouring surgery for massive weight loss: patient risk factors and treatment strategies. *Plast Reconstr Surg*. 2008 Jul;122(1):280-8.
2. Michaels J 5th, Coon D, Rubin JP. Complications in postbariatric body contouring: postoperative management and treatment. *Plast Reconstr Surg*. 2011 Apr;127(4):1693-1700.

195. Which of the following is the most accurate location of the elliptical skin island of a profunda artery perforator (PAP) flap?
- A) Anteromedial thigh with the superior border within the groin crease
  - B) Inferior buttock with the inferior border within the gluteal fold
  - C) Lateral hip superior to the iliac crest
  - D) Middle buttock, from the posterior superior iliac spine to the apex of the greater trochanter
  - E) Posteromedial thigh with the superior border within the gluteal fold

The correct response is Option E.

According to the literature, the skin island of the profunda artery perforator (PAP) flap is inferior to the gluteal fold.<sup>1,2</sup> An ellipse of the inferior buttock with the inferior border within the gluteal fold describes the skin island of the inferior gluteal artery perforator (IGAP) free flap.<sup>3</sup> An ellipse of the anteromedial thigh with the superior border within the gluteal fold describes the transverse upper gracilis (TUG) flap. An ellipse of the middle buttock, from the posterior superior iliac spine to the apex of the greater trochanter, describes the superior gluteal artery perforator (SGAP) flap.<sup>3</sup> An ellipse of the lateral hip superior to the iliac crest describes the Rubens or lateral hip flap.<sup>4</sup> The only option that correctly identifies the skin island for the PAP flap is an ellipse of the posteromedial thigh with the superior border within the gluteal fold. The superior marking is within or just below the gluteal fold and the inferior marking is roughly 7 cm below the superior marking. The flap is an ellipse so the scar does not extend outside of the gluteal fold.<sup>1,2</sup>

## REFERENCES:

1. DeLong MR, Hughes DB, Bond JE, et al. A detailed evaluation of the anatomical variations of the profunda artery perforator flap using computed tomographic angiograms. *Plast Reconstr Surg*. 2014 Aug;134(2):186e-192e.
2. Haddock NT, Greaney P, Otterburn D, et al. Predicting perforator location on preoperative imaging for the profunda artery perforator flap. *Microsurgery*. 2012 Oct;32(7):507-511. Epub 2012 Mar 31.
3. Georgantopoulou A, Papadodima S, Vlachodimitropoulos D, et al. The microvascular anatomy of superior and inferior gluteal artery perforator (SGAP and IGAP) flaps: a fresh cadaveric study and clinical implications. *Aesthet Plast Surg*. 2014 Dec;38(6):1156-1163. Epub 2014 Sep 11.

4. Chang DW, Kroll SS, Dackiw A, et al. Reconstructive management of contralateral breast cancer in patients who previously underwent unilateral breast reconstruction. *Plast Reconstr Surg*. 2001 Aug;108(2):352-358.

196. A 28-year-old woman, gravida 2, para 2, undergoes augmentation mammoplasty 1 year post partum. On postoperative day 3, the patient comes to the office because of impaired wound healing at the incision site. Physical examination shows white viscous discharge leaking from the edge of the wound consistent with galactorrhea. Which of the following is the most appropriate management?
- A) Administration of bromocriptine
  - B) Administration of metoclopramide
  - C) Administration of trimethoprim-sulfamethoxazole
  - D) Application of negative pressure wound therapy
  - E) Debridement of the wound edges with wet-to-dry dressings

The correct response is Option A.

There are incidents of surgical procedures of the breast associated with galactorrhea leading to skin breakdown, nipple necrosis, and cellulitis. A dopamine agonist such as bromocriptine will cause decreased lactation in cases of galactorrhea/galactocele, thereby improving wound healing. Antibiotics such as sulfamethoxazole and trimethoprim (Bactrim) are generally not required, because the exudate is sterile. There is no need for debridement of the wound edges. Negative pressure wound therapy may increase lactation and galactorrhea, further impairing wound healing. Metoclopramide is a dopamine antagonist used for nausea and vomiting.

## REFERENCES:

1. Yang EJ, Lee KT, Pyon JK, et al. Treatment algorithm of galactorrhea after augmentation mammoplasty. *Ann Plast Surg.* 2012 Sep;69(3):247-249.
2. Tung A, Carr N. Postaugmentation galactocele: a case report and review of literature. *Ann Plast Surg.* 2011 Dec;67(6):668-670.

197. A 27-year-old woman comes to the office for evaluation of her nasal tip. She asks for rhinoplasty for improvement of her aesthetic appearance. Physical examination shows asymmetric projection of the nasal tip with a pinched nasal deformity. Which of the following cartilage grafts would best correct this deformity?

- A) Columellar strut
- B) Lateral crural strut
- C) Septal extension
- D) Spreader
- E) Subdomal

The correct response is Option E.

Correction of aesthetic and functional deformities of the nasal tip requires an understanding of the underlying anatomy and the use of cartilage grafting. A pinched nasal tip deformity results from decreased interdomal distance or narrow domal arches of the lower lateral cartilages.

Subdomal grafts can be used to correct a pinched nasal tip deformity as well as asymmetry of the domes. The subdomal graft is bar shaped, spanning beneath both domes, controlling the horizontal and vertical orientation of the domes.

The columellar strut graft corrects an underprojecting tip by increasing tip projection. The lateral crural graft is utilized to correct alar contour deformities secondary to deformed lateral crus of the lower lateral cartilages. Septal extension grafts control projection, shape, and rotation of the nasal tip. The spreader graft will expand the internal nasal valve and middle one-third of the nose but not correct a pinched tip.

## REFERENCES:

1. Gunter JP, Landecker A, Cochran CS. Frequently used grafts in rhinoplasty: nomenclature and analysis. *Plast Reconstr Surg*. 2006 Jul;118(1):14e-29e.
2. Guyuron B, Poggi JT, Michelow BJ. The subdomal graft. *Plast Reconstr Surg*. 2004 Mar;113(3):1037-1040; discussion 1041-1043.
3. Ghavami A, Janis JE, Acikel C, et al. Tip shaping in primary rhinoplasty: an algorithmic approach. *Plast Reconstr Surg*. 2008 Oct;122(4):1229-1241.

198. A 25-year-old woman comes to the office because she is dissatisfied after undergoing breast augmentation mammoplasty for correction of tuberous breast deformities. Physical examination shows two parallel creases running transversely across the lower pole of each breast with inferior displacement of the implant. Which of the following best describes the position of the original inframammary fold in this patient?
- A) Above the superior and inferior transverse creases
  - B) At the inferior transverse crease
  - C) At the superior transverse crease
  - D) Below the superior and inferior transverse creases

The correct response is Option C.

A double-bubble breast deformity following breast augmentation mammoplasty is represented by the development of two parallel, curvilinear transverse lines in the lower pole of the breast. The native inframammary fold is disrupted and represented by the superior transverse line. The lower transverse line represents the lower limit of implant pocket dissection or the final position of implant descent.

Predisposing anatomic factors for the development of a double-bubble deformity include tuberous breasts, constricted inframammary folds, or a short inframammary fold-to-nipple distance. Other factors that can increase the risk for the development of a double-bubble deformity include glandular ptosis, postpartum involution of the breasts, excessive implant size, and overdissection of the implant pocket. Correction of the double-bubble deformity may require conversion of the implant to a subglandular position, capsulorrhaphies, use of form-stable implants, or dermal grafts.

## REFERENCES:

1. Handel N. The double-bubble deformity: cause, prevention, and treatment. *Plast Reconstr Surg*. 2013 Dec;132(6):1434-1443.
2. Hidalgo D, Spector JA. Breast augmentation. *Plast Reconstr Surg*. 2014 Apr;133(4):567e-583e.

199. When skin excisions are designed for upper blepharoplasty, carrying the medial extent past the punctum is most likely to result in which of the following adverse effects?
- A) Inadequate vertical skin excision
  - B) Injury to the lacrimal system
  - C) Lagophthalmos
  - D) Retrobulbar hematoma
  - E) Webbing of the nasal skin

The correct response is Option E.

Extending the skin incisions too far medially can create a webbing of the nasal skin. Carrying the incision medially does not promote inadequate skin excision, lagophthalmos, or retrobulbar hematoma. Injury to the lacrimal system is unlikely to occur with a more medial incision.

#### **REFERENCES:**

1. Drolet BC, Sullivan PK. Evidence-based medicine: Belpharoplasty. *Plast Reconstr Surg*. 2014 May;133(5):1195-1205.
2. Rohrich RJ, Coberly DM, Fagien S, et al. Current concepts in aesthetic upper blepharoplasty. *Plast Reconstr Surg*. 2004 Mar;113(3):32e-42e.

200. A 47-year-old woman undergoes bilateral reduction mammoplasty surgery. Pathologic analysis of the resected breast tissue shows atypical ductal hyperplasia in the left breast. Which of the following is the most appropriate next step in management?

- A) Gail model risk assessment
- B) Hormonal therapy with aromatase inhibitors
- C) Hormonal therapy with selective estrogen receptor modulators
- D) Left-sided mastectomy
- E) Postoperative radiation therapy

The correct response is Option A.

Atypical ductal hyperplasia is a risk factor for breast cancer in both the ipsilateral and contralateral breast, although the risk for the ipsilateral breast is higher. There is an approximately three-fold to five-fold increase in the risk for breast cancer in patients who have had biopsy-proven atypia. In an excisional biopsy, no additional surgery is needed for a finding of atypia; this is in distinction to atypia found on core biopsy, in which excision is recommended. In neither case is mastectomy indicated.

Radiation therapy is indicated for positive surgical margins in breast cancer excision, tumor size greater than 5 cm, more than four positive axillary nodes, and T4 disease.

The finding in this scenario should prompt the practitioner to perform a full risk assessment. Although the Gail model has been criticized for underestimating the risk for cancer in the context of atypical hyperplasia, it is still the most appropriate choice of the options listed. If the risk for breast cancer is sufficiently high after all factors are considered, hormonal therapy as a preventive measure may be indicated.

## REFERENCES:

1. Margenthaler JA, Duke D, Monsees BS, et al. Correlation between core biopsy and excisional biopsy in breast high-risk lesions. *Am J Surg*. 2006 Oct;192(4):534-537.
2. Degnim AC, Visscher DW, Berman HK, et al. Stratification of breast cancer risk in women with atypia: a Mayo cohort study. *J Clin Oncol*. 2007 Jul 1;25(19):2671-2677. Epub 2007 Jun 11.

3. Pankratz VS, Hartmann LC, Degnim AC, et al. Assessment of the accuracy of the Gail model in women with atypical hyperplasia. *J Clin Oncol*. 2008 Nov 20;26(33):5374-5379. Epub 2008 Oct 14.

# Section 5: Core Surgical Principles

201. A 26-year-old woman is evaluated for burns on the dorsum of the right hand. After serial debridement is performed, the patient has exposed extensor tendons, wrist capsule, and superficial radial nerve. A pedicled groin flap is planned for coverage. Which of the following vessels is most likely to supply arterial blood to the groin flap?
- A) Deep circumflex iliac
  - B) Deep external pudendal
  - C) Lateral femoral circumflex
  - D) Superficial circumflex iliac
  - E) Superficial inferior epigastric

The correct response is Option D.

Although all of these vessels supply flaps in the region of the lower abdominal wall, groin, and thigh, the superficial circumflex iliac artery (SCIA) is the dominant pedicle for free or pedicled, fasciocutaneous groin flaps. The long axis of the flap is centered over a line parallel and 3 cm inferior to the inguinal ligament, with a maximum reliable width of 10 cm. The flap is harvested from lateral to medial, beginning caudad to the posterior iliac spine and extending across the sartorius muscle to femoral vessels. To improve the reliability of the flap, Scarpa's fascia should be incorporated with the flap laterally, and dissection must continue below the sartorius fascia, as the deep circumflex iliac artery (DCIA) courses between the deep investing fascia of the sartorius and Scarpa's fascia. The base of the flap can be tubed to improve wound care and allow for closure of most of the donor site.

## REFERENCES:

1. Mathes SJ, Nahai F. Groin Flap. In: *Reconstructive Surgery: Principles, Anatomy & Technique*. Philadelphia: Churchill Livingstone; 1997:1005-1020.
2. Smith PJ, Foley B, McGregor IA, et al. The anatomical basis of the groin flap. *Plast Reconstr Surg*. 1972 Jan;49(1):41-47.

202. A 72-year-old man with type 2 diabetes mellitus is evaluated because of a 2-month history of a plantar heel ulcer. Routine standard therapies have been unsuccessful. Administration of a new topical growth factor ointment indicated for refractory diabetic foot ulcers is planned. The best literature supporting the use of this product for this patient describes a single non-blinded, prospective, randomized controlled trial with low patient numbers and poor long-term follow-up. Which of the following is the level of evidence associated with the therapeutic use of this product?

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

The correct response is Option B.

The practice of evidence-based medicine involves the interpretation of the best available evidence in order to make informed clinical decisions regarding the care and treatment of patients. Because the quality of studies published in the literature is of varying quality, a hierarchical grading system often described as the levels of evidence has been employed by multiple different specialties.

Typically, randomized controlled trials (RCTs) are considered the highest level of evidence. However, RCTs cannot be used to answer all types of clinical questions. For example, clinical questions regarding the prognosis of a given condition without any treatment cannot be answered with an RCT. In addition, all RCTs are not of the same quality. Systematic reviews or meta-analysis of similar RCTs can increase the power of the studies. In contrast, RCTs that are not blinded, have poor methods of randomization, lack exclusion criteria, or that have low numbers and are underpowered are considered to be a lower level of evidence. The RCT in this question is non-blinded and underpowered with poor follow up and, therefore, a level II.

The ASPS has published the following evidence rating scale:

## Evidence Rating Scale for Therapeutic Studies

| Level of Evidence | Qualifying Studies                                                                                                                                      |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| I                 | High-quality, multicentered or single-centered, randomized controlled trial with adequate power; or systematic review of these studies                  |
| II                | Lesser-quality, randomized controlled trial; prospective cohort or comparative study; or systematic review of these studies                             |
| III               | Retrospective cohort or comparative study; case-control study; or systematic review of these studies                                                    |
| IV                | Case series with pre/post test; or only post test                                                                                                       |
| V                 | Expert opinion developed via consensus process; case report or clinical example; or evidence based on physiology, bench research, or "first principles" |

## REFERENCES:

1. Burns PB, Rohrich RJ, Chung KG. The levels of evidence and their role in evidence-based medicine. *Plast Reconstr Surg*. 2011;128(1):305-310.
2. American Society of Plastic Surgeons. ASPS Evidence Rating Scales. Available at: <http://www.plasticsurgery.org/Documents/medical-professionals/health-policy/evidence-practice/ASPS-Rating-Scale-March-2011.pdf>. Accessed December 31, 2014.

203. A 37-year-old postal worker is brought to the emergency department 2 hours after he sustained a crush injury to his right leg when his truck rolled downhill and pinned him to a wall. He reports progressive, intense burning pain of the right leg. On examination, the leg appears swollen and there is a tense woody feeling anterolaterally associated with severe tenderness on passive range of motion of the ankle. There is decreased sensation between the first and second toes. Palpable dorsalis pedis and posterior tibial pulses are noted. The difference between diastolic blood pressure and the anterior compartment pressure (delta pressure) is 15 mmHg. X-ray studies show no fracture. Which of the following is the most appropriate next step?
- A) Perform emergency fasciotomy
  - B) Recheck anterior compartment pressure in 1 hour
  - C) Test electromyographic activity of the anterior tibialis
  - D) Test serum creatinine kinase activity
  - E) Wean analgesics to reduce variability in serial review

The correct response is Option A.

This patient is manifesting signs and symptoms of progressive acute compartment syndrome (ACS). ACS is a surgical emergency, and the next step in management is acute fasciotomy to fully decompress all involved compartments. Delays in fasciotomy increase unrecoverable tissue injury leading to permanent functional loss and morbidity such as muscle contractures, sensory deficits, paralysis, and infection.

Compartment syndrome occurs when increased pressures within unyielding fascial compartments lead to progressive cellular anoxic injury to tissues within the compartment. Symptoms of ACS include pain out of proportion to injury and deep aching or burning pain. Complaints of paresthesia suggest progressive ischemic nerve dysfunction. Signs of ACS include pain with passive ranging of muscles in the affected compartment, a tense compartment with a firm and indurated "woody" feeling, and diminished sensation.

Most cases of ACS occur with long-bone fractures, and risk increases with comminuted fractures. Other common forms of trauma including crush injury, severe thermal burns, constrictive bandages, penetrating trauma, vascular injuries, and ischemia-reperfusion injuries can lead to ACS. The anterior compartment of the leg is the most common site for ACS. Early signs of ACS affecting this compartment

include loss of sensation in the distribution of the deep peroneal nerve, and weakness of dorsiflexion.

Normal compartment pressures fall between 0 and 8 mmHg. Pain develops as compartment pressures increase, and tissue ischemia occurs as compartment pressures approach diastolic pressure. Differences between diastolic blood pressure and measured compartment pressure (delta pressure) less than 20 to 30 mmHg indicate a need for fasciotomy.

As ACS evolves, muscle breakdown can lead to elevations in serum creatine kinase and myoglobinuria. Sensory deficits typically preclude motor deficits and EMG abnormalities progressing to total paralysis will occur. These are relatively late findings in ACS; they should not delay fasciotomy once progressive ACS is diagnosed.

There is no diagnostic role for withholding analgesics in extremity trauma.

## **REFERENCES:**

1. Elliott KG, Johnstone AJ. Diagnosing acute compartment syndrome. *J Bone Joint Surg Br.* 2003 Jul;85(5):625-632.
2. Olson SA, Glasgow RR. Acute compartment syndrome in lower extremity musculoskeletal trauma. *J Am Acad Orthop Surg.* 2005 Nov;13(7):436-444.
3. Patel RV, Haddad FS. Compartment syndromes. *Br J Hosp Med (Lond).* 2005 Oct;66(10):583-586.

204. A healthy 154-lb (70-kg), 30-year-old woman is undergoing liposuction of multiple sites. Five minutes after the local anesthetic infusion, she sustains a cardiac arrest. Local anesthetic systemic toxicity is diagnosed. After CPR is initiated, administration of which of the following is the most appropriate next step in management?

- A) Adenosine
- B) Intralipid
- C) Propranolol
- D) Vasopressin
- E) Verapamil

The correct response is Option B.

This patient has sustained a cardiovascular collapse secondary to local anesthetic systemic toxicity (LAST). The maximum safe dose of lidocaine with epinephrine in this patient is 35 to 55 mg/kg.

Lipid Rescue protocol recommends an initial intralipid 20% bolus of 1.5 mL/kg over 1 minute. This should be followed immediately with a continuous infusion at 0.25 mL/kg/min. A single bolus is typical, but should be repeated or the infusion increased if spontaneous circulation fails to return or blood pressure declines.

Cardiovascular collapse from LAST differs from that secondary to myocardial ischemia. In LAST, raising the peripheral vascular resistance with vasopressors like vasopressin, can impair cardiac output and impede resuscitation. Epinephrine should be given in small doses (<1 mcg/kg). Pharmacologic agents that reduce contractility (beta blockers {propranolol}, calcium channel blockers {verapamil}, or propofol) should be avoided when there is evidence of cardiovascular instability.

Adenosine is not useful in the management of LAST patients. It is typically used to treat supraventricular tachycardia.

## REFERENCES:

1. Young VL. Lipid Rescue for Local-Anesthetic-Induced Cardiac Arrest. Available at: [http://www.plasticsurgerypulsenews.com/7/article\\_dtl.php?QnCategoryID=67&QnArticleID=153](http://www.plasticsurgerypulsenews.com/7/article_dtl.php?QnCategoryID=67&QnArticleID=153). Accessed January 6, 2015.
2. Weinberg GL. Lipid emulsion infusion: resuscitation for local anesthetic and other drug overdose. *Anesthesiology*. 2012 Jul;117(1):180-187.

205. A 66-year-old man with paraplegia is evaluated because of a 6-month history of Grade IV pressure ulcer. Medical history includes multiple debridements with appropriate off-loading and good wound care. The patient shows no clinical improvement. Chronic osteomyelitis is suspected. Which of the following is the most appropriate next step in diagnosis?

- A) Bone biopsy
- B) CT scan
- C) Dual energy x-ray absorptiometry (DEXA) scan
- D) MRI
- E) Triphasic technetium scan

The correct response is Option A.

The accurate diagnosis of chronic osteomyelitis in long-standing wounds can be extremely difficult. The gold standard to diagnose chronic osteomyelitis is bone biopsy. Bone biopsy can provide histopathologic as well as microbiologic data that are sensitive and specific for chronic osteomyelitis.

Triphasic technetium-99 bone scan or scintigraphy is a nuclear study that serves as a functional test to assess bone metabolism. MRI uses a magnetic field and radio waves to reconstruct anatomical structures of interest. CT scan can reveal small areas of osteolysis, small foci of gas, or foreign bodies. Triphasic bone scan, MRI, and CT scan have all been used to evaluate for osteomyelitis clinically. However, these studies lack specificity and can be misleading in the presence of a chronic soft-tissue injury or previous bony injury from prior debridements.

A dual energy x-ray absorptiometry (DEXA) scan is a low-exposure x-ray study measuring bone density in order to assess for osteoporosis. It has no role in evaluating osteomyelitis.

## REFERENCES:

1. Cushing CA, Phillips LG. Evidence-based medicine: pressure sores. *Plast Reconstr Surg*. 2013 Dec;132(6):1720-1732.
2. Wheat J. Diagnostic strategies in osteomyelitis. *Am J Med*. 1985 Jun 28;78(6B):218-224.

206. A non-emancipated, 17-year-old girl comes to the office to request bilateral reduction mammoplasty. Which of the following is the most appropriate next step in management?
- A) Perform reduction mammoplasty after obtaining consent from both parents
  - B) Perform reduction mammoplasty after obtaining consent from one parent
  - C) Perform reduction mammoplasty without parental consent
  - D) Wait to perform reduction mammoplasty until the patient is 18 years old
  - E) Wait to perform reduction mammoplasty until the patient is 21 years old

The correct response is Option B.

The next most appropriate step in management is to perform the reduction mammoplasty with parental consent from one parent. Almost all states require patients younger than 18 years of age to have the consent of one parent for a surgical procedure. Emancipated minors younger than 18 years of age are legally able to consent for medical procedures without parental consent. The criteria for an emancipated minor generally include: marriage, military service, financial independence, living apart from the parents, and parenthood.

## REFERENCES:

1. Committee on Bioethics, American Academy of Pediatrics. Informed consent, parental permission, and assent in pediatric practice. *Pediatrics*. 1995 Feb;95(2):314-317.
2. Kuther TL. Medical decision-making and minors: issues of consent and assent. *Adolescence*. 2003 Summer;38(150):343-358.

207. A hospital undertakes a root cause analysis to investigate a wrong-site surgery. The first step is to determine if there was compliance with the Universal Protocol mandated by the Joint Commission. Which of the following is a required component as mandated by the Universal Protocol?
- A) Insurance pre-authorization for the procedure
  - B) Preoperative marking of the surgical site
  - C) Surgical debrief immediately following the procedure
  - D) Use and documentation of a safe surgery checklist
  - E) Use of standardized preoperative order templates for common procedures

The correct response is Option B.

In 2003, the Joint Commission (formerly, the Joint Commission on Accreditation of Healthcare Organizations or JCAHO) made the elimination of wrong-site surgeries a national patient safety goal and the following year required compliance with the Universal Protocol for Preventing Wrong Site, Wrong Procedure, and Wrong Person Surgery. The Universal Protocol requires three separate steps:

- The proper preoperative identification of the patient by the three members of the team (surgeon, anesthesiologist, and nurse)
- Preoperative marking of the surgical site
- A final "time out" just prior to the surgery or procedure regardless of where it is performed

Use and documentation of a safe surgery checklist is a new quality reporting program implemented by the Centers for Medicare and Medicaid Services (CMS) for ambulatory surgery centers and became part of the payment determination in 2015. Although this has been used to help fulfill the requirements of the Universal Protocol, it is not a required component of the Universal Protocol.

Incorporating a debrief immediately following a surgical procedure is a typical hospital policy requirement and good medical practice, but will not prevent wrong site, wrong procedure, or wrong person surgery. It is not a required component of the Joint Commission's Universal Protocol.

Use of standardized preoperative order templates and insurance pre-authorization is not a required element of the Universal Protocol.

## **REFERENCES:**

1. The Joint Commission. National Patient Safety Goals; 2015. Available at: [http://www.jointcommission.org/assets/1/6/2015\\_NPSG\\_HAP.pdf](http://www.jointcommission.org/assets/1/6/2015_NPSG_HAP.pdf). Accessed March 29, 2015.
2. Centers for Medicare & Medicaid Services. ACS Quality Reporting. Available at: <http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/ASC-Quality-Reporting/>. Accessed December 31, 2014.

208. A morbidly obese woman is brought to the emergency department after being found unconscious at home. Her family reports that both of the patient's arms were pinned beneath her body when emergency medical service responders arrived. Physical examination shows tense swelling of the upper extremities. The now conscious patient reports severe pain to passive extension of the digits. In addition to appropriate urgent operative management, the surgeon should anticipate which of the following?

- A) Decreased glomerular filtration rate
- B) Hypercalcemia
- C) Hyperglycemia
- D) Hypokalemia
- E) ST-segment elevation

The correct response is Option A.

This patient has bilateral upper extremity compartment syndrome. The emergency department examination of concern for a long-standing period of upper extremity ischemia. The surgeon should anticipate rhabdomyolysis and its consequent renal and metabolic disorders. Supportive treatment should be undertaken. Hyperkalemia is common in rhabdomyolysis manifesting as peaked T waves on ECG as serum potassium concentrations rise. Glucose D50W, 50 mL intravenously, plus regular insulin (5 to 10 units) move potassium from the extracellular fluid to the intracellular fluid. Intravenous mannitol increases renal blood flow (GFR), attracts fluid from the interstitium (thereby counterbalancing hypovolemia), increases urinary flow (prevents myoglobin cast obstruction), and functions as a free radical scavenger. Allopurinol may be helpful in reducing the production of uric acid. It also acts as a free radical scavenger.

Hypocalcemia is commonplace in the initial phase of rhabdomyolysis; however, it does not usually require correction because this would increase the risk of intramuscular calcium deposition. Indication for correcting hypocalcemia would be impending seizures.

## REFERENCES:

1. Vanholder R, Sever MS, Ereik E, et al. Rhabdomyolysis. *J Am Soc Nephrol.* 2000 Aug;11(8):1553-1561.

2. Friedrich JB, Shin AY. Management of forearm compartment syndrome.  
*Hand Clin.* 2007 May;23(2):245-254.

209. A 46-year-old woman comes to the emergency department because of a 5-day history of profound physical deterioration, nausea, and vomiting. She underwent breast reconstruction 3 weeks ago. Medical history includes delayed right latissimus dorsi tissue expansion breast reconstruction 1 year after completing radiation therapy. She has no other comorbidities. Physical examination shows erythematous rash involving and extending beyond the surgical sites. There are no notable fluid collections and the surgical wounds are not draining. Temperature is 103.5°F (39.7°C) and blood pressure is 90/50 mmHg. Laboratory studies show:

|                               |                        |
|-------------------------------|------------------------|
| Leukocyte count               | 15,000/mm <sup>3</sup> |
| K <sup>+</sup>                | 6.0 mEq/L              |
| Na <sup>+</sup>               | 122 mEq/L              |
| HCO <sub>3</sub> <sup>-</sup> | 12 mEq/L               |

Intraoperative cultures of the explored surgical sites are most likely to grow which of the following organisms?

- A) *Bacteroides*
- B) *Clostridium*
- C) *Enterobacter*
- D) *Pseudomonas*
- E) *Streptococcus*

The correct response is Option E.

The Centers for Disease Control and Prevention support criteria indicate that toxic shock syndrome may be diagnosed when patients present with a temperature exceeding 102°F (38.9°C), multisystems organ failure, rash, and/or multiple constitution symptoms.

Exotoxin1 and exfoliative toxin-producing *Staphylococcus aureus* are the most common pathogen, but enterotoxin A, B, and C, producing *Streptococcus pyogenes* infections, yield a worse prognosis. Blood cultures may be negative for the causative organism.

Although *Clostridium*, *Enterobacter*, *Pseudomonas*, and *Bacteroides* species are polymicrobial species associated with necrotizing fasciitis, the description of this otherwise healthy patient is not consistent with its typical presentation of discolored blistered skin and crepitus.

## REFERENCES:

1. Vendemia N, Rohde C. Toxic shock syndrome after prosthetic breast reconstruction with AlloDerm. *Plast Reconstr Surg*. 2009 Jul;124(1):173e-174e.
2. Centers for Disease Control and Prevention (CDC). Toxic shock syndrome--United States. 1980. *MMWR Morb Mortal Weekly Rep*. 1997 Jun 6;46(22):492-493.
3. Shalaby T, Anandappa S, Pocock NJ, et al. Lesson of the month 2: toxic shock syndrome. *Clin Med*. 2014 Jun;14(3):316-318.

210. A 61-year-old woman is evaluated 7 hours after undergoing bilateral lower blepharoplasty with septal release and fat repositioning. She reports pain and diminished vision in the right eye. Physical examination shows more swelling on the right side than on the left and tender proptosis of the right eye. Which of the following is the most appropriate treatment?

- A) Administration of stronger pain medication
- B) Head elevation and ice packs
- C) Lasix administration and observation
- D) Orbital decompression
- E) Tarsorrhaphy

The correct response is Option D.

The most appropriate treatment is orbital decompression for retrobulbar hematoma. Most complications after blepharoplasty are correctable and minor. However, postoperative bleeding into the orbit causes a retrobulbar hematoma. With a large enough hematoma, orbital pressure increases, causing increased swelling, eye pain, and proptosis. With continued pressure, the optic nerve is compressed, leading to reduction in vision and ultimately blindness. The cause of a retrobulbar hematoma is bleeding within the orbit. As such, the blepharoplasty technique would be one in which the orbital septum was opened. Nevertheless, this complication must be considered in all blepharoplasty patients.

The treatment for retrobulbar hematoma is emergent orbital decompression. The incision needs to be opened and the orbital space accessed for the hematoma and soft tissues to decompress and alleviate traction or pressure on the optic nerve. A lateral canthotomy is done as well to ensure maximal decompression. In the past, mannitol has been given as a diuretic for reduction of edema, but also as a free radical scavenger in hopes of protecting the optic nerve from compressive ischemia. Lasix is often administered as a quick controllable diuretic to lessen edema.

This is a very rare complication of blepharoplasty. Mejia et al. surveyed plastic surgeons in the United States and Great Britain and derived data from over 750,000 blepharoplasties. In this study, 25 patients had permanent visual loss and 14 had temporary loss of vision. The overall incidence of visual loss due to retrobulbar hematoma was 0.0052% or one in 20,000 cases, with permanent loss occurring in 0.0033% or one in 30,000. Symptoms as noted above occurred in all patients within

the first 24 hours, and hypertension was found to be the most common risk factor.

All patients will develop postoperative swelling and ecchymosis to varying degrees. Head elevation and ice packs are appropriate for standard swelling noted without findings of orbital pain, proptosis, or changes in vision. Tarsorrhaphy is useful for patients with lagophthalmos or ectropion but has no role in globe protection for acute proptosis in the above setting. Lasix infusion is part of the treatment for retrobulbar hematoma, but as a stand-alone therapy it is inadequate. Provision of more pain medication is inappropriate in the presence of pain and reduced vision and will only serve to mask some symptoms related to the hematoma.

## **REFERENCES:**

1. Mejia JD, Ergo FM, Nahai F. Visual loss after blepharoplasty: incidence, management, and preventive measures. *Aesthet Surg J*. 2011 Jan;31(1):21-29.
2. Wolford FG, Vaughan TE, Wolford SF, et al. Retrobulbar hematoma and blepharoplasty. *Plast Reconstr Surg*. 1999 Dec;104(7):2154-2162.

211. A 10-month-old male infant has undergone a cranial vault remodeling for sagittal synostosis. The child has no other comorbidities. On the second postoperative day, the patient's serum sodium concentration decreases from 140 to 129 mEq/L. Laboratory studies show a suppressed plasma aldosterone concentration. The suspected diagnosis is cerebral salt wasting (CSW). An increase in which of the following is most likely to support this diagnosis?

- A) Plasma antidiuretic hormone concentration
- B) Plasma sodium concentration
- C) Plasma volume
- D) Serum uric acid concentration
- E) Urine output

The correct response is Option E.

Cerebral salt wasting (CSW) is a condition that combines renal sodium and fluid loss after intracranial injury with an overall negative sodium balance and volume contraction. It responds to fluid and salt replacement. It contrasts with the syndrome of inappropriate antidiuretic hormone (SIADH), which is part of the differential diagnosis in hyponatremia as follows:

| <b>Variable</b>                   | <b>CSW</b> | <b>SIADH</b> |
|-----------------------------------|------------|--------------|
| Plasma volume                     | decreased  | increased    |
| Clinical volume depletion         | present    | absent       |
| Plasma Na <sup>+</sup>            | low        | low          |
| Urine Na <sup>+</sup>             | high       | high         |
| Urine flow rate                   | very high  | usually low  |
| Net sodium loss                   | very high  | normal       |
| Plasma renin activity             | suppressed | suppressed   |
| Plasma aldosterone activity       | suppressed | suppressed   |
| Plasma antidiuretic hormone       | suppressed | high         |
| Serum uric acid                   | normal     | low          |
| Plasma atrial natriuretic hormone | high       | high         |

## REFERENCES:

1. Levine JP, Stelnicki E, Weiner HL, et al. Hyponatremia in the postoperative craniofacial pediatric patient population: a connection to cerebral salt wasting syndrome and management of the disorder. *Plast Reconstr Surg*. 2001 Nov;108(6):1501-1508.
2. Sterns RH, Silver SM. Cerebral salt wasting versus SIADH: what difference? *J Am Soc Nephrol*. 2008 Feb;19(2):194-196. Epub 2008 Jan 23.

212. A physician wants to research the effectiveness of a new pain medication with his patients. He plans a prospective randomized study with an experimental group that will receive the new pain medication and a control group that will receive a placebo. Data from each group will be reported and analyzed for the significance of pain relief from the new medication. Which of the following statistical tests is most likely to determine the appropriate sample size for this study?

- A) ANOVA
- B) Chi-square
- C) Fisher exact test
- D) Statistical power
- E) Student *t*-test

The correct response is Option D.

Statistical power is the likelihood of identifying a predefined clinical significance. Analysis of statistical power explores associations among effect size, sample size, test size, and power of the test. Statistical power can be used to determine sample size or verify a nonsignificant result after data collection. Statistical power of 80% is ideal for any study.

## REFERENCES:

1. Suresh K, Chandrashekara S. Sample size estimation and power analysis for clinical research studies. *J Hum Reprod Sci*. 2012 Jan;5(1):7-13.
2. Park HM. Hypothesis Testing and Statistical Power of a Test. Available at: <http://www.indiana.edu/~statmath/stat/all/power/power.pdf>. Accessed January 6, 2015.

213. A 55-year-old woman is evaluated for an incisional hernia that developed after a complicated right hemicolectomy 5 years ago. Medical history includes hypertension. BMI is 34 kg/m<sup>2</sup>. She reports shortness of breath when trying to scrub floors at work but is able to climb a flight of stairs or walk up a hill without symptoms. There are no other respiratory or cardiovascular issues. Cardiovascular examination shows no abnormalities. Recent electrocardiography, complete blood count, and basic metabolic panel show no abnormalities. Hernia repair with separation of components is being considered. Which of the following is the most appropriate next step in the preoperative cardiac assessment of this patient?

- A) Cardiac catheterization
- B) Echocardiographic exercise stress testing
- C) Echocardiography at rest
- D) Nuclear cardiac pharmacologic stress testing
- E) No further cardiac testing is needed

The correct response is Option E.

No further preoperative cardiac testing is needed for this patient being considered for an elective, greater-than-low-risk procedure, without any evidence of active cardiac conditions or clinical risk factors, and with moderate functional capacity (metabolic equivalents, or METs,  $\geq 4$ ).

Assessment of left ventricular function at rest, whether by echocardiogram, radionuclide angiogram, or contrast ventriculography, has not been shown to be a consistent predictor of perioperative ischemic events. Cardiac stress testing, including by exercise or drug induced, is not indicated in this patient.

In 2007, the American College of Cardiology and the American Heart Association published updated guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery (NCS), suggesting a stepwise algorithmic approach to perioperative cardiac risk assessment:

1. Is there need for emergency NCS? If yes, proceed with surgery.
2. Are there active cardiac conditions (unstable coronary syndromes, decompensated heart failure, significant arrhythmias, severe valvular

disease)? If yes, evaluate and treat per specific guidelines before considering NCS.

3. Is the NCS considered low risk (e.g., superficial and ophthalmologic procedures)? If yes, proceed with low-risk NCS.
4. Does the patient have good functional capacity ( $\text{METs} \geq 4$ ) without symptoms? If yes, proceed with NCS.
5. Are there clinical risk factors (history of ischemic heart disease, history of compensated or prior heart failure, history of cerebrovascular disease, diabetes mellitus, or renal insufficiency)? If no, proceed with NCS.
  - Three or more clinical risk factors undergoing vascular surgery: consider testing if it will change management
  - One or two clinical risk factors undergoing vascular surgery or one or more clinical risk factors undergoing intermediate-risk surgery: either proceed with surgery with heart rate control (beta blockade) or consider noninvasive testing if it will change management

Preoperative cardiac assessment should include an estimation of the patient's functional capacity, based on his/her ability to perform a spectrum of common daily tasks. This has been shown to correlate well with maximum oxygen uptake by treadmill testing. Four METs is a common threshold used in many decision-making points in the perioperative cardiac evaluation.

## REFERENCES:

1. Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA 2007 Guidelines on Perioperative Cardiovascular Evaluation and Care for Noncardiac Surgery: Executive Summary. *J Am Coll Cardiol*. 2007 Oct 23;50(17):1707-1732.
2. Cinello M, Nucifora G, Bertolissi M, et al. American College of Cardiology/American Heart Association perioperative assessment guidelines for noncardiac surgery reduces cardiologic resource utilization preserving a favourable clinical outcome. *J Cardiovasc Med (Hagerstown)*. 2007 Nov;8(11):882-888.
3. Hlatky MA, Boineau RE, Higginbotham MB, et al. A brief self-administered questionnaire to determine functional capacity (the Duke Activity Status Index). *Am J Cardiol*. 1989 Sep 15;64(10):651-654.

214. A 55-year-old woman undergoes unilateral breast reconstruction using a deep inferior epigastric artery perforator (DIEP) flap. After the mastectomy, the skin flaps appear dusky. You perform intraoperative indocyanine-green angiography to assess perfusion of the mastectomy flaps and the DIEP flap. Rib resection is performed and the patient's internal mammary vessels are prepared as the perforator flap is harvested. Anastomosis is performed under the microscope and the abdomen is closed. Which of the following are the most appropriate current procedural terminology (CPT) codes for this case?

| CPT code | Description                                                                                 |
|----------|---------------------------------------------------------------------------------------------|
| 15860    | intravenous injection of agent [e.g., fluorescein] to test vascular flow in flap or graft   |
| 19364    | breast reconstruction with free flap                                                        |
| 21600    | partial rib resection                                                                       |
| 92240    | indocyanine-green angiography (includes multi-frame imaging) with interpretation and report |

- A) 15860, 19364  
B) 19364, 21600  
C) 19364, 92240  
D) 15860, 19364, 21600  
E) 19364, 21600, 99240

The correct response is Option A.

Partial rib resection (21600) is bundled within the 19364 code. 92240 is the code used for indocyanine green in retinal surgery, so is inappropriate. 15860 is the most appropriate code for assessing flap perfusion with indocyanine green. This code can be reported separately from the free flap code.

## REFERENCES:

1. American Medical Association CPT Assistant Online. <https://ocm.ama-assn.org/OCM/CPTAA/Overview.do>
2. Janevicius R. So why is there no CPT code for DIEP flap procedures? *Plastic Surgery News*. 2009 February.

215. An otherwise healthy 25-year-old woman is scheduled to undergo resection of a 3 × 5-cm atypical nevus of the right thigh. Medical history includes systemic lupus erythematosus. She has been receiving oral corticosteroid therapy for more than 5 years. She is well nourished. Perioperatively, administration of which of the following vitamins is most likely to improve this patient's wound healing?

- A) A
- B) B complex
- C) C
- D) D
- E) E

The correct response is Option A.

Perioperative administration of vitamin A is most likely to improve wound healing in this well-nourished patient receiving chronic corticosteroid therapy.

Corticosteroids have been shown to negatively affect all major steps of the wound healing process. Several mechanisms have been proposed, including a stabilizing effect in the lysosomal membrane of cells. Vitamin A was known to cause the opposite (destabilizing) effect in lysosomal membranes *in vivo*, which led to the first studies on the interaction between these two classes of drugs in wound healing in the 1960s. Since then, supplementation of vitamin A in patients receiving corticosteroids has been shown to counteract most of the deleterious effects of corticosteroids in wound healing, with the exception of wound contraction and infection.

There is no consensus in dose and duration of treatment. Most proposed regimens include oral administration of 10,000 to 25,000 international units (IU) per day for 5 to 14 days. Various topical regimens have also been proposed, with doses around 200,000 IU every 8 hours.

Administration of vitamins B, C, D, or E has not been shown to significantly improve wound healing in well-nourished patients. Vitamin C deficiency impairs collagen synthesis, which may lead to poor wound healing and scurvy.

## REFERENCES:

1. Abdelmalek M, Spencer J. Retinoids and wound healing. *Dermatol Surg.* 2006 Oct;32(10):1219-1230.
2. Burns JL, Mancoll JS, Phillips LG. Impairments to wound healing. *Clin Plast Surg.* 2003 Jan;30(1):47-56.
3. Wicke C, Halliday B, Allen D, et al. Effects of steroids and retinoids on wound healing. *Arch Surg.* 2000 Nov;135(11):1265-1270.
4. Hunt TK, Ehrlich HP, Garcia JA, et al. Effect of vitamin A on reversing the inhibitory effect of cortisone on healing of open wounds in animals and man. *Ann Surg.* 1969 Oct;170(4):633-641.
5. Ehrlich HP, Hunt TK. Effects of cortisone and vitamin A on wound healing. *Ann Surg.* 1968 Mar;167(3):324-328.

216. A 154-lb (70-kg) man is evaluated 1 hour after sustaining deep partial-thickness burns to 50% of his total body surface area when attempting to light a gas grill. Paramedics administered 2 L of intravenous fluid during ground transport. Using the Parkland formula, which of the following is the starting rate for fluid resuscitation in this patient?

- A) 375 mL/hr
- B) 437 mL/hr
- C) 583 mL/hr
- D) 714 mL/hr
- E) 875 mL/hr

The correct response is Option D.

The Parkland formula estimates the amount of crystalloid fluid needed for resuscitation of the burn patient, over the first 24 hours after injury. Volume needed =  $4 \text{ mL} \times \text{mass (kg)} \times \% \text{ TBSA} \times 100$ . This patient would require  $4 \times 70 \times 50\% \times 100 = 14,000 \text{ mL}$  over the first 24 hours. Half of this, or 7 L, is given in the first 8 hours after injury. Because the patient received 2 L prior to arrival, during the first hour he would still need 5 L over the next 7 hours, or 714 mL/hr. Eight hours after injury, he would receive the other half, over 16 hours, or 437 mL/hr. It should be stressed that the Parkland formula serves as an initial guide to fluid resuscitation, and that actual volumes are titrated up or down, depending on urine output.

## REFERENCES:

1. Kahn SA, Schoemann M, Lentz CW. Burn resuscitation index: a simple method for calculating fluid resuscitation in the burn patient. *J Burn Care Res.* 2010 Jul-Aug;31(4):616-623.
2. Greenhalgh DH. Burn resuscitation: the results of the ISBI/ABA survey. *Burns.* 2010 Mar;36(2):176-182. Epub 2009 Dec 16.

217. A 65-year-old woman is scheduled to undergo unilateral breast reconstruction with tissue expander. Medical history includes placement of a drug-eluting stent 4 months ago. Current medications include aspirin and clopidogrel. The surgical oncologist does not want to wait longer to perform the mastectomy. Which of the following is the most appropriate management of preoperative medications in this patient?

- A) Continue both aspirin and clopidogrel
- B) Discontinue aspirin and continue clopidogrel
- C) Discontinue both aspirin and clopidogrel
- D) Discontinue both aspirin and clopidogrel; start prophylactic enoxaparin
- E) Discontinue clopidogrel and continue aspirin

The correct response is Option A.

A patient who underwent placement of a drug-eluting stent 4 months ago should continue on aspirin and clopidogrel for at least 6 months, except in cases with high risk of bleeding (intracranial or spine surgery). The combination of aspirin and clopidogrel appears to reduce the rates of cardiovascular ischemic events. Patients with coronary stents have an 8 to 10% risk of developing major adverse cardiovascular events and stent thrombosis after elective noncardiac surgery, which exceeds the 1 to 5% risk of major adverse cardiovascular events in non-stented patients having noncardiac surgery.

## REFERENCES:

1. Brilakis ES, Patel VG, Banerjee S. Medical management after coronary stent implantation: a review. *JAMA*. 2013 Jul 10;310(2):189-198.
2. Iakovou I, Schmidt T, Bonizzoni E, et al. Incidence, predictors, and outcome of thrombosis after successful implantation of drug-eluting stents. *JAMA*. 2005 May 4;293(17):2126-2130.
3. Wilson SH, Rihal CS, Bell MR, et al. Timing of coronary stent thrombosis in patients treated with ticlopidine and aspirin. *Am J Cardiol*. 1999 Apr;83(7):1006-1011.
4. Devereaux PJ, Goldman L, Cook DJ, et al. Perioperative cardiac events in patients undergoing noncardiac surgery: a review of the magnitude of the problem, the pathophysiology of the events and methods to estimate and communicate risk. *CMAJ*. 2005 Sep 13;173(6):627-634.

5. American College of Cardiology, American Heart Association Task Force on Practice Guidelines. 2007 Focused update of the ACC/AHA/SCAI 2005 guideline update for percutaneous coronary intervention. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines. *Catheter Cardiovasc Interv*. 2008 Jan 1;71(1):E1-40.
6. Darvish-Kazem S, Gandhi M, Marcucci M, et al. Perioperative management of antiplatelet therapy in patients with a coronary stent who need noncardiac surgery: a systematic review of clinical practice guidelines. *Chest*. 2013 Dec;144(6):1848-1856.

218. A critically ill 69-year-old man is observed to have new-onset atrial fibrillation complicated by rapid ventricular response. Angina and hemodynamic instability with hypotension and acute ST depression is noted. Which of the following is the next step in management?
- A) Emergency cardiac catheterization with AV nodal ablation followed by permanent ventricular pacing
  - B) Heparin anticoagulation and emergency transesophageal echocardiography (TEE) to rule out left atrial thrombus
  - C) Immediate external electrical cardioversion
  - D) Intravenous administration of amiodarone with loading dose and titrated infusion until sinus rhythm is restored
  - E) Intravenous administration of a beta blocker or nondihydropyridine calcium channel blocker to slow the ventricular heart rate

The correct response is Option C.

Immediate cardioversion is recommended for patients with atrial fibrillation (AF) or atrial flutter with rapid ventricular response associated with hemodynamic instability such as hypotension, ongoing myocardial ischemia, or decompensated heart failure. Both chemical and electrical cardioversion can be attempted according to established protocols until sinus rhythm is restored with a goal of optimizing hemodynamic parameters. If initial cardioversion is unsuccessful, repeated attempts at cardioversion may be made after adjusting the location of the electrodes, applying pressure over the electrodes, or following administration of an antiarrhythmic medication according to Advanced Cardiac Life Support (ACLS) algorithms.

A trial of medical management for rate control is appropriate in the absence of hemodynamic instability. In general, beta blockers are the most common agents used for rate control, followed by nondihydropyridine calcium channel blockers such as diltiazem, as well as other agents such as digoxin and amiodarone. Patient comorbidities influence the choice of medical therapy to minimize risk of adverse events such as heart failure decompensation, exacerbation of chronic obstructive pulmonary disease, or acceleration of conduction in patients with preexcitation physiology.

Appropriate anticoagulation management around the time of elective cardioversion is essential for reducing thromboembolic risk. When AF has clearly existed at  $< 48$

hours' duration, it is common practice to perform cardioversion without transesophageal echocardiography (TEE) or antecedent anticoagulation. When AF has existed at >48 hours' duration or duration is unknown, then anticoagulation for  $\geq 3$  weeks before and continuing for  $\geq 4$  weeks after cardioversion is recommended unless otherwise contraindicated. In case of relative contraindications to anticoagulation, TEE can be performed to help guide relative risk assessment related to thromboembolism of preexisting cardiac thrombi arising in the setting of prolonged atrial dysfunction. Importantly, when emergent cardioversion is indicated because of hemodynamic instability, initiation of anticoagulation and TEE should not delay acute interventions to stabilize the patient's condition.

AV nodal ablation with permanent ventricular pacing can be considered to improve rate control when other attempts at maintaining rate control through medical management are unsuccessful. This intervention is usually reserved for elderly patients, because it leads to pacemaker dependency. However, patients with symptoms refractory to medical therapy who are treated with AV nodal ablation and permanent pacemaker implantation have demonstrated an improvement in cardiac symptoms, quality of life, and health care utilization.

## REFERENCES:

1. January CT, Wann LS, Alpert JS, et al. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *J Am Coll Cardiol*. 2014;64(21):e1-76.
2. Anderson JL, Adams CD, Antman EM, et al. 2012 ACCF/AHA focused update incorporated into the ACCF/AHA 2007 guidelines for the management of patients with unstable angina/non-ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;127:e663–828.

219. A 42-year-old lineman is evaluated after sustaining a high-voltage electrical injury while working on a transformer. Physical examination shows entrance wounds on the volar aspect of the right distal forearm. He reports numbness and tingling of the little finger and weakness of the grip of the right hand. Which of the following is the most appropriate next step in management?

- A) Elevation of the forearm and observation
- B) Escharotomy and carpal tunnel release
- C) Escharotomy and excision of the burned tissue
- D) Fasciotomy of the forearm
- E) Fasciotomy and release of Guyon canal

The correct response is Option E.

This lineman has developed compartment syndrome involving at least the ulnar nerve and has signs of motor and sensory impairment. Escharotomy is not an adequate release in electrical injuries, which often involve deeper structures, such as the pronator quadratus. Therefore, fasciotomy is required. While a carpal tunnel release should be performed in this case, release of Guyon's canal and decompression of the ulnar nerve in the forearm, wrist, and hand must be performed.

## REFERENCES:

1. Pannucci CJ, Osborne NH, Jaber RM, et al. Early fasciotomy in electrically injured patients as a marker for injury severity and deep venous thrombosis risk: an analysis of the National Burn Repository. *J Burn Care Res.* 2010 Nov-Dec;31(6):882-887.
2. Handschin AE, Vetter S, Jung FJ, et al. A case-matched controlled study on high-voltage electrical injuries vs thermal burns. *J Burn Care Res.* 2009 May-Jun;30(3):400-407.

220. A 30-year-old man is evaluated one year after undergoing vascularized allograft transplantation at the midforearm level. Surveillance angiogram and duplex ultrasound show 60% closure of the ulnar artery and complete occlusion of the radial artery. The patient is adherent to the prescribed immunosuppressive therapy. Clinical evidence of chronic ischemia is suspected. Which of the following underlying processes is most likely in this patient?

- A) Deposition of preformed immune complex and complement activation
- B) IgA-mediated response
- C) IgM and IgG antigen-mediated response
- D) T-cell-modulated immune response

The correct response is Option D.

Hypersensitivity reactions are divided into four different responses.

- Type 1 (allergy) refers to immediate release of IgE, mediated release of histamine, and other vasoactive mediators resulting in manifestation within minutes. Examples include asthma or anaphylaxis.
- Type 2 (cytotoxic-antibody dependent) refers to binding of IgM or IgG to the target cell, which in this case is a host cell. This results in the membrane attack complex (MAC) destruction of the targeted cell. Examples include thrombocytopenia, Goodpasture, and membranous nephropathy.
- Type 3 (immune complex-mediated reaction) refers to IgG binding to circulating antigen resulting in formation of an immune complex. These complexes can end up collecting in the vasculature, joints, and kidneys resulting in local destruction. Examples include rheumatoid arthritis, systemic lupus erythematosus, and serum sickness.
- Type 4 (delayed type hypersensitivity) refers to the activation of TH1 helper T cells by an antigen-presenting cell. This establishes an immune response memory and when activated again, the TH1 cells activate a macrophage-mediated response resulting in cellular damage. Examples include chronic transplant rejection, contact dermatitis, and multiple sclerosis.

Transplant patients require immunosuppression to avoid a type 4 hypersensitivity. Although an overwhelming majority of the recent upper extremity transplants have done well, there have been several cases of vascular compromise attributed to chronic rejection. Close monitoring of vascular status is part of the vascularized composite transplant protocol.

## REFERENCES:

1. Robbins and Cotran pathologic basis of disease. (8th ed.). Philadelphia, PA: Saunders/Elsevier.
2. Schneeberger S, Khalifian S, Brandacher G. Immunosuppression and monitoring of rejection in hand transplantation. *Tech Hand Up Extrem Surg*. 2013 Dec;17(4):208-214.
3. Leonard DA, Kurtz JM, Cetrulo CL Jr. Achieving immune tolerance in hand and face transplantation: a realistic prospect? *Immunotherapy*. 2014 May;6(5):499-502.

221. A 15-year-old boy is evaluated for clusters of open and closed comedones on his forehead, cheeks, and chin. Physical examination shows similar lesions on the upper chest and back. Which of the following is the mechanism of retinoic acid in the treatment of pustular acne?

- A) Atrophy of pilosebaceous glands
- B) Decreased cohesiveness of keratinocytes
- C) Disruption of cell walls and denaturation of proteins
- D) Interference with DNA synthesis
- E) Suppression of metabolic processes of melanocytes

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

The correct response is Option B.

In addition to treatment of acne and associated skin conditions, topical retinoids are also commonly used as a method of nonsurgical facial rejuvenation. Topical retinoids act by decreasing corneocyte adhesion in the stratum corneum, resulting in reduced follicular occlusion and comedone formation. In addition to acne treatments, topical retinoids also improve fine rhytides, correct mild hyperpigmentation changes, and create smoother skin.

Phenol chemical peels are used to improve rhytides and pigment changes in the aging face. They penetrate to the upper layer of reticular dermis and act by disrupting cell walls and denaturing proteins.

Hydroquinone causes reversible depigmentation of the skin and is also used in nonsurgical facial rejuvenation. It works by suppressing metabolic processes of the melanocyte, specifically the inhibition of the oxidation of tyrosine to 3,4-dihydroxyphenylalanine (DOPA). The depigmentation effect is reversible; if a patient stops using hydroquinone, the pigmentation changes will return.

5-Fluorouracil acts by interfering with DNA synthesis by blocking the methylation of deoxyuridylic acid. It is used in the treatment of cutaneous malignancy and is not used in the treatment of pustular acne.

Systemic isotretinoin remains the most effective and aggressive drug for severe cystic

acne. It functions by causing atrophy of the pilosebaceous gland and attenuating the secretion of sebum. Isotretinoin is not used for cosmetic purposes. In fact, the reduced activity of the sebaceous glands predisposes patients to hypertrophic scarring, and any skin resurfacing procedure (chemical peel, carbon dioxide laser) is contraindicated in patients who have been on systemic retinoid therapy within 6 months to 1 year.

## **REFERENCES:**

1. Keri JE, Neild LS. Acne, rosacea, and hidradenitis suppurativa. In: Schwarzenberger K, ed. *General Dermatology: Requisites in Dermatology*. Philadelphia: Elsevier-Saunders; 2009:305-314.
2. Haider A, Shaw JC. Treatment of acne vulgaris. *JAMA*. 2004 Aug 11;292(6):726-735.

222. A 17-year-old boy is brought to the emergency department because of profuse bleeding from a stab wound to the neck above the angle of the mandible anterior to the sternocleidomastoid muscle. After airway stabilization is established, vascular repair of a laceration of the jugular vein is performed. Where is this injury located?

A) Posterior triangle

B) Zone I

C) Zone II

D) Zone III

The correct response is Option D.

Effective treatment of penetrating neck injuries depends on a thorough understanding of neck anatomy. The neck houses vital structures from six organ systems: The vascular system includes the innominate, subclavian, axillary, carotid, jugular, and vertebral vessels. The respiratory system includes the larynx, trachea, and the lung. The digestive system includes the pharynx and esophagus. The neurologic system includes the spinal cord, brachial plexus, cranial nerves, and the sympathetic chain. The endocrine system includes the thyroid and parathyroid. The skeletal system includes the cervical spine.

Anatomy of the neck may be considered using two anatomical paradigms: the concept of “triangles” and the concept of “zones.” The triangles are divided into anterior and posterior, while the zones are divided in a cranial/caudal orientation anterior to the sternocleidomastoid muscle. An understanding of both is important when considering penetrating injuries.

The neck may be divided into two triangles, anterior and posterior to the sternocleidomastoid muscle. The anterior triangle is bordered anteriorly by the midline, posteriorly by the sternocleidomastoid muscle, and superiorly by the lower edge of the mandible. Most vital structures are located in the anterior triangle. The posterior triangle is located within the boundaries of the sternocleidomastoid muscle anteriorly, inferiorly by the clavicle, and the anterior border of the trapezius muscle posteriorly. Trauma to the posterior triangle, excluding the spine, carries a much lower likelihood of significant injury.

Zone I is in the inferior neck and includes the base of the neck and thoracic inlet. It extends from the sternal notch and clavicles to the cricoid cartilage. Zone I contains

the thoracic outlet vasculature, vertebral and proximal carotid arteries, apices of the lungs, trachea, esophagus, spinal cord, and thoracic duct.

Zone II is in the mid-neck and continues cephalad from the cricoid cartilage to the angle of the mandible, and contains the jugular veins, vertebral and common carotid arteries, and internal and external branches of the carotid arteries. It also includes nonvascular structures including the trachea, esophagus, larynx, and spinal cord.

Zone III (upper neck) includes the region above the angle of the mandible up to the base of the skull and contains the pharynx along with the jugular veins, vertebral arteries, and the distal portion of the internal carotid arteries. Its caudal border is distal to the common carotid arteries.

Portions of the jugular vein are located in all three zones. Only Zone III is located above the angle of the mandible.

## **REFERENCES:**

1. Thompson EC, Porter JM, Fernandez LG. Penetrating neck trauma: an overview of management. *J Oral Maxillofac Surg*. 2002 Aug;60(8):918-923.
2. Low GM, Inaba K, Chouliaras K, et al. The use of the anatomic 'zones' of the neck in the assessment of penetrating neck injury. *Am Surg*. 2014 Oct;80(10):970-974.

223. In a transplanted hand, which of the following tissue components is most likely to elicit an IgM and IgG immune response that results in cellular destruction?

- A) Bone marrow
- B) Endothelium
- C) Muscle
- D) Nerve
- E) Skin

The correct response is Option E.

Skin is the most reactive component of vascularized tissue allograft. Initial response is an acute rejection, which is modulated by type II hypersensitivity. This is when IgG and IgM antibodies bind to the offending cell, targeting it for destruction by the immune response. Dr. Joseph Edward Murray, plastic surgeon and Nobel Laureate who performed the first human kidney transplant in 1954, elucidated the difficulty in suppressing skin immunogenicity. In fact, the first hand transplant was performed in Ecuador in 1964; however, it quickly failed because of acute rejection. This demonstrated that although the technical ability of vascularized allografting was possible, the medical knowledge of transplant immunology was not yet advanced enough for success.

Since it contains antigen-presenting cells such as Langerhans cells, skin is quite immunogenic and current therapy and monitoring of upper extremity vascularized composite allograft relies on skin monitoring to detect for acute rejection. Interestingly, although the skin may be in the process of being rejected, other tissue components of the vascularized composite allograft do not appear to suffer the same amount of immune-modulated damage.

## REFERENCES:

1. Shores JT, Brandacher G, Lee WA. Hand and Upper Extremity Transplantation: An Update of outcomes in the Worldwide Experience. *Plast Reconstr Surg*. 2014 Nov 14. [Epub ahead of print]
2. Schneeberger S, Khalifian S, Brandacher G. Immunosuppression and monitoring of rejection in hand transplantation. *Tech Hand Up Extrem Surg*. 2013 Dec;17(4):208-214.

3. Murray JE. Organ transplantation (skin, kidney, heart) and the plastic surgeon. *Plast Reconstr Surg*. 1971 May;47(5):425-431.

224. A 23-year-old man is brought to the emergency department 30 minutes after sustaining a self-inflicted shotgun wound to the face. Physical examination shows loss of soft tissue of the mid face with exposed mandible and maxilla, sonorous respiration, and periods of apnea. Heart rate is 100 bpm and blood pressure is 65/30 mmHg. Which of the following is the most appropriate course of management?
- A) Assess and establish airway, control bleeding, perform secondary survey, stabilize cervical spine
  - B) Assess and establish airway, stabilize cervical spine, control bleeding, perform secondary survey
  - C) Assess and establish airway, stabilize cervical spine, perform secondary survey, control bleeding
  - D) Stabilize cervical spine, control bleeding, assess and establish airway, perform secondary survey
  - E) Take the patient to the operating room for debridement of facial wound with reconstruction

The correct response is Option B.

The appropriate management sequence in this patient is to assess and establish the airway, stabilize the cervical spine, control bleeding, and perform a secondary survey. Only after the patient's condition has been stabilized using standard Advanced Trauma Life Support (ATLS) protocol would he be taken to the operating room for debridement and eventual facial reconstruction. While the deformity is obvious, and will require near-immediate attention in the operating theater, it can easily distract the evaluator from executing the ATLS management protocol.

The ATLS protocol was developed by the American College of Surgeons (ACS) Committee on Trauma (COT) in 1980 and is the standard of care for all trauma patients. The steps of the primary survey are remembered by the mnemonic ABCDE (Airway, Breathing, Circulation, Disability, Environment/exposure). The airway is the first priority and is assessed by determining the ability of air to pass unobstructed into the lungs. Treatment may require endotracheal intubation or establishment of a surgical airway. Breathing should then be evaluated to determine the patient's ability to ventilate and oxygenate. Circulation is evaluated by identifying hypovolemia and external sources of hemorrhage. Disability is determined by performing gross mental status and motor examinations. The final step includes patient exposure and control

of the immediate environment. The secondary survey should only be completed after following the fundamental steps of the ATLS protocol.

Cervical spine injury should be assumed in all trauma patients and should be managed as such until it can be definitively excluded. This patient with a gunshot wound to the face should have the cervical spine stabilized immediately and strict cervical spine precautions should be maintained during the assessment of the patient's airway and breathing. During assessment of the airway, the cervical spine should not be flexed, extended, or rotated. If the external neck support must be removed, a member of the trauma team should maintain control of the head and neck using the in-line immobilization technique.

## REFERENCES:

1. American College of Surgeons. *Advanced Trauma Life Support*. 9th ed. Chicago: American College of Surgeons; 2012:2-47.
2. Perry M. Advanced Trauma Life Support (ATLS) and facial trauma: can one size fit all? Part 1: Dilemmas in the management of the multiply injured patient with coexisting facial injuries. *Int J Oral Maxillofac Surg*. 2008 Mar;37(3):209-214.

225. The concept of "meaningful use" in the context of the electronic medical record refers to which of the following?

- A) Compartmentalization of medical records between a patient's providers, requiring individual release forms for records in compliance with Health Insurance Portability and Accountability Act (HIPAA) regulations
- B) Increasing the ability of health care systems to allow small business employers access to patient medical information for calculation of insurance premiums
- C) Increasing the ability of health care systems to protect patient medical information in compliance with HIPAA regulations
- D) Providing documentation of only vital signs in electronic medical records for each patient seen
- E) Using electronic prescriptions when more convenient for the patient

The correct response is Option C.

Implementation of electronic medical record (EMR) is one part of updating the United States health care infrastructure. Part of utilizing EMR is the concept of "meaningful use," which refers to using the approved EMR systems to their full potential in order to provide optimization of health care data documentation to improve the quality of health care. There are five categories that have become priorities in establishing adequate parameters of health care:

1. Improve quality, safety, efficiency, and reducing health disparities
2. Engage patients and families in their health
3. Improve care coordination
4. Improve population and public health
5. Ensure adequate privacy and security protection for personal health information

## REFERENCES:

1. Centers for Disease Control and Prevention. Meaningful Use: Introduction. Available at: <http://www.cdc.gov/EHRmeaningfuluse/introduction.html>. Accessed January 8, 2015.

2. Office for the National Coordinator for Health Information Technology. Meaningful Use Regulations: <http://www.healthit.gov/policy-researchers-implementers/meaningful-use-regulations>. Accessed May 22, 2015.
3. Centers for Medicare and Medicaid Services. Certified EHR Technology: What is a certified EHR? Available at: <http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/Certification.html>. Accessed May 22, 2015.

226. Nipple-sparing mastectomy is CONTRAINDICATED in which of the following women considering mastectomy and immediate breast reconstruction?
- A) A 21-year-old with *BRCA1* mutation and grade I breast ptosis
  - B) A 31-year-old with *BRCA2* mutation; subglandular augmentation mammoplasty 1 year ago
  - C) A 45-year-old with unilateral breast cancer and need for postoperative radiation therapy
  - D) A 50-year-old with unilateral breast cancer in the tail of Spence
  - E) A 61-year-old with unilateral breast cancer; tumor-to-nipple distance of 1 cm

The correct response is Option E.

Nipple-sparing mastectomy is increasingly prevalent owing to perceived improvement in reconstructive outcome and patient satisfaction. Prevalence of nipple ischemia, which can vary in severity from incomplete, partial-thickness epidermolysis to total nipple loss, ranges from 2 to 60% depending on the definition used. A recent pooled analysis found a cumulative prevalence of 7%. Most cases respond to local wound care; reoperation for total nipple loss is relatively infrequent.

Patient selection remains paramount to successful nipple preservation. Typically, thin, non-smoking patients with small, non-ptotic breasts are considered ideal candidates. Severe macromastia and ptosis may not only increase risk of poor nipple vascularity, but also contribute to nipple malposition. Oncologic determinants of the safety of nipple preservation should also be considered. Noninflammatory cancers located in excess of 2 cm from the nipple can generally be safely extirpated without removal of the nipple. Usually, an intraoperative frozen section biopsy of the retroareolar tissue ("doughnut") is performed after excision of the main mastectomy specimen to demonstrate nipple margins free of tumor. Patients undergoing prophylactic mastectomy in the setting of high genetic predisposition are also considered good candidates. Successful nipple preservation has also been described in patients with a history of reduction mammoplasty or mastopexy.

Successful nipple-sparing mastectomy with implant reconstruction has been described recently in patients who require postoperative radiation, albeit with higher risk of capsular contracture and nipple malposition. Prior augmentation in the subglandular or subpectoral positions does not contraindicate nipple-sparing mastectomy; rather, the latter group may present opportunities for direct-to-implant

reconstruction. Location of a breast cancer in the tail of Spence (axillary extension of breast tissue) should not contraindicate nipple-sparing mastectomy, as it is likely to be far enough from the nipple to safely spare it.

## REFERENCES:

1. Endara M, Chen D, Verma K, et al. Breast reconstruction following nipple-sparing mastectomy: a systematic review of the literature with pooled analysis. *Plast Reconstr Surg*. 2013 Nov;132(5):1043-1054.
2. Spear SL, Shuck J, Hannan L, et al. Evaluating long-term outcomes following nipple-sparing mastectomy and reconstruction in the irradiated breast. *Plast Reconstr Surg*. 2014 May;133(5):605e-614e.
3. Alperovich M, Tanna N, Samra F, et al. Nipple-sparing mastectomy in patients with a history of reduction mammoplasty or mastopexy: how safe is it? *Plast Reconstr Surg*. 2013 May;131(5):962-967.

227. A 62-year-old woman is evaluated for lower blepharoplasty. On examination, negative vector is noted. Postoperatively, this patient is at increased risk for which of the following conditions?
- A) Dystopia
  - B) Ectropion
  - C) Enophthalmos
  - D) Lagophthalmos
  - E) Proptosis

The correct response is Option B.

The finding of a negative vector places the patient at an elevated risk for lower lid malposition and ectropion. The negative vector refers to the anatomic relationship on lateral view of the maximum projecting point of the globe and the maximum projecting point of the infraorbital malar prominence. If the globe projects less than the malar prominence, a negative vector exists. Conversely, if the malar prominence projects more than the globe, a positive vector exists.

The negative vector finding indicates potentially deficient globe and lid support based on skeletal anatomy. Such patients will often have minor scleral show or lateral lid lag. It is important to recognize these findings prior to blepharoplasty surgery in order to surgically address the risks of ectropion via primary lid suspension during the blepharoplasty. Occasionally, lower lid blepharoplasty may be avoided if a negative vector is present and other conditions such as dry eye exist. Other findings or conditions that are associated with postoperative ectropion and lower lid malposition are: orbicular weakness, anterior lamellar shortage, inferior eyelid/orbital volume deficit, and eyelid laxity. Excessive or prominent middle lamellar scarring can occur after surgery, which can also lead to lid malposition.

Lagophthalmos is the inability to lower the upper lid fully and is a negative consequence of upper blepharoplasty due to excessive tissue resection or fibrosis. Enophthalmos is interior retraction or displacement of the globe related to increased orbital volume. This is unrelated to lower blepharoplasty surgery. Proptosis is an external displacement of the globe giving the appearance that the eyeball is extruding from the orbit. This is most often associated with Graves disease, head trauma, and increased intracranial pressure. It can also be due to a retrobulbar hematoma after blepharoplasty, which is a surgical emergency due to the risk of blindness.

Dystopia refers to malposition of the globe related to skeletal changes of the orbit. This would not be a result of blepharoplasty, but can occur after facial trauma or facial tumor resection.

## **REFERENCES:**

1. Griffin G, Azizzadeh B, Massry GG. New insights into physical findings associated with postblepharoplasty lower eyelid retraction. *Aesthet Surg J*. 2014 Sep;34(7):995-1004.
2. Jindal K, Sarcia M, Codner MA. Functional considerations in aesthetic eyelid surgery. *Plast Reconstr Surg*. 2014 Dec;134(6):1154-1170.

228. A 42-year-old woman is scheduled to undergo reduction mammoplasty. Medical history includes macromastia and von Willebrand disease. Preoperatively, administration of desmopressin (DDAVP) is planned for bleeding prophylaxis. The total preoperative dose is best determined by measuring the activity levels of vWF:RCoF (von Willebrand factor ristocetin cofactor) and which of the following coagulation factors?

- A) II
- B) V
- C) VII
- D) VIII
- E) X

The correct response is Option D.

In surgical patients with von Willebrand disease (vWD) receiving desmopressin (DDAVP) for bleeding prophylaxis, total preoperative dose should be determined by preoperative measurement of activity levels of von Willebrand factor ristocetin cofactor (vWF:RCoF) and coagulation factor VIII.

The other listed coagulation factors are not associated with isolated vWD.

vWD is the most common congenital bleeding disorder, with estimated prevalence as high as 1.3%. It is caused by deficiency (types I and III) or dysfunction (type II) of von Willebrand factor (vWF), leading to impaired platelet adhesion and possibly lower levels of coagulation factor VIII. In its normal state, vWF is a plasma protein that mediates the initial adhesion of platelets at sites of vascular injury and also binds and stabilizes coagulation factor VIII in the circulation. Both vascular endothelial cells and platelets synthesize and store vWF.

DDAVP is a synthetic derivative of ADH (vasopressin, antidiuretic hormone) that is used for treatment and prophylaxis of bleeding in patients with vWD. It promotes release of stored vWF from endothelial cells into the plasma, being particularly effective in patients with partial quantitative deficiency of vWF, or type I (about 75% of cases of vWD). Patients who do not appropriately respond to DDAVP administration should receive vWF concentrate.

For bleeding prophylaxis for minor surgery, the preoperative goal should be to achieve vWF:RCoF and factor VIII activity levels of at least 30 IU/dL (preferably >50 IU/dL). Such levels should be maintained for 1 to 5 days postoperatively. For prophylaxis for major surgery, preoperative activity levels should be at least 100 IU/dL and maintained above 50 IU/dL for at least 7 to 10 days.

To decrease risk of perioperative thromboembolism, vWF:RCoF levels should not exceed 200 IU/dL and factor VIII activity should not exceed 250 IU/dL. Fluid restriction is advised for patients receiving DDAVP perioperatively, to avoid hyponatremia and seizures.

## REFERENCES:

1. Nichols WL, Hultin MB, James AH, et al. von Willebrand disease (vWD): evidence-based diagnosis and management guidelines, the National Heart, Lung, and Blood Institute (NHLBI) Expert Panel report (USA). *Haemophilia*. 2008 Mar;14(2):171-232.
2. Stone ME, Mazzeffi M, Derham J, et al. Current management of von Willebrand disease and von Willebrand syndrome. *Curr Opin Anaesthesiol*. 2014 Jun;27(3):353-358.
3. Svensson PJ, Bergqvist PB, Juul KV, et al. Desmopressin in treatment of haematological disorders and in prevention of surgical bleeding. *Blood Rev*. 2014 May;28(3):95-102. Epub 2014 Mar 22.

229. A 21-year-old man is evaluated after being struck in the chin with a lead pipe during a bar fight. Physical examination shows a 6-mm displaced bicortical right parasymphyseal fracture and left nondisplaced subcondylar fracture with open crossbite. A full trauma evaluation is performed; no injury to the cervical spine or intracranial injury is noted. Which of the following is the most appropriate treatment in this patient?
- A) Liquid diet for 3 weeks, followed by mechanical soft diet for 3 weeks
  - B) Maxillomandibular fixation followed by open reduction and internal fixation (ORIF) in 4 weeks
  - C) Maxillomandibular fixation alone for 4 to 6 weeks
  - D) ORIF of the parasymphyseal fracture followed by immediate maxillomandibular fixation
  - E) Maxillomandibular fixation followed by immediate ORIF of the parasymphyseal fracture

The correct response is Option E.

The proper surgical repair is rigid maxillomandibular fixation, followed by open reduction and internal fixation (ORIF) of the parasymphyseal fracture. Patients with mandibular fractures sustain significant blunt force trauma and require a full trauma assessment. Closed head injury and cervical spine trauma must be excluded. Additionally, a thorough assessment of the facial skeleton for other fractures is necessary.

Mandibular fracture repair is based on the paramount principle of restoring proper dental occlusion. As such it is necessary to place the patient into maxillomandibular fixation (MMF), rigidly with arch bar technique prior to addressing the parasymphyseal fracture. MMF will effectively reduce the subcondylar fracture and realign the bicortical anterior fracture, allowing plate and screw fixation to be done anatomically. Rigid fixation is needed in this particular case due to the need for full immobilization of several weeks while the subcondylar fracture sets and heals.

Mandibular fracture rigid fixation with plates and screws without proper restoration of dental occlusion can potentially lead to severe consequences. Patients will have temporomandibular joint pain due to the malalignment of the maxilla and mandible. They can develop associated painful trismus. Nonunion with or without osteomyelitis can also occur due to the force of the muscles of mastication and the abnormal

mandibular forces created by the malocclusion.

Starting the surgical repair with ORIF of the parasymphyseal fracture followed by MMF is inappropriate since proper dental occlusion is not assured prior to the rigid fixation. With the presence of the subcondylar fracture, the MMF placed after plating the parasymphyseal fracture can still achieve dental occlusion by further displacement of the subcondylar fracture, rather than reducing it.

MMF with elastics followed by open repair of the parasymphyseal fracture in 4 weeks is inappropriate. Because of displacement of both fractures, rigid MMF is needed. Furthermore, waiting 4 weeks to reduce and fixate the parasymphyseal fracture will likely lead to fibrous non-union or malunion. Facial fractures in adults should be repaired within 10 to 14 days so as to readily manipulate the fracture elements for anatomical reduction.

MMF with elastics as the only treatment is also inappropriate for the treatment as indicated above. Similarly liquid and soft mechanical diets without fixation is inappropriate and will lead to nonunion or malunion with subsequent malocclusion and pain.

## REFERENCES:

1. Morrow BT, Samson TD, Schubert W, et al. Evidence-based medicine: mandible fractures. *Plast Reconstr Surg*. 2014 Dec;134(6):1381-1390.
2. Mahajan SV, Datarkan AN, Borle RM. Time lapse from the occurrence of trauma to the definitive management of mandibular fractures: a retrospective study. *J Maxillofac Oral Surg*. 2009 Dec;8(4):320-323. Epub 2010 Apr 24.

230. A 52-year-old man is evaluated 7 months after sustaining an isolated left-sided orbital blowout fracture for which no surgical intervention was performed. Physical examination shows extraocular movements are intact. He reports gradual and progressive episodes of double vision over the past 3 months. Which of the following physical findings is most likely associated with this condition?

- A) Ectropion
- B) Muscle entrapment
- C) Exophthalmos
- D) Vertical dystopia
- E) Orbital proptosis

The correct response is Option D.

The physical finding that would most likely be associated with the finding of double vision 7 months after having sustained an orbital blowout fracture is enophthalmos. The position of the globe is altered in enophthalmos. Because of increased orbital volume, the globe is situated deeper or more inferiorly, such that the direct line of vision of the affected eye no longer matches that of the unaffected eye. The two eyes no longer track appropriately, causing double vision or diplopia by virtue of not having the same visual field.

Orbital fractures frequently occur in conjunction with other facial fractures, most commonly the zygomaticomaxillary complex fracture. Often the orbital floor or sidewall can be fractured without concomitant fractures. This occurs from a direct blow to the orbit/eye, most often by a punch or elbow/ball in sports. The absolute indication for operative repair acutely is the presence of entrapment, most often of the inferior rectus muscle. The belly of the muscle herniates into and remains within the fracture site in the orbital floor. The finding of diplopia on upward, lateral gaze with the affected eye having reduced movement in that upward direction indicates entrapment. The forced duction test further documents this condition. Surgical repair is indicated acutely to avoid permanent damage and fibrosis to the inferior rectus muscle and consequent visual difficulties.

In the absence of entrapment or orbital hematoma, surgical repair is a judgment call based on the location and extent of the fractures. If the fracture is deemed sizable enough to increase the orbital volume, then the risk of subsequent enophthalmos and diplopia is considered high and surgical repair is indicated. The repair involves

reduction of orbital contents and restoration of the orbital floor, most often with titanium mesh. Large fractures may require primary bone grafting.

The conventional means of correcting post-traumatic enophthalmos is bone grafting. However, it is often difficult to accurately judge the correction needed due to multimodal increase in orbital volume from the combination of increase orbital volume and potential reduction in periorbital fat from traumatic atrophy. New techniques of alloplastic floor restoration and periorbital fat grafting have shown encouraging results.

Exophthalmos, ectropion, and proptosis are not conditions typically associated with isolated orbital blowout fractures. Furthermore, these conditions frequently occur without diplopia.

Entrapment of the periorbital muscles, most usually the inferior oblique, can cause entrapment by limiting proper movement of the involved globe. However, this is usually an acute symptom and would not present initially several months after the trauma.

## **REFERENCES:**

1. Yano H, Nakano M, Anraku K, et al. A consecutive case review of orbital blowout fractures and recommendations for comprehensive management. *Plast Reconstr Surg*. 2009 Aug;124(2):602-611.
2. Metzler P, Ezaldein HH, Pfaff MJ, et al. Correction of severe enophthalmos by simultaneous fat grafting and anatomic orbital reconstruction. *J Craniofac Surg*. 2014 Sep;25(5):1829-1832.

231. A 4-year-old boy is brought to a small community hospital by his grandmother, who reports that he fell into a bathtub filled with hot water while under the care of his stepfather. Physical examination shows deep partial-thickness burns on the lower extremities, including the feet, with a clear line of demarcation on the upper ankles; there are no splash marks. Multiple bruises scattered across the chest and periorbital ecchymoses are noted. Child abuse is suspected. Which of the following is the most appropriate next step?
- A) Admit the patient to the community hospital for a full skeletal survey
  - B) Admit the patient to the community hospital for local wound care
  - C) Notify local police to apprehend the stepfather
  - D) Transfer the patient to a burn center by emergency medical services
  - E) Transfer the patient to a burn center by private vehicle

The correct response is Option D.

This child meets several criteria for transfer to a burn center: suspected child abuse, significant burns to the hands or feet, and a history that does not match the physical examination. While local police and the department of social services should be notified about this case, the role of the burn care provider is to make sure that the patient receives appropriate treatment and is transferred or discharged to a safe environment. The child will require assessment of the household by a social worker, as well as a pediatric consult to help look for other occult injuries, such as acute or healing long-bone fractures. Transfer to a burn center by private vehicle, despite the wishes of the family, would be placing the child at excessive risk for further injury. Transfer must be coordinated and performed by emergency medical services.

## REFERENCES:

1. Wibbenmeyer L, Liao J, Heard J, et al. Factors related to child maltreatment in children presenting with burn injuries. *J Burn Care Res.* 2014 Sep-Oct;35(5):374-381.
2. Hultman CS, Priolo D, Cairns BA, et al. Return to jeopardy: the fate of pediatric burn patients who are victims of abuse and neglect. *J Burn Care Rehabil.* 1998 Jul-Aug;19(4):367-376.

232. A 28-year-old man presents 8 days after open reduction and internal fixation of an unstable distal tibia fracture. Postoperatively, the incision has dehisced. Examination shows a 5 × 2-cm open wound with marginal skin necrosis and exposed hardware. Which of the following is the most appropriate next step in soft-tissue coverage?

- A) Debridement with application of skin substitute
- B) Hardware removal, casting, and wound care
- C) Hyperbaric oxygen and wound care
- D) Operative debridement and placement of a VAC for a bridge to skin grafting
- E) Operative debridement and vascularized reconstruction with a flap

The correct response is Option E.

The best treatment that would allow salvage of the fracture fixation is operative debridement and vascularized flap reconstruction. Stable fixation has been achieved and subacute wound dehiscence has occurred because of ischemia or devitalization of the overlying soft tissue. This is due to the forces of the original trauma as well as potential further traumatic insult of the tissue during surgical repair. In the absence of infection, immediate soft-tissue reconstruction will provide stable vascularized soft-tissue coverage of the fracture site and the hardware. As such, vascularized flap reconstruction is appropriate. In the distal leg, this often requires free tissue transfer, but depending on the location and size of the defect, soleus flap or perforator propeller flaps can be used.

Gustilo provided a classification of open fractures of the leg in which the fracture site was exposed through a disruption of soft-tissue integrity:

- I. Open fracture with clean wound less than 1 cm
- II. Open fracture with a 1- to 10-cm wound without extensive soft-tissue damage or loss
- III. Open wound with extensive soft-tissue injury greater than 10 cm in length, significant soft-tissue avulsion/loss. Also includes complex fractures such as those associated with vascular repair, fractures/injuries open for more than 8 hours prior to intervention, industrial or farming injuries. IIIA: Extensive soft-tissue injury/damage but adequate periosteal coverage of the fracture site; IIIB: Extensive damage/stripping of the periosteum with extensive soft-tissue injury; IIIC: Any type III fracture in which arterial repair is needed.

Determination of the type of flap reconstruction required requires assessment of not only the location and size of the defect, but also the zone of injury. Greater degrees of force are associated with the increasing Gustilo classification such that type III fractures often require free tissue transfer because of concomitant damage of the regional and local tissues.

Operative debridement and placement of a VAC for a bridge to skin grafting is a potential treatment for an open wound with exposed bone without hardware. The period of time in which the wound remains open and granulates during this process provides a very high risk for hardware infection, nonunion, and osteomyelitis.

Debridement with skin advancement and closure is likely to fail because of the difficulty in providing appropriate tension-free advancement flaps in the leg, combined with the need to accommodate for tissue loss from the debridement and ischemia of the advancing skin edges. The reliability of this treatment is poor and would have high risk for failure and subsequent hardware infection and nonunion or osteomyelitis.

Hardware removal, casting, and wound care is not indicated since the fracture repair is intact and no signs of infection are present. However, if hardware removal were required because of overt infection, the most appropriate treatment would be placement of an external fixator and soft-tissue flap reconstruction.

Hyperbaric oxygen and wound care is not the best option in this acute situation in which prompt soft-tissue reconstruction and vascularized coverage of the fracture site are required to salvage the existent fixation and avoid mal/nonunion or osteomyelitis.

## REFERENCES:

1. Jenkinson RJ, Kiss A, Johnson S, et al. Delayed wound closure increases deep-infection rate associated with lower grade open fractures: a propensity-matched cohort study. *J Bone Joint Surg Am*. 2014 Mar 5;96(5):380-386.
2. Khan MA, Jose RM, Taylor C, et al. Free radial forearm fasciocutaneous flap in the treatment of distal third tibial osteomyelitis. *Ann Plast Surg*. 2012 Jan;68(1):58-61.
3. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long bones: retrospective and prospective analyses. *J Bone Joint Surg Am*. 1976 Jun;58(4):453-458.

233. A 56-year-old woman undergoes reduction mammoplasty. Her primary insurance coverage is provided by Medicare. The surgeon, a contracted provider, submits a bill for \$3100. Per the contract with the insurance company, the provider is paid \$1475 from Medicare and the patient is responsible for a co-pay of \$250. Which of the following statements in regard to the difference between the provider's bill and his payment is most accurate?
- A) The difference can be allocated to bad debt for reasons of accounting and tax preparation
  - B) The difference can be recouped by the provider by submitting a new bill for local flap rearrangement and complex wound repair of the breasts
  - C) The difference is a contractual adjustment and the service is considered paid in full
  - D) The difference should be billed to the patient
  - E) The difference should be financed on a payment plan

The correct response is Option C.

The difference of the bill and the payment is considered a contractual adjustment and the services are paid in full. As a contracted provider for Medicare, the physician agrees to accept payment according to the Medicare fee schedule. Payment comes in two forms: direct payment from Medicare and co-payment from the patient. Many Medicare enrollees also pay for a supplemental health insurance policy. This plan provides payment for deductibles and co-pays that Medicare does not pay. If such insurance is carried, then the patient's co-payment for services is paid by the supplemental insurance company. The patient's obligation is the contracted co-payment, whether paid personally by them or by their supplemental policy. Virtually all insurance companies follow these same regulations.

Medicare consists of two basic parts: Part A and Part B. Part A covers hospitalization, skilled nursing facilities, and hospice care. Part B covers provider and related services: doctors, physical therapists, laboratories, durable equipment, mental health, etc. Enrollees do not pay a monthly premium for Part A if Medicare taxes were paid while they were employed and they are age 65 and receive retirement benefits (social security), or if they are under age 65 and receive social security benefits or have end-stage renal disease (with specific sub-requirements). In 2014, Part B carried a monthly premium of \$104.90, and a yearly deductible of \$147. Both fees will not change in 2015.

Based on federal and state laws, it is illegal to balance bill patients for fees greater than the contractual agreement for those services. The difference between the bill and the payments cannot be written off as bad debt. Truly owed money that is not paid is considered bad debt. No further money is owed after all contractual agreed-upon payments have been made. Submitting new bills for local flap rearrangement is considered to be unbundling, since this aspect of the procedure is included in breast reduction surgery and payment. Unbundling is a form of insurance fraud and is subject to significant penalties.

## **REFERENCES:**

1. The Official US Government Site for Medicare. Medicare.gov
2. Paying for the doctor when you have Original Medicare. Medicare Interactive website. Available at: [http://www.medicareinteractive.org/page2.php?topic=counselor&page=script&script\\_id=357](http://www.medicareinteractive.org/page2.php?topic=counselor&page=script&script_id=357). Accessed December 23, 2014.

234. A 55-year-old woman is evaluated for mild cellulitis after undergoing cosmetic excision of a facial mole 7 days ago. Cephalexin is prescribed. Approximately 30 minutes after taking her first dose, she returns to the office because of sudden and progressive onset of generalized hives, periorbital edema, and flushing. The patient appears confused and then collapses. Blood pressure is 85/50 mmHg. An audible wheeze is noted. Which of the following is the most appropriate next step in management?

- A) Administration of albuterol nebulizer
- B) Administration of diphenhydramine and ranitidine intravenously
- C) Injection of epinephrine (1 mg/mL) 0.3 to 0.5 mg intramuscularly
- D) Injection of methylprednisolone 125 mg intramuscularly
- E) Rapid infusion of 0.9% saline 1 to 2 L intravenously

The correct response is Option C.

This patient is presenting with anaphylaxis. The first and most crucial step in managing acute anaphylaxis is the administration of epinephrine.

Anaphylaxis is a serious and life-threatening hypersensitivity reaction. Medications and insect stings are the most common triggers in adults, with beta-lactam antibiotic exposure among the most implicated medications. In this setting, anaphylaxis is diagnosed when two or more of the following are observed minutes to hours after exposure:

- Skin-mucosal tissue reactions (such as generalized urticaria, swollen lip, pruritus, and flushing)
- Respiratory compromise (such as dyspnea, wheeze, bronchospasm, stridor, and hypoxemia)
- Hypotension or associated findings (such as syncope, confusion, collapse, and incontinence)
- Persistent gastrointestinal reactions (such as crampy abdominal pain and vomiting)

Intramuscular epinephrine can be repeated every 5 to 15 minutes as needed. If given promptly, most patients respond to one or two doses. Simultaneous with this treatment, an emergency team can be summoned. The patient should be placed in a recumbent position with legs elevated and supplemental oxygen administered.

Volume resuscitation can be initiated to compensate for severe loss of intravascular volume that can accompany fluid shifts of untreated anaphylaxis and to support blood pressure not responsive to epinephrine.

Bronchodilators, H1 and H2 antihistamines such as diphenhydramine and ranitidine, and glucocorticoids such as methylprednisolone are all reasonable but second-line treatments for acute anaphylaxis.

Intubation should be performed immediately in the setting of progressive upper airway closure such as stridor and tongue edema, or if respiratory arrest is present. However, first-dose epinephrine administration should not be delayed for intubation. Epinephrine works rapidly to reduce airway edema that might otherwise prevent successful intubation, if not completely reverse the underlying etiology of cardiopulmonary collapse in anaphylaxis.

While cardiovascular disease is a risk factor for poor outcome from anaphylaxis, it is not a contraindication for epinephrine administration. It is generally accepted that the risk of death or brain damage from prolonged or undertreated anaphylaxis outweighs the risk of appropriately administered epinephrine. If there is inadequate response to initial intramuscular epinephrine and volume resuscitation, then intravenous epinephrine can be introduced in an intensive care setting by slow infusion at 2 to 10 mcg per minute and titrated to effect.

## REFERENCES:

1. Kemp SF, Lockey RF, Simons FE, et al. Epinephrine: the drug of choice for anaphylaxis. A statement of the World Allergy Organization. *Allergy*. 2008 Aug;63(8):1061-1070.
2. Sampson HA, Muñoz-Furlong A, Campbell RL, et al. Second symposium on the definition and management of anaphylaxis: summary report—Second National Institute of Allergy and Infectious Disease/Food Allergy and Anaphylaxis Network symposium. *J Allergy Clin Immunol*. 2006 Feb;117(2):391-397.
3. Simons FE, Arduzzo LR, Bilò MB, et al. World Allergy Organization anaphylaxis guidelines: summary. *J Allergy Clin Immunol*. 2011 Mar;127(3):587-593.

235. A critically ill 85-year-old man requires arterial catheterization for serial arterial blood testing and continuous blood pressure monitoring. Which of the following is the most likely complication of brachial artery catheterization in this patient?
- A) Increased risk of catheter thrombosis compared with radial artery catheterization
  - B) Increased risk of infection compared with femoral artery catheterization
  - C) Paresthesia to the radial three digits
  - D) Progressive clawing of the ring and little fingers
  - E) Transient loss of wrist and finger extension

The correct response is Option C.

Of the choices given, the most likely complication of brachial artery catheterization is paresthesia to the lateral three digits due to median nerve injury. The median nerve travels adjacent to the brachial artery along its length of the arm until the two separate deep to the bicipital aponeurosis and is thus subject to unintended injury in the course of attempted cannulation in the distal arm.

Progressive clawing of the ring and little fingers, and transient loss of wrist and finger extension, manifesting ulnar and high radial nerve injuries, respectively, have not been described as complications of brachial artery catheterization.

Common sites of arterial catheterization in adults include the radial, femoral, brachial, dorsalis pedis, and axillary arteries. Complications common to all sites include local and systemic infection, catheter thrombosis, bleeding, hematoma, and pain. One prospective cohort study involving almost 2500 patients found that femoral artery catheters were associated with increased incidence of both local infection and bloodstream infection when compared with radial arterial catheters. A significant relationship between other anatomical sites of arterial catheterization and increased incidence of infection has not been shown in other large studies.

There is a decreased risk of catheter thrombosis in larger caliber vessels like the brachial artery compared with smaller vessels such as the radial artery. Other risk factors for catheter thrombosis include duration of catheterization greater than 72 hours, larger gauge catheters, low blood flow states, peripheral artery disease, and vasospastic disorders.

## REFERENCES:

1. Frezza EE, Mezghebe H. Indications and complications of arterial catheter use in surgical or medical intensive care units: analysis of 4932 patients. *Am Surg.* 1998 Feb;64(2):127-131.
2. Lorente L, Santacreu R, Martín MM, et al. Arterial catheter-related infection of 2,949 catheters. *Crit Care.* 2006;10(3):R83. Epub 2006 May 24.
3. Weiss BM, Gattiker RI. Complications during and following radial artery cannulation: a prospective study. *Intensive Care Med.* 1986;12(6):424-428.

236. A critically ill 65-year-old woman is brought to the intensive care unit, where she sustains respiratory arrest. Temperature is 101.3°F (38.5°C), heart rate is 105 bpm, and blood pressure is 85/60 mmHg. Hematocrit is 35%. She is immediately intubated. Noninvasive pulse oximetry is initiated to monitor oxygen saturation (SaO<sub>2</sub>). Which of the following conditions is most likely to alter pulse oximetry values in this patient?

- A) Anemia
- B) Fever
- C) Hypotension
- D) Tachycardia
- E) Tachypnea

The correct response is Option C.

Hypotension is most likely to alter pulse oximetry values by reducing peripheral arterial blood flow.

Pulse oximetry measures the relative transmission of light at two wavelengths that differ significantly when passed through loaded versus non-loaded hemoglobin (e.g., oxyhemoglobin versus deoxyhemoglobin). In order to provide values that correlate with arterial oxygen saturation levels as opposed to tissue bed or venous saturation levels, standard pulse oximeters require pulsatile blood to distinguish transmission at the peak of arterial pulsation relative to baseline transmission levels. Thus, pulse oximetry measurements will change both with changes in hemoglobin oxygen saturation and with conditions that interfere with the device's ability to detect pulsatile blood flow.

Other conditions that alter pulse oximetry measurements by reducing the detection of fluctuations from arterial blood flow include peripheral vasoconstriction from hypothermia and vasopressor and interference from motion, such as tremors or shivering. Incorrect sensor application, highly calloused skin, and nail polish can also affect measurements by interfering with transmission readings.

Because standard pulse oximetry only measures the relative difference in transmission between oxygenated and deoxygenated hemoglobin and not the absolute value of oxygenated hemoglobin, anemia does not significantly affect pulse oximetry values within physiologic ranges.

Tachycardia, tachypnea, and fever do not directly affect pulse oximetry values.

## **REFERENCES:**

1. Epstein CD, Haghenbeck KT. Bedside assessment of tissue oxygen saturation monitoring in critically ill adults: an integrative review of the literature. *Crit Care Res Pract.* 2014;2014:709683. Epub 2014 May 8.
2. Sinex JE. Pulse oximetry: principles and limitations. *Am J Emerg Med.* 1999 Jan;17(1):59-67.

237. A 2-month-old female infant is evaluated because of a pigmented skin lesion on the midline lumbar region. Physical examination shows a dark brown lesion that is 10 cm in diameter with an irregular surface and coarse hairs. This patient is at increased risk for which of the following?

- A) Basal cell carcinoma
- B) Occult spina bifida
- C) Precocious puberty
- D) Renal anomalies
- E) Vascular malformations

The correct response is Option B.

The lesion described is a congenital melanocytic nevus (CMN). Basal cell carcinomas are associated with nevus sebaceous. Precocious puberty is seen in congenital adrenal hyperplasia, which is associated with generalized hyperpigmentation most apparent in the areolas and genitalia. Renal anomalies and vascular malformations are not associated with CMN. Abnormalities of the vertebral column including spina bifida are seen with CMN overlying the spine. These lesions are also associated with neurocutaneous melanosis.

## REFERENCES:

1. Bauer BS, Adler N. Congenital melanocytic nevi. In: Neligan PC, Rodriguez ED, Losee JE, eds. *Plastic Surgery*. Vol 3. Philadelphia: Elsevier-Saunders; 2013:837-854.
2. Vourc'h-Jourdain M, Martin L, Barbarot S, et al. Large congenital melanocytic nevi: therapeutic management and melanoma risk: a systematic review. *J Am Acad Dermatol*. 2013 Mar;68(3):493-498. Epub 2012 Nov 19.
3. Alikhan A, Ibrahimi OA, Eisen DB. Congenital melanocytic nevi: where are we now? Part I. Clinical presentation, epidemiology, pathogenesis, histology, malignant transformation, and neurocutaneous melanosis. *J Am Acad Dermatol*. 2012 Oct;67(4):495.



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

238. A 58-year-old man is brought to the emergency department for frostbite injury of the right thumb. A photograph is shown. Which of the following is the inciting mechanism of the injury?
- A) Failure of DNA repair mechanisms
  - B) Formation of extracellular ice crystals
  - C) Osteonecrosis secondary to vasoconstriction
  - D) Polymerization of intracellular amino acids
  - E) Vascular endothelial damage

The correct response is Option B.

Frostbite occurs by the formation of ice crystals in the intracellular and extracellular spaces. During the cooling process, the extracellular ice crystals form, and osmotic pressure increases, dragging water out of the cells. This leads to intracellular

dehydration and an increase in intracellular electrolytes, proteins, and enzymes that lead to cell death. Additionally, there is vascular endothelial damage leading to intravascular thrombosis and decreased blood flow. Arteriovenous shunting occurs at the capillary level, and end-organ tissue damage is compounded.

During the warming process, there is an influx of fluid back into the cells, causing intracellular swelling. The warming process also allows reflow, vasodilation, and reactive hyperemia to occur, leading to increased inflammatory mediators causing further cell death.

Frostbitten extremities should be rapidly rewarmed in water at a temperature of 104.0°F (40.0°C). Typically, rewarming can be completed in 20 to 30 minutes. Adjunctive use of anti-inflammatory medications and anticoagulants also has been described. Patience is required in determining which areas need debridement.

## **REFERENCES:**

1. Klein MW. Thermal, chemical, and electrical injuries. In: Thorne CH, Beasley RW, Aston SJ, et al, eds. *Grabb and Smith's Plastic Surgery*. 6th ed. Philadelphia: Lippincott Williams & Wilkins; 2007:147.
2. Lee CK, Hansen SL. Management of acute wounds. *Clin Plast Surg*. 2007 Oct;34(4):685-96.

239. A 45-year-old woman, gravida 3, para 3, undergoes reduction mammoplasty. Pathologic examination of excised tissue shows a completely excised, 1-cm papilloma. Which of the following is the most appropriate next step in management?
- A) External radiation therapy
  - B) Mammography
  - C) Sentinel lymph node biopsy
  - D) Subcutaneous mastectomy
  - E) Tamoxifen therapy

The correct response is Option B.

The management of papillomas found on breast core needle biopsy specimens is controversial. The concern is malignancy, and some institutions have reported false-negative rates in biopsy. The presence of atypia is an indication for complete excision, and is also associated with a final upstaging to in situ or invasive carcinoma. For these reasons, excisional biopsy is recommended for lesions found on core needle biopsy. In this case, the lesion was completely excised, which is the most aggressive treatment. Because the final pathology was benign disease, this excision is adequate.

A subcutaneous mastectomy is not necessary, and a sentinel lymph node biopsy is not indicated because the pathology is benign. Similarly, tamoxifen treatment and external radiation therapy are not indicated for this benign condition.

## REFERENCES:

1. McGhan LJ, Pockaj BA, Wasif N, et al. Papillary lesions on core breast biopsy: excisional biopsy for all patients? *Am Surg*. 2013 Dec;79(12):1238-1242.
2. Amin AL, Purdy AD, Mattingly JD, et al. Benign breast disease. *Surg Clin North Am*. 2013 Apr;93(2):299-308. Epub 2013 Feb 8.

240. Since August of 2013, manufacturers of medical devices and pharmaceuticals must report physician payments greater than \$10.00 or \$100 annually. Centers for Medicare & Medicaid Services (CMS) has now publicly released this information in compliance with which of the following legislative mandates?

- A) Government in Sunshine Act
- B) The Health Insurance Portability and Accountability Act
- C) The Patient Safety and Quality Improvement Act
- D) The Physician Reporting Act
- E) The Protecting Access to Medicare Act

The correct response is Option A.

The CMS Sunshine Act is also known as Open Payments. It mandates that manufacturers of devices, biologics, drugs, and medical supplies, and reports all physician payments starting on August 1, 2013. Starting March 31, 2014, the manufacturers began reporting. Payments of less than \$10 are exempt from reporting. Aggregate annual totals of \$100 or more per company must be disclosed. CMS plans to release the reported payment information on a public Web site by September 30, 2014. The Protecting Access to Medicare Act mandates that implementation of ICD-10 does not begin until FY16. The Health Insurance Portability and Accountability Act (HIPAA) of 1996 provides rules about individual health information identifier protection. The Patient Safety and Quality Improvement Act of 2005 is legislation regulating the protection of patient safety work product and enforcement activities. The Physician Reporting Act does not exist.

## **REFERENCES:**

1. CFS Clinical. The Sunshine Act – Open Payments. CFS Clinical website. Available at: <http://thesunshineact.org>. Accessed May 1, 2014.
2. Centers for Medicare and Medicaid Services. ICD-10. Available at: <http://www.cms.gov/medicare/coding/icd10/index.html?redirect=/icd10>. Accessed June 30, 2014.

241. A 42-year-old man undergoes resection of a dermatofibrosarcoma protuberans of the lower abdomen. A 15 × 9-cm skin and subcutaneous defect results and is closed with a pedicled anterolateral thigh flap. The most common dominant blood supply to this flap is which of the following arteries?

- A) Ascending branch of the lateral femoral circumflex
- B) Ascending branch of the medial femoral circumflex
- C) Descending branch of the lateral femoral circumflex
- D) Descending branch of the medial femoral circumflex
- E) Transverse branch of the lateral femoral circumflex

The correct response is Option C.

The anterolateral thigh flap (ATL) is most frequently used as a free flap. However, it is an extremely reliable and versatile pedicled flap which can be used to reconstruct a variety of lower abdominal, perineal, and pelvic defects. Proximally based ATL flaps are based on flow from the descending branch of the lateral femoral circumflex artery. The descending branch runs between the vastus lateralis laterally and the rectus femoris medially. The perforators from this vessel run through the vastus lateralis to supply the overlying skin. Perforators usually penetrate the anterior aspect of the vastus lateralis. In less than 15% of cases, the perforators run in the septum between the vastus lateralis and the rectus femoris, and in this case, no intramuscular dissection is required.

The medial femoral circumflex is the other main branch of the profunda femoris artery. It divides into the ascending superficial, deep, and acetabular branches and supplies the adductor brevis and magnus as well as the femoral neck. The lateral femoral circumflex divides into ascending, descending, and transverse branches. The ascending or transverse branch and its perforators supplies the tensor fascia lata muscle, and the descending branch supplies the rectus femoris. Its perforators supply the vastus lateralis and its overlying skin.

## REFERENCES:

1. Neligan PC, Lannon DA. Versatility of the pedicled anterolateral thigh flap. *Clin Plast Surg*. 2010 Oct;37(4):677-681.

2. Lannon DA, Ross GL, Addison PD, et al. Versatility of the proximally pedicled anterolateral thigh flap and its use in complex abdominal and pelvic reconstruction. *Plast Reconstr Surg*. 2011 Feb;127(2):677-688.
3. Maxhimer JB, Hui-Chou HG, Rodriguez ED. Clinical applications of the pedicled anterolateral thigh flap in complex abdominal-pelvic reconstruction. *Ann Plast Surg*. 2011 Mar;66(3):285-291.

242. A 45-year-old man is brought to the emergency department with a Gustilo IIIB tibial fracture that he sustained falling off a tractor in a pasture. Medical history shows no drug allergies. Administration of which of the following antibiotics is most appropriate in this patient?

- A) Amoxicillin
- B) Ceftriaxone
- C) Ciprofloxacin
- D) Clindamycin
- E) Vancomycin

The correct response is Option B.

The most appropriate antibiotic prophylaxis for this patient with a Gustilo grade III fracture is a third generation cephalosporin. Although much debate exists regarding antibiotic prophylaxis in open tibial fractures, it is generally accepted that antibiotic prophylaxis reduces the rate of infection. When antibiotic prophylaxis is not used, infection occurs in approximately 24% of open fractures. Thus, selecting the appropriate antibiotic, as well as duration, is of utmost importance. Antibiotic prophylaxis should be administered as soon as possible after injury and should be limited to a 72-hour course. In general, broad-spectrum antibiotics and multiple antibiotics should be avoided because they have been shown to increase the risk of nosocomial infections, including pneumonia. Of the antibiotics listed, the most appropriate choice for a patient with no drug allergies is ceftriaxone. Clindamycin and vancomycin should be reserved for cases of true penicillin allergy. Ciprofloxacin alone has been shown to be inferior to prevent infection after open tibial fractures.

## REFERENCES:

1. Melvin JS, Dombroski DG, Torbert JT, et al. Open tibial shaft fractures: I. Evaluation and initial wound management. *J Am Acad Orthop Surg*. 2010 Jan;18(1):10-19.
2. Rodriguez L, Jung HS, Goulet JA, et al. Evidence-based protocol for prophylactic antibiotics in open fractures: improved antibiotic stewardship with no increase in infection rates. *J Trauma Acute Care Surg*. 2014 Sep;77(3):400-407.

243. A 29-year-old woman is evaluated because of a 2.5-year history of painful, draining lesions from the axillae and groin. Physical examination shows multiple nodules and abscesses. Conservative treatment with loose clothing, topical antibiotics, and antibacterial washes is unsuccessful. These findings are most consistent with which of the following disease processes?
- A) Candidal infection of the intertriginous areas
  - B) Follicular occlusion of the apocrine sweat gland areas
  - C) Follicular occlusion of the eccrine sweat glands areas
  - D) Inflammatory and ulcerative skin condition mediated by neutrophils
  - E) Sexually transmitted infection caused by *Klebsiella granulomatis*

The correct response is Option B.

Hidradenitis suppurativa (HS), also known as acne inversa, is a chronic inflammatory disease of the skin and subcutaneous structures. Initially presenting as tender, subcutaneous nodules, the disease can advance to cause abscesses and large areas of subcutaneous scarring and draining sinus tracts.

Historically, HS has been thought to originate from the apocrine sweat glands. However, research in recent years has demonstrated that the mechanism is one of follicular occlusion: hair follicles become occluded due to an overproliferation of ductal keratinocytes, rupture, and subsequently re-epithelialize. As this cycle continues, sinus tracts form that house bacteria and cause chronic, painful infections and inflammation that can involve the skin and subcutaneous structures including muscle, fascia, and lymph nodes.

HS lesions typically occur predominately in the apocrine-gland bearing areas of the axillary, inguinal, perianal, and perineal areas. Lesions typically correspond with the “milk-line” pattern of apocrine-related mammary tissue in mammals.

Eccrine, or merocrine, sweat glands are found throughout the body, but their highest concentrations are in the palms and soles. These areas are typically spared by HS.

Follicular pyodermas, including folliculitis, furuncles, and carbuncles, arise primarily from the infection of hair follicles. They do not cause the sinus tracts, comedones, and scarring caused by HS.

Granuloma inguinale is a sexually transmitted infection of the genitalia, perineum, and/or perineal area caused by *Klebsiella granulomatis*.

Pyoderma gangrenosum is a dermatologic condition mediated by neutrophils that causes skin ulceration and breakdown.

## **REFERENCES:**

1. Alikhan A, Lynch PJ, Eisen DB. Hidradenitis suppurativa: a comprehensive review. *J Am Acad Dermatol*. 2009 Apr;60(4):539-561.
2. von Laffert M, Stadie V, Wohlrab J, et al. Hidradenitis suppurativa/acne inversa: bilocated epithelial hyperplasia with very different sequelae. *Br J Dermatol*. 2011 Feb;164(2):367-371. Epub 2010 Nov 23.

244. A 63-year-old man with end-stage renal failure is evaluated for unilateral leg swelling and shortness of breath 2 days after undergoing bilateral axillary hidradenitis excision. Current medication includes aspirin. Oxygen saturation on room air is 88%. During diagnostic evaluation, empiric administration of which of the following drugs is most appropriate?

- A) Intravenous heparin
- B) Oral clopidogrel
- C) Oral rivaroxaban
- D) Oral warfarin
- E) Subcutaneous enoxaparin

The correct response is Option A.

The patient has a presumed diagnosis of deep vein thrombosis (DVT) and pulmonary embolism (PE). Enoxaparin and rivaroxaban are contraindicated in patients with renal failure. Warfarin is used for long-term treatment of established DVT. Clopidogrel is an antiplatelet inhibitor that inhibits blood clots in coronary artery disease, peripheral vascular disease, cerebrovascular disease, and prevents myocardial infarction. Heparin is safe in renal failure patients and is indicated for treatment in acute DVT/PE.

## REFERENCES:

1. Clagett GP, Anderson FA Jr, Heit J, et al. Prevention of venous thromboembolism. *Chest*. 1995 Oct;108(4 Suppl):312S-334S.
2. Hyers TM, Hull RD, Weg JG, et al. Antithrombotic therapy for venous thromboembolic disease. *Chest*. 1995 Oct;108(4 Suppl):335S-351S.

245. A 43-year-old woman undergoes implant exchange and fat grafting 3 months after full expansion. Intraoperatively, complete capsulectomy is performed because of the thickness and position of the capsule. Which of the following is the correct current procedural terminology (CPT) code for this case?

| <b>CPT code</b> | <b>Description</b>                                                                          |
|-----------------|---------------------------------------------------------------------------------------------|
| 11970           | removal of tissue expander and replacement with permanent prosthesis                        |
| 19328           | removal of intact mammary implant                                                           |
| 19342           | delayed insertion of breast prosthesis following mastopexy, mastectomy or in reconstruction |
| 19371           | periprosthetic capsulectomy, breast                                                         |
| 20926           | fat grafting                                                                                |

- A) 11970 and 20926  
B) 19342 and 20926  
C) 19371 and 11970  
D) 19328, 19342, and 20926  
E) 19371, 11970, and 20926

The correct response is Option E.

The current procedural terminology (CPT) code 11970 includes the capsulotomy as the approach to the tissue expander but does not include the total capsulectomy, 19371, which is separately reportable. Fat grafting is also reported separately from the tissue expander replacement, 20926. Alternatively, this could be reported as a single code, 19342, which includes removal of the tissue expander, replacement with permanent prosthesis, capsulectomy, capsular adjustments, fat grafting and other necessary adjustments. If this one code is used, then using the additional codes of 19328 and 20926 separately would be considered unbundling.

## REFERENCES:

1. American Medical Association CPT Assistant Online.
2. Janevicius R. Testing your coding knowledge with this end of the year quiz. *Plastic Surgery News*. December 2013.

246. Which of the following is the most appropriate term for the amount of air that is inspired and expired with a single breath during normal resting respiration?

- A) Dead-space volume
- B) Functional capacity
- C) Residual volume
- D) Tidal volume
- E) Vital capacity

The correct response is Option D.

Tidal volume (VT) is the volume of air that is moved into or out of the lungs during quiet breathing. Tidal volume can be measured directly through spirometry or estimated based on a patient's ideal body mass. It is a key parameter in mechanical ventilation to allow adequate ventilation without causing barotrauma to the lungs.

Vital capacity (VC) is the volume of air expired after deepest inspiration.

Functional capacity is a physiologic description of an individual's ability to complete activities of daily living. It can be estimated through exercise treadmill testing and reported in metabolic equivalents (METs).

Residual volume (RV) is the volume of air remaining in the lungs after maximal exhalation.

Dead-space volume is the volume of air inhaled that does not take part in gas exchange. This volume can include both gas that remains in conducting airways (e.g., trachea, bronchi) during respiration and gas that reaches nonfunctional alveoli (e.g., nonperfused lung parenchyma following pulmonary embolism).

## REFERENCES:

1. Fleg JL, Piña IL, Balady GJ, et al. Assessment of functional capacity in clinical and research applications: An advisory from the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, American Heart Association. *Circulation*. 2000 Sep 26;102(13):1591-1597.
2. Hall JE. Pulmonary Ventilation. In: *Guyton and Hall Textbook of Medical Physiology*. 12th ed. Philadelphia: Elsevier-Saunders; 2010:465-476.

247. A 154-lb (70-kg), 45-year-old man undergoes excision and skin grafting after sustaining total body surface area burns to over 40% of his body. Using the Curreri formula, which of the following is this patient's total daily caloric need?
- A) 2250 kCal/day
  - B) 3350 kCal/day
  - C) 4450 kCal/day
  - D) 5550 kCal/day
  - E) 6650 kCal/day

The correct response is Option B.

The Curreri formula is used to calculate caloric needs:  $25 \text{ kCal/kg/day} + 40 \text{ kCal/\%TBSA/day}$ . So  $25 \times 70 + 40 \times 40 = 3350 \text{ kCal/day}$ .

#### REFERENCES:

1. Curreri PW. Assessing nutritional needs for the burned patient. *J Trauma*. 1990 Dec;30(12 Suppl):S20-S23.
2. Turner WW Jr., Ireton CS, Hunt JL, Baxter CR. Predicting energy expenditures in burned patients. *J Trauma*. 1985 Jan; 25(1):11-6.

248. A 5-year-old boy is brought to the emergency department after sustaining a traumatic amputation of the right thumb. Medical history includes an allergy to sulfa drugs. The thumb is successfully replanted, and the patient is admitted for observation. Twenty-four hours postoperatively, venous congestion of the replanted thumb is noted. Leeches are placed to improve congestion. It is suspected that the leeches will be required for several days until venous outflow is reestablished. Administration of which of the following antibiotics is most appropriate?

- A) Cefotaxime
- B) Ciprofloxacin
- C) Clindamycin
- D) Tetracycline
- E) Trimethoprim-sulfamethoxazole

The correct response is Option A.

Medicinal leeches are still commonly used as an adjunct in the treatment of venous congestion. They secrete a powerful anticoagulant called hirudin that promotes bleeding in the congested tissues until venous outflow can be reestablished. Leeches are also known to harbor the gram-negative bacterium *Aeromonas*. Because leeches can be exposed to open wounds on the patient for several days during treatment, antibiotic prophylaxis against *Aeromonas* is recommended.

Ciprofloxacin, tetracycline, trimethoprim-sulfamethoxazole (Bactrim), and third-generation cephalosporins have all been shown to be effective against *Aeromonas*. However, in the scenario above, all of these antibiotics have a contraindication except cefotaxime, a third-generation cephalosporin.

Ciprofloxacin is contraindicated in children when a suitable alternative exists secondary to the risk of arthropathy and arthrotoxicity. Similarly, the use of tetracycline is relatively contraindicated in children owing to the potential for abnormalities with the teeth, including permanent staining and growth retardation. While Bactrim is often used in children to treat various infections, this child has an allergy to sulfa drugs and should not be given this antibiotic.

Clindamycin does not provide effective antibiotic coverage against *Aeromonas*.

## REFERENCES:

1. Whitaker IS, Josty IC, Hawkins S, et al. Medicinal leeches and the microsurgeon: a four-year study, clinical series and risk benefit review. *Microsurgery*. 2011 May;31(4):281-287. Epub 2011 Apr 25.
2. Rhodes KH, Henry NK. Antibiotic therapy for severe infections in infants and children. *Mayo Clin Proc*. 1992 Jan;67(1):59-68.

249. A 67-year-old man with type 1 diabetes mellitus is evaluated for full-thickness perineal burns sustained by falling onto a space heater. Forty-eight hours after admission, he has onset of fever and tachycardia. Complete blood cell count grows leukocytosis, and wound culture shows gram-negative rods consistent with *Pseudomonas*. Pending sensitivity report, empiric coverage is initiated. Which of the following antibiotics is clinically CONTRAINDICATED for initial therapy?

- A) Ceftazidime
- B) Ceftriaxone
- C) Ciprofloxacin
- D) Imipenem
- E) Tigecycline

The correct response is Option E.

Although tigecycline has excellent coverage of most staphylococcal and many gram-negative rod infections, this tetracycline derivative is not effective against pseudomonal infections. Patients with pseudomonal sepsis benefit from double coverage. Furthermore, sensitivities to different antimicrobial agents are quite variable from one health care system to another, so providers must remain vigilant after beginning therapy and change coverage based on lack of clinical response and determination of final sensitivities. An essential component of this patient's care would be urgent burn wound excision, after he has been resuscitated and empiric antibiotics have been initiated.

## REFERENCES:

1. Weber DJ, van Duin D, DiBiase LM, et al. Healthcare-associated infections among patients in a large burn intensive care unit: incidence and pathogens, 2008-2012. *Infect Control Hosp Epidemiol*. 2014 Oct;35(10):1304-1306. Epub 2014 Sep 2.
2. Turner KH, Everett J, Trivedi U, et al. Requirements for *Pseudomonas aeruginosa* acute burn and chronic surgical wound infection. *PLoS Genet*. 2014 Jul 24;10(7):e1004518. eCollection 2014.

250. A 69-year-old man is evaluated in the intensive care unit 5 days after undergoing abdominal wall reconstruction for a multiple-recurrence ventral hernia. Medical history shows no cardiac disease. Temperature is 103°F (39°C), heart rate is 110 bpm, and mean arterial pressure (MAP) is 50 mmHg. Airway and ventilation are secured, and supplemental oxygen is initiated. Hemoglobin concentration is 9 g/dL. Which of the following is the most appropriate next step in management?

- A) Initiation of inotropic support
- B) Initiation of vasopressor support
- C) Introduction of a pulmonary artery catheter to monitor wedge pressures
- D) Volume resuscitation with crystalloid
- E) Volume resuscitation with packed red blood cells

The correct response is Option D.

In this patient with septic shock, once airway and breathing are secured, the next most appropriate step in management is to restore effective circulation and perfusion to peripheral tissues starting with a trial of volume resuscitation with crystalloid.

Signs of impaired end organ perfusion in septic shock include hypotension (e.g., mean arterial pressure <70 mmHg), tachycardia (e.g., heart rate >100 bpm), warm flushed skin giving way to cool clammy skin as blood flow is redirected to core organs, obtundation, and an elevated serum lactate concentration (e.g., >1 mmol/L).

First-line therapy for restoration of tissue perfusion is volume resuscitation using intravenous crystalloid targeted to physiologic end points while monitoring for clinical or radiographic evidence of either cardiogenic or non-cardiogenic pulmonary edema (ie, ARDS).

The addition of pulmonary artery catheters has not been shown to improve outcomes in the routine management of septic shock and is associated with increased complications.

As in the given scenario, evidence and expert opinion do not support the transfusion of blood products greater than a hemoglobin concentration of 7 g/dL in the absence of concurrent hemorrhagic shock, cardiac history, or active myocardial ischemia. For example, a recent multicenter randomized study involving 998 patients with septic shock reported no significant difference in mortality or rate of ischemic events

between patients transfused when hemoglobin concentration was  $<7$  g/dL compared with patients transfused when hemoglobin was  $<9$  g/dL. Their former (more restrictive) transfusion trigger resulted in 50% fewer red blood cell transfusions compared with the more liberal strategy.

Vasopressors (e.g., norepinephrine) are second-line agents in the treatment of septic shock refractory to trial of volume resuscitation as long as intravenous fluids successfully improve perfusion without impairing gas exchange.

Inotropic agents (e.g., dobutamine) are also second-line agents to initial volume resuscitation in this scenario. They may be useful with refractory shock in the setting of diminished cardiac output.

## REFERENCES:

1. Dellinger RP, Levy MM, Rhodes A, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock: 2012. *Crit Care Med*. 2013 Feb;41(2):580-637.
2. Holst LB, Haase N, Wetterslev J, et al. Lower versus higher hemoglobin threshold for transfusion in septic shock. *N Engl J Med*. 2014 Oct 9;371(15):1381-1391.
3. Reinhart K, Bloos F, Spies C. Vasoactive drug therapy in sepsis. In: Sibbald WJ, Vincent JL, eds. *Clinical Trials for the Treatment of Sepsis*. Berlin: Springer-Verlag; 1995:207.
4. Richard C, Warszawski J, Anguel N, et al. Early use of the pulmonary artery catheter and outcomes in patients with shock and acute respiratory distress syndrome: a randomized controlled trial. *JAMA*. 2003 Nov 26;290(20):2713-2720.

**Thank you for your participation.**

|    |                     |
|----|---------------------|
| 1  | (A) (B) (C) (D) (E) |
| 2  | (A) (B) (C) (D) (E) |
| 3  | (A) (B) (C) (D) (E) |
| 4  | (A) (B) (C) (D) (E) |
| 5  | (A) (B) (C) (D) (E) |
| 6  | (A) (B) (C) (D) (E) |
| 7  | (A) (B) (C) (D) (E) |
| 8  | (A) (B) (C) (D) (E) |
| 9  | (A) (B) (C) (D) (E) |
| 10 | (A) (B) (C) (D) (E) |
| 11 | (A) (B) (C) (D) (E) |
| 12 | (A) (B) (C) (D) (E) |
| 13 | (A) (B) (C) (D) (E) |
| 14 | (A) (B) (C) (D)     |
| 15 | (A) (B) (C) (D) (E) |
| 16 | (A) (B) (C) (D) (E) |
| 17 | (A) (B) (C) (D) (E) |
| 18 | (A) (B) (C) (D) (E) |
| 19 | (A) (B) (C) (D) (E) |
| 20 | (A) (B) (C) (D) (E) |
| 21 | (A) (B) (C) (D) (E) |
| 22 | (A) (B) (C) (D) (E) |
| 23 | (A) (B) (C) (D) (E) |
| 24 | (A) (B) (C) (D) (E) |
| 25 | (A) (B) (C) (D) (E) |
| 26 | (A) (B) (C) (D) (E) |
| 27 | (A) (B) (C) (D)     |
| 28 | (A) (B) (C) (D) (E) |
| 29 | (A) (B) (C) (D)     |
| 30 | (A) (B) (C) (D) (E) |
| 31 | (A) (B) (C) (D)     |
| 32 | (A) (B) (C) (D) (E) |
| 33 | (A) (B) (C) (D) (E) |
| 34 | (A) (B) (C) (D) (E) |
| 35 | (A) (B) (C) (D) (E) |
| 36 | (A) (B) (C) (D) (E) |
| 37 | (A) (B) (C) (D) (E) |
| 38 | (A) (B) (C) (D) (E) |
| 39 | (A) (B) (C) (D)     |
| 40 | (A) (B) (C) (D) (E) |
| 41 | (A) (B) (C) (D) (E) |
| 42 | (A) (B) (C) (D) (E) |
| 43 | (A) (B) (C) (D) (E) |
| 44 | (A) (B) (C) (D) (E) |
| 45 | (A) (B) (C) (D) (E) |
| 46 | (A) (B) (C) (D) (E) |
| 47 | (A) (B) (C) (D) (E) |
| 48 | (A) (B) (C) (D)     |
| 49 | (A) (B) (C) (D) (E) |
| 50 | (A) (B) (C) (D) (E) |
| 51 | (A) (B) (C) (D) (E) |
| 52 | (A) (B) (C) (D) (E) |

|     |                         |
|-----|-------------------------|
| 53  | (A) (B) (C) (D) (E)     |
| 54  | (A) (B) (C) (D) (E)     |
| 55  | (A) (B) (C) (D)         |
| 56  | (A) (B) (C) (D) (E)     |
| 57  | (A) (B) (C) (D)         |
| 58  | (A) (B) (C) (D) (E)     |
| 59  | (A) (B) (C) (D) (E)     |
| 60  | (A) (B) (C) (D) (E)     |
| 61  | (A) (B) (C) (D) (E)     |
| 62  | (A) (B) (C) (D) (E)     |
| 63  | (A) (B) (C) (D) (E)     |
| 64  | (A) (B) (C) (D) (E)     |
| 65  | (A) (B) (C) (D) (E)     |
| 66  | (A) (B) (C) (D) (E)     |
| 67  | (A) (B) (C) (D) (E)     |
| 68  | (A) (B) (C) (D) (E)     |
| 69  | (A) (B) (C) (D) (E)     |
| 70  | (A) (B) (C) (D) (E)     |
| 71  | (A) (B) (C) (D) (E)     |
| 72  | (A) (B) (C) (D) (E)     |
| 73  | (A) (B) (C) (D)         |
| 74  | (A) (B) (C) (D) (E)     |
| 75  | (A) (B) (C) (D) (E)     |
| 76  | (A) (B) (C) (D) (E)     |
| 77  | (A) (B) (C) (D) (E)     |
| 78  | (A) (B) (C) (D) (E)     |
| 79  | (A) (B) (C) (D)         |
| 80  | (A) (B) (C) (D) (E)     |
| 81  | (A) (B) (C) (D) (E)     |
| 82  | (A) (B) (C) (D)         |
| 83  | (A) (B) (C) (D) (E)     |
| 84  | (A) (B) (C) (D) (E)     |
| 85  | (A) (B) (C) (D) (E)     |
| 86  | (A) (B) (C) (D) (E)     |
| 87  | (A) (B) (C) (D) (E)     |
| 88  | (A) (B) (C) (D) (E)     |
| 89  | (A) (B) (C) (D) (E)     |
| 90  | (A) (B) (C) (D) (E)     |
| 91  | (A) (B) (C) (D) (E)     |
| 92  | (A) (B) (C) (D) (E) (F) |
| 93  | (A) (B) (C) (D) (E)     |
| 94  | (A) (B) (C) (D) (E)     |
| 95  | (A) (B) (C) (D) (E)     |
| 96  | (A) (B) (C) (D) (E)     |
| 97  | (A) (B) (C) (D) (E)     |
| 98  | (A) (B) (C) (D) (E)     |
| 99  | (A) (B) (C) (D) (E)     |
| 100 | (A) (B) (C) (D) (E)     |
| 101 | (A) (B) (C) (D) (E)     |
| 102 | (A) (B) (C) (D) (E)     |
| 103 | (A) (B) (C) (D) (E)     |
| 104 | (A) (B) (C) (D) (E)     |

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 105 | (A) | (B) | (C) | (D) | (E) |
| 106 | (A) | (B) | (C) | (D) |     |
| 107 | (A) | (B) | (C) | (D) | (E) |
| 108 | (A) | (B) | (C) | (D) | (E) |
| 109 | (A) | (B) | (C) | (D) | (E) |
| 110 | (A) | (B) | (C) | (D) | (E) |
| 111 | (A) | (B) | (C) | (D) | (E) |
| 112 | (A) | (B) | (C) | (D) | (E) |
| 113 | (A) | (B) | (C) | (D) | (E) |
| 114 | (A) | (B) | (C) | (D) | (E) |
| 115 | (A) | (B) | (C) | (D) | (E) |
| 116 | (A) | (B) | (C) | (D) | (E) |
| 117 | (A) | (B) | (C) | (D) | (E) |
| 118 | (A) | (B) | (C) | (D) | (E) |
| 119 | (A) | (B) | (C) | (D) | (E) |
| 120 | (A) | (B) | (C) | (D) | (E) |
| 121 | (A) | (B) | (C) | (D) | (E) |
| 122 | (A) | (B) | (C) | (D) | (E) |
| 123 | (A) | (B) | (C) | (D) | (E) |
| 124 | (A) | (B) | (C) | (D) | (E) |
| 125 | (A) | (B) | (C) | (D) | (E) |
| 126 | (A) | (B) | (C) | (D) | (E) |
| 127 | (A) | (B) | (C) | (D) | (E) |
| 128 | (A) | (B) | (C) | (D) | (E) |
| 129 | (A) | (B) | (C) | (D) | (E) |
| 130 | (A) | (B) | (C) | (D) | (E) |
| 131 | (A) | (B) | (C) | (D) | (E) |
| 132 | (A) | (B) | (C) | (D) | (E) |
| 133 | (A) | (B) | (C) | (D) | (E) |
| 134 | (A) | (B) | (C) | (D) | (E) |
| 135 | (A) | (B) | (C) | (D) | (E) |
| 136 | (A) | (B) | (C) | (D) | (E) |
| 137 | (A) | (B) | (C) | (D) | (E) |
| 138 | (A) | (B) | (C) | (D) | (E) |
| 139 | (A) | (B) | (C) | (D) | (E) |
| 140 | (A) | (B) | (C) | (D) | (E) |
| 141 | (A) | (B) | (C) | (D) | (E) |
| 142 | (A) | (B) | (C) | (D) | (E) |
| 143 | (A) | (B) | (C) | (D) | (E) |
| 144 | (A) | (B) | (C) | (D) | (E) |
| 145 | (A) | (B) | (C) | (D) | (E) |
| 146 | (A) | (B) | (C) | (D) | (E) |
| 147 | (A) | (B) | (C) | (D) | (E) |
| 148 | (A) | (B) | (C) | (D) | (E) |
| 149 | (A) | (B) | (C) | (D) | (E) |
| 150 | (A) | (B) | (C) | (D) | (E) |
| 151 | (A) | (B) | (C) | (D) | (E) |
| 152 | (A) | (B) | (C) | (D) | (E) |
| 153 | (A) | (B) | (C) | (D) | (E) |
| 154 | (A) | (B) | (C) | (D) | (E) |
| 155 | (A) | (B) | (C) | (D) | (E) |
| 156 | (A) | (B) | (C) | (D) | (E) |

|     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|
| 157 | (A) | (B) | (C) | (D) | (E) |
| 158 | (A) | (B) | (C) | (D) | (E) |
| 159 | (A) | (B) | (C) | (D) | (E) |
| 160 | (A) | (B) | (C) | (D) | (E) |
| 161 | (A) | (B) | (C) | (D) | (E) |
| 162 | (A) | (B) | (C) | (D) | (E) |
| 163 | (A) | (B) | (C) | (D) | (E) |
| 164 | (A) | (B) | (C) | (D) | (E) |
| 165 | (A) | (B) | (C) | (D) | (E) |
| 166 | (A) | (B) | (C) | (D) | (E) |
| 167 | (A) | (B) | (C) | (D) | (E) |
| 168 | (A) | (B) | (C) | (D) | (E) |
| 169 | (A) | (B) | (C) | (D) | (E) |
| 170 | (A) | (B) | (C) | (D) | (E) |
| 171 | (A) | (B) | (C) | (D) | (E) |
| 172 | (A) | (B) | (C) | (D) | (E) |
| 173 | (A) | (B) | (C) | (D) |     |
| 174 | (A) | (B) | (C) | (D) | (E) |
| 175 | (A) | (B) | (C) | (D) | (E) |
| 176 | (A) | (B) | (C) | (D) | (E) |
| 177 | (A) | (B) | (C) | (D) | (E) |
| 178 | (A) | (B) | (C) | (D) | (E) |
| 179 | (A) | (B) | (C) | (D) | (E) |
| 180 | (A) | (B) | (C) | (D) | (E) |
| 181 | (A) | (B) | (C) | (D) | (E) |
| 182 | (A) | (B) | (C) | (D) | (E) |
| 183 | (A) | (B) | (C) | (D) | (E) |
| 184 | (A) | (B) | (C) | (D) | (E) |
| 185 | (A) | (B) | (C) | (D) | (E) |
| 186 | (A) | (B) | (C) | (D) | (E) |
| 187 | (A) | (B) | (C) | (D) | (E) |
| 188 | (A) | (B) | (C) | (D) | (E) |
| 189 | (A) | (B) | (C) | (D) | (E) |
| 190 | (A) | (B) | (C) | (D) | (E) |
| 191 | (A) | (B) | (C) | (D) | (E) |
| 192 | (A) | (B) | (C) | (D) | (E) |
| 193 | (A) | (B) | (C) | (D) | (E) |
| 194 | (A) | (B) | (C) | (D) |     |
| 195 | (A) | (B) | (C) | (D) | (E) |
| 196 | (A) | (B) | (C) | (D) | (E) |
| 197 | (A) | (B) | (C) | (D) | (E) |
| 198 | (A) | (B) | (C) | (D) |     |
| 199 | (A) | (B) | (C) | (D) | (E) |
| 200 | (A) | (B) | (C) | (D) | (E) |
| 201 | (A) | (B) | (C) | (D) | (E) |
| 202 | (A) | (B) | (C) | (D) | (E) |
| 203 | (A) | (B) | (C) | (D) | (E) |
| 204 | (A) | (B) | (C) | (D) | (E) |
| 205 | (A) | (B) | (C) | (D) | (E) |
| 206 | (A) | (B) | (C) | (D) | (E) |
| 207 | (A) | (B) | (C) | (D) | (E) |
| 208 | (A) | (B) | (C) | (D) | (E) |

|            |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|
| <b>209</b> | (A) | (B) | (C) | (D) | (E) |
| <b>210</b> | (A) | (B) | (C) | (D) | (E) |
| <b>211</b> | (A) | (B) | (C) | (D) | (E) |
| <b>212</b> | (A) | (B) | (C) | (D) | (E) |
| <b>213</b> | (A) | (B) | (C) | (D) | (E) |
| <b>214</b> | (A) | (B) | (C) | (D) | (E) |
| <b>215</b> | (A) | (B) | (C) | (D) | (E) |
| <b>216</b> | (A) | (B) | (C) | (D) | (E) |
| <b>217</b> | (A) | (B) | (C) | (D) | (E) |
| <b>218</b> | (A) | (B) | (C) | (D) | (E) |
| <b>219</b> | (A) | (B) | (C) | (D) | (E) |
| <b>220</b> | (A) | (B) | (C) | (D) |     |
| <b>221</b> | (A) | (B) | (C) | (D) | (E) |
| <b>222</b> | (A) | (B) | (C) | (D) |     |
| <b>223</b> | (A) | (B) | (C) | (D) | (E) |
| <b>224</b> | (A) | (B) | (C) | (D) | (E) |
| <b>225</b> | (A) | (B) | (C) | (D) | (E) |
| <b>226</b> | (A) | (B) | (C) | (D) | (E) |
| <b>227</b> | (A) | (B) | (C) | (D) | (E) |
| <b>228</b> | (A) | (B) | (C) | (D) | (E) |
| <b>229</b> | (A) | (B) | (C) | (D) | (E) |

|            |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|
| <b>230</b> | (A) | (B) | (C) | (D) | (E) |
| <b>231</b> | (A) | (B) | (C) | (D) | (E) |
| <b>232</b> | (A) | (B) | (C) | (D) | (E) |
| <b>233</b> | (A) | (B) | (C) | (D) | (E) |
| <b>234</b> | (A) | (B) | (C) | (D) | (E) |
| <b>235</b> | (A) | (B) | (C) | (D) | (E) |
| <b>236</b> | (A) | (B) | (C) | (D) | (E) |
| <b>237</b> | (A) | (B) | (C) | (D) | (E) |
| <b>238</b> | (A) | (B) | (C) | (D) | (E) |
| <b>239</b> | (A) | (B) | (C) | (D) | (E) |
| <b>240</b> | (A) | (B) | (C) | (D) | (E) |
| <b>241</b> | (A) | (B) | (C) | (D) | (E) |
| <b>242</b> | (A) | (B) | (C) | (D) | (E) |
| <b>243</b> | (A) | (B) | (C) | (D) | (E) |
| <b>244</b> | (A) | (B) | (C) | (D) | (E) |
| <b>245</b> | (A) | (B) | (C) | (D) | (E) |
| <b>246</b> | (A) | (B) | (C) | (D) | (E) |
| <b>247</b> | (A) | (B) | (C) | (D) | (E) |
| <b>248</b> | (A) | (B) | (C) | (D) | (E) |
| <b>249</b> | (A) | (B) | (C) | (D) | (E) |
| <b>250</b> | (A) | (B) | (C) | (D) | (E) |