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REVIEW OF ORTHOPAEDICS SIXTH EDITION MILLER

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chapter 1 Review Questions

Section 1 Bone

1 The organic component of bone matrix, which includes collagen, proteoglycans, and other noncollagenous proteins, comprises what proportion of the dry weight of bone?

A 20%
B 40%
C 60%
D 80%
E 95%

ANSWER 1: **B.** Of the organic component, 90% is type I collagen. The most abundant noncollagenous protein is osteocalcin. Proteoglycans, growth factors, and cytokines are also included in the organic component. The inorganic (mineral) component, comprising the remaining 60% of dry bone weight, is primarily calcium hydroxyapatite and calcium phosphate.

2 Bone formation occurs in several ways. Which of the following involves undifferentiated mesenchymal cells aggregating into layers, then differentiating into osteoblasts, and finally depositing an organic matrix that mineralizes?

A Appositional ossification
B Embryonic long bone formation
C Enchondral ossification
D Intramembranous ossification
E Ossification of fracture callus

ANSWER 2: **D.** Appositional ossification involves osteoblasts aligning on an existing bone surface and laying down new bone. Embryonic long bone formation, enchondral ossification, and ossification of fracture callus involve undifferentiated cells secreting a cartilaginous matrix that mineralizes; vascularization involves osteoprogenitor cells, with osteoclasts resorbing the calcified cartilage and osteoblasts forming bone.

3. Which of the following characterizes fresh-frozen cortical allograft as a bone graft material?

A Osteoconductive, osteogenic, good structural integrity
B Osteoconductive, osteoinductive, osteogenic
C Osteoconductive, osteoinductive, good structural integrity
D Osteoconductive, osteogenic, low immunogenicity
E Osteoconductive, osteoinductive, lacks structural integrity

ANSWER 3: **C.** Bone grafts have several properties. Osteoconduction is the provision of a matrix for bone growth. Osteoinduction is the presence of growth factors that stimulate bone formation. Osteogenicity is the presence of cells related to bone formation, such as primitive mesenchymal cells, osteoblasts, and osteocytes. Structural integrity addresses the ability of the graft to provide support to the graft site. Immunogenicity is a property of allografts, which may contain antigens that elicit an immune response in the host. Autografts provide osteoconduction, osteoinduction, and osteogenicity; cortical autografts also provide structural integrity. Synthetic bone grafts provide osteoconduction and may provide structural integrity. Demineralized bone matrix provides osteoconduction and osteoinduction but no structural integrity. Allografts are osteoconductive and osteoinductive, and cortical allografts provide structural integrity, but allografts provide no osteogenicity and may be immunogenic, depending on how they are processed.

4 What is the underlying cause of the orthopedic effects of high-turnover renal osteodystrophy?

- **A** Hyperphosphatemia
- **B** Hypercalcemia
- **C** Secondary hyperthyroidism
- **D** Aluminum toxicity
- **E** Vitamin C deficiency

ANSWER 4: **A.** Renal osteodystrophy is a spectrum of bone mineral metabolism disorders in chronic renal disease. In high-turnover renal bone disease, there is diminished renal phosphorous excretion, causing hyperphosphatemia, which lowers serum calcium (hypocalcemia) and stimulates chronically elevated serum PTH, leading to secondary hyperparathyroidism. Aluminum toxicity is key in low-turnover renal bone disease. Vitamin C deficiency is causal in scurvy.

5 What is the World Health Organization's definition of osteoporosis, as assessed at the lumbar spine by dual-energy x-ray absorptiometry (DEXA)?

- **A** More than 1 standard deviation below peak bone density of age-matched healthy subjects of the same sex
- **B** More than 2.5 standard deviations below peak bone density of age-matched healthy subjects of the same sex
- **C** More than 1 standard deviation below peak bone density of young (ages 20 to 25 years) healthy subjects of the same sex
- **D** More than 2.5 standard deviations below peak bone density of young (ages 20 to 25 years) healthy subjects of the same sex
- **E** Current standards are highly age- and sex-dependent, requiring the use of population-specific tables

ANSWER 5: **D.** The World Health Organization defines osteoporosis as lumbar spine (L2-L4) density more than 2.5 standard deviations lower than the mean of a young (ages 20 to 25 years) sex-matched healthy population. Osteopenia is defined as a density 1.0 to 2.5 standard deviations below the mean of a young (ages 20 to 25 years) sex-matched healthy population.

Section 2 Joints

6 The primary component by wet weight of articular cartilage is water. The second most abundant substance is collagen. What is the predominant collagen type in normal articular cartilage?

- **A** I
- **B** II
- **C** IV
- **D** VI
- **E** X

ANSWER 6: **B.** Type II collagen constitutes 95% of the collagen content of normal articular cartilage, providing the cartilaginous framework and tensile strength. Type II collagen is very stable, with a half-life of approximately 25 years. Types IV, V, VI, XI, X, and XI collagen are also present in articular cartilage in small amounts.

7 Proteoglycan aggregates are responsible for providing compressive and elastic strength to articular cartilage, as well as regulating fluid in the cartilage matrix. Which best describes their structure?

- **A** Chondroitin sulfate and keratin sulfate attached to hyaluronic acid by link proteins and bonded to aggrecans
- **B** Glycosaminoglycan molecules attached to a hyaluronic acid and linked to a protein core by sugar bonds
- **C** Aggrecan molecules linked to a keratin sulfate core, in turn bonded to hyaluronic acid
- **D** Aggrecans of glycosaminoglycans attach to a protein core, which is linked to hyaluronic acid
- **E** Chondroitin sulfate and keratin sulfate link to a protein core via sugar bonds to form the aggrecan

molecule

ANSWER 7: **D.** Proteoglycans are composed of subunits known as glycosaminoglycans. Glycosaminoglycans include two subtypes: chondroitin sulfate and keratin sulfate. These glycosaminoglycans link to a protein core by sugar bonds to form an aggrecan molecule. Link proteins then stabilize many of these aggrecan molecules to hyaluronic acid to form the proteoglycan aggregate.

8 Which of the following is the predominant type of joint lubrication during dynamic movement of a healthy joint?

- **A** Boosted lubrication
- **B** Boundary lubrication
- **C** Elastohydrodynamic lubrication
- **D** Hydrodynamic lubrication
- **E** Weeping substitution

ANSWER 8: **C.** All of these occur to some extent, but elastohydrodynamic lubrication is the predominant mechanism during dynamic joint function. With elastohydrodynamic lubrication, elastic deformation of articular surfaces occurs, and thin films of joint lubricants separate the weight-bearing surfaces. Boosted lubrication concentrates lubricating fluid in pools trapped by regions of weight-bearing surfaces that are in contact. Boundary lubrication occurs when lubricant partially separates nondeformable surfaces. Hydrodynamic lubrication occurs when fluid separates the surfaces when one of the surfaces is sliding on the other. With weeping lubrication, fluid shifts out of articular cartilage in response to load, separating the surfaces by hydrostatic pressure.

9 Which of the following are present in osteoarthritic articular cartilage but not in normal aging articular cartilage?

- **A** Increased water content, increased proteoglycan degradation
- **B** Decreased water content, decreased proteoglycan concentration
- **C** Decreased water content, decreased collagen concentration
- **D** Increased water content, decreased collagen concentration
- **E** Increased proteoglycan degradation, decreased collagen concentration

ANSWER 9: **A.** Relative to the normal aging process in articular cartilage, osteoarthritic changes include increased water content, a relative increase in collagen concentration as a result of loss of proteoglycans through increased degradation, increase in chondroitin sulfate, decrease in keratin sulfate, and decrease in elastic modulus.

10. Approximately what proportion of adults with rheumatoid arthritis have a positive RF titer (IgM)?

- **A** <5%
- **B** 20%
- **C** 40%
- **D** 60%
- **E** 80%

ANSWER 10: **E.** Rheumatoid arthritis is also associated with the HLA-DR gene (HLA-DR4 and HLA-DR1 alleles).

Section 3 Neuromuscular And Connective Tissues

11 Which neurotransmitter propagates the action potential across the synaptic plate at the motor end plate?

- **A** Acetylcholine
- **B** Epinephrine
- **C** γ-Aminobutyric acid (GABA)
- **D** Nitric oxide
- **E** Serotonin

ANSWER 11: **A.** Myasthenia gravis results from a shortage of acetylcholine receptors. Botulinum A injections reduce spasticity by blocking presynaptic acetylcholine release. The other substances are all neurotransmitters, but only acetylcholine is active at the motor end plate.

12 Which of the following energy systems is the primary source of energy for intense muscle activity lasting 20 to 120 seconds?

- **A** ATP–creatine phosphate system
- **B** Lactic acid system
- **C** Aerobic system
- **D** Krebs (tricarboxylic acid) system
- **E** Phosphagen system

ANSWER 12: **B.** Lactic acid anaerobic metabolism provides energy by hydrolysis of glucose to produce energy and lactic acid. The aerobic system and tricarboxylic acid cycle require oxygen to produce energy for longer activity at lower intensities, and in the ATP–creatine phosphate (or phosphagen) system, hydrolysis of carbohydrate in the muscle tissue is used to produce energy for brief, high-intensity activity.

13 Creatine phosphate is used by some athletes as a nutritional supplement to enhance performance. What effect does creatine phosphate have?

- **A** Increased mRNA activity and protein synthesis
- **B** Selective hypertrophy of type I muscle fibers
- **C** Increased work during the first few anaerobic trials
- **D** Increased peak force production
- **E** Increased energy substrate for aerobic energy pathways

ANSWER 13: **C.** Creatine phosphate is converted to phosphocreatine, which acts as an energy reservoir for ATP in muscle. Creatine supplementation can increase work produced in the first few maximum-effort anaerobic trials but does not increase peak force production. Anabolic steroids increase mRNA and protein synthesis. Growth hormone (somatotropin) induces selective hypertrophy of type I muscle fibers. Substrates for aerobic energy pathways are carbohydrates, fats, and proteins.

14 Fibroblasts are the predominant cell type in tendon tissue and produce what type of collagen?

- **A** I
- **B** III
- **C** VI
- **D** X
- **E** XI

ANSWER 14: **A.** Fibroblasts produce type I collagen, which is the primary collagen type in bone, tendon, and ligament tissues. Type III collagen is present in tendons in smaller amounts and is involved in early tendon healing.

15 Which of the following is not a limitation of soft tissue allografts in relation to autografts?

- **A** Potential immunogenic response
- **B** Less predictable histologic recovery
- **C** Weaker at 6 months after implantation
- **D** No donor site morbidity
- **E** Possibility of transmitting infection

ANSWER 15: **C.** Same-site soft tissue allografts and autografts appear to have similar strengths at 6 months after implantation. A primary advantage to soft tissue allografts is the lack of donor site morbidity, although they carry additional issues related to immunogenicity, infection transmission, histological recovery, and tissue processing.

Section 4 Cellular And Molecular Biology, Immunology, And Genetics Of Orthopaedics

16 The process by which amino acids are ordered to build a protein by using mRNA is called:

A Translation
B Transcription
C Restriction
D Western blotting
E Ligation

ANSWER 16: **A.** Transcription is the process by which mRNA is produced from DNA. Restriction enzymes are used by investigators to cleave DNA at reproducible locations. Western blotting is a laboratory technique used to identify specific proteins in a sample of mixed proteins. Ligation is a process used by investigators to link human DNA strands to nonhuman DNA.

17 In the immune system, which of the following are involved with immunoglobulins and the HLA system?

A Histamine
B T lymphocytes
C B lymphocytes
D Phagocytic leukocytes
E Complement system

ANSWER 17: **C.** Histamine and the complement system are involved in the innate (nonspecific, nonadaptive) immune response. T lymphocytes are involved in the cell-mediated response and interact indirectly with antigens. Phagocytic leukocytes ingest antigens.

18 Which are the three most common primary tumors to metastasize to bone?

A Lung, kidney, thyroid
B Breast, brain, lung
C Lung, breast, brain
D Breast, prostate, lung
E Breast, lung, thyroid

ANSWER 18: **D.** The five most common primary tumors to metastasize to bone in decreasing incidence are breast, prostate, lung, kidney, and thyroid.

19 In genetic analysis, the traits that are expressed by the animal are referred to as its:

A Homozygosity
B Heterozygosity
C Hemizygosity
D Phenotype
E Genotype

ANSWER 19: **D.** Homozygosity is the presence of the same allele (specific form of gene) on paired chromosomes. Heterozygosity is the presence of different alleles on paired chromosomes. Hemizygosity is the absence of one of the genes on paired chromosomes. Genotype is the genetic make-up of the animal without regard to expression of traits.

20 In Ewing's sarcoma, the cytogenic abnormality noted in the majority of tumor cells is:

A Trisomy 21
B Translocation 11;22
C XO
D XXY
E TP53 deletion

ANSWER 20: **B.** Trisomy 21 is the abnormality in Down's syndrome. The XO genotype is the abnormality in Turner syndrome. The XXY genotype is the abnormality in Kleinfelter's syndrome. TP53 codes the tumor-suppressing protein P53; therefore, gene deletion is associated with tumor formation and decreased resistance to tumors.

21 Which of the following diseases has a sex-linked recessive inheritance pattern?

A Diastrophic dysplasia
B Hypophosphatemic rickets
C Scoliosis
D Hemophilia
E Syndactyly type I

ANSWER 21: **D.** Diastrophic dysplasia is an autosomal recessive condition. Hypophosphatemic rickets is an X-linked dominant condition. Idiopathic scoliosis is has polygenic origins. Syndactyly type I is an autosomal dominant condition.

Section 5 Orthopaedic Infections And Microbiology

22 What bacterium is most often responsible for infections involving total joint prostheses?

A Staphylococcus aureus
B Staphylococcus epidermidis
C Group A β-hemolytic streptococci
D Pseudomonas aeruginosa
E Streptococcus viridans

ANSWER 22: **B.**

23 Epiphyseal osteomyelitis is almost exclusively caused by:

A Group A streptococci
B Group B streptococci
C Haemophilus influenzae
D Staphylococcus aureus
E Pseudomonas organisms

ANSWER 23: **D.**

24 A 12-year-old boy steps on a nail, which causes a puncture wound of the heel. Ten days later, his heel is red, tender, and swollen. Radiographs suggest some early periosteal reaction on the plantar surface of the calcaneus. The most likely offending organism is:

A Bacteroides fragilis
B Eikenella corrodens
C Clostridium tetani
D Atypical mycobacteria
E Pseudomonas aeruginosa

ANSWER 24: **E.**

25 What is the risk of HIV seroconversion from a contaminated needlestick?

A 0.1%
B 0.3%
C 0.5%
D 1%
E 3%

ANSWER 25: **B.**

26 A 32-year-old man sustained an open tibial fracture (Gustillo grade III-A) after a motorcycle accident. After initial cultures have been obtained, the most appropriate antibiotic regimen to use is:

A Cefazolin

B Gentamicin

C Cefazolin and gentamicin
D Ciprofloxacin and gentamicin
E Penicillin, cefazolin, and gentamicin

ANSWER 26: **C.**

Section 6 Perioperative Problems

27 Which parameter would indicate a good probability of amputation healing in a patient with diabetes?
A Ankle-brachial systolic index of 0.40
B Transcutaneous oxygen tension higher than 30 mm Hg
C Total lymphocyte count of 10/mm3
D Albumin of 2.5 g/dL
E Uric acid of <4.5 mg/dL

ANSWER 27: **B.**

28 A 20-year-old man is undergoing repair of a ruptured flexor tendon in his palm. Five minutes after induction of general anesthesia, his temperature has risen to 106° F (41.4° C). The most appropriate therapy for this development is:
A Administration of calcium gluconate
B Administration of dantrolene sodium
C Administration of succinylcholine for muscle relaxation
D Use of a different anesthetic agent
E Cooling and acidosis reversal

ANSWER 28: **B.** The patient has malignant hyperthermia, which involves impaired function of the sarcoplasmic reticulum and calcium homeostasis, leading to muscle rigidity and hypermetabolism. Dantrolene sodium blocks calcium release by stabilizing the sarcoplasmic reticulum. It also allows uptake of calcium and decreases the intracellular concentration of calcium.

29 What proportion of patients show electromyographic abnormalities following routine surgery involving tourniquet use?
A 10%
B 25%
C 50%
D 70%
E 90%

ANSWER 29: **D.** Careful application of wide or double cuffs with lower pressures may decrease injury.

30 What is the most common adverse event associated with blood transfusion?
A Allergic reaction
B Febrile reaction
C Hemolytic reaction
D Hepatitis C infection
E Clerical error leading to hemolytic reaction

ANSWER 30: **E.**

Section 7 Imaging And Special Studies

31 The most sensitive test for diagnosing discitis in its early stages is:

A MRI scan
B CT scan
C Gallium scan
D Technetium bone scan
E Plain radiograph

ANSWER 31: **A.**

32 Which of the following show dark T1-weighted MRI and bright T2-weighted MRI?

A Fat
B Bone marrow
C Fibrous tissue
D Soft tissue tumors
E Hyaline cartilage

ANSWER 32: **D.**

33 What proportion of people younger than 40 years show evidence of degeneration or bulging of lumbar discs on MRI?

A 10% to 20%
B 20% to 30%
C 30% to 40%
D 40% to 50%
E 50% to 60%

ANSWER 33: **B.**

34 Which of the following imaging studies best demonstrates details of bony anatomy?

A Plain radiography
B Arthrography
C MRI
D CT scan
E Ultrasonography

ANSWER 34: **D.**

35 Which of the following is most accurate and reliable for predicting fracture risk attributable to decreased bone density?

A Single-photon absorptiometry
B Dual-photon absorptiometry
C Quantitative computed tomography
D Dual-energy x-ray absorptiometry
E Plain radiography

ANSWER 35: **D.**

Section 8 Biomaterials And Biomechanics

36 Doubling the thickness of a metal plate will have which of the following results on its mechanical properties?

A Axial stiffness increases four times
B Axial stiffness increases eight times
C Elastic modulus increases two times
D Bending stiffness increases four times
E Bending stiffness increases eight times

ANSWER 36: **E.**

37 Which of the following is the factor most likely to contribute to joint reaction force?

A Specific limb gravity
B Joint deformity
C Muscle contraction about the joint
D Joint contact area
E Ligamentous tension about the joint

ANSWER 37: **C.**

38 Retention of the posterior cruciate ligament during total condylar knee arthroplasty is advantageous in comparison with the use of PCL-substituting prostheses because it results in:

A Maintenance of the normal rollback that occurs with flexion
B Decreased polyethylene wear and reduction in the “cold flow” phenomenon
C Enhanced surgical exposure, permitting accurate control of tibial rotation
D Enhanced anterior-posterior stability
E Decreased loads across the joint surfaces

ANSWER 38: **A.**

39 In mechanically characterizing a material, which of the following terms involves the use of constant force applied to a test specimen while monitoring the change in deformation with time?

A Uniaxial tension
B Stiffness
C Impact
D Surface hardness
E Creep

ANSWER 39: **E.**

40 What is the advantage of titanium alloy over stainless steel as a material for a fracture fixation plate?

A Flexibility
B High tensile strength
C Low modulus and high yield strength
D High modulus and yield strength
E High modulus and low yield strength

ANSWER 40: **C.**

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chapter 2 Review Questions

Section 2 Upper Extremity

1 A patient with a known brachial plexus injury is being examined in your office. Posterior examination of the right shoulder reveals medial scapular winging with muscle wasting or atrophy in the supraspinatus and infraspinatus fossa, indicative of chronic dysfunction of the suprascapular nerve. Which type of plexus injury pattern does this represent?

A Supraclavicular
B Infraclavicular
C Preclavicular
D Infraclavicular
E Both a and c
F Both b and d

ANSWER 1: **E.** Muscle atrophy in the infraspinatus and supraspinatus scapula fossae indicate injury to the preclavicular (or supraclavicular) suprascapular nerve. Medial scapular winging results from long thoracic nerve injury that causes serratus anterior dysfunction. Remember that chronic muscle denervation produces MRI changes of fatty infiltration, volume loss, and high signal intensity on T1-weighted sequences and fibrillations and sharp waves on electromyographic (EMG) testing.

2 The scapula has a suprascapular and spinoglenoid notch. Which notch has the inferior transverse scapular ligament?

A Suprascapular notch
B Spinoglenoid notch

ANSWER 2: **B.** The inferior transverse scapular ligament passes through the spinoglenoid notch, and the suprascapular artery and suprascapular nerve pass inferior to this ligament. Compression at the spinoglenoid notch (i.e., ganglion cyst caused by glenoid labral disease) results in suprascapular nerve dysfunction and causes infraspinatus atrophy.

3 With electric shock and seizures, why are posterior shoulder dislocations more common than anterior dislocations?

A The glenoid is retroverted.
B The humeral head is retroverted.
C The internal rotators of the shoulder are stronger than the external rotators.
D The external rotators of the shoulder are stronger than the internal rotators.

ANSWER 3: **C.** The shoulder internal rotators (pectoralis major, latissimus dorsi, and subscapularis) are stronger than the external rotators (teres minor and infraspinatus), which is why posterior shoulder dislocations are more common than anterior dislocations after electrical shock and seizures.

4 During the surgical approach to the forearm in which the interval between the radial nerve and the median nerve is used, what forearm motion moves the posterior interosseous nerve (PIN) ulnarly?

A Supination
B Pronation

ANSWER 4: **A.** The anterior (Henry's) approach to the forearm interval is between the brachioradialis (radial nerve) and the pronator teres and flexor carpi radialis distally (median nerve). The forearm is supinated during this approach to displace the PIN ulnarly.

5 There are 10 structures within the carpal tunnel: the median nerve and nine tendons (four flexor digitorum superficialis [FDS], four flexor digitorum profundus [FDP], and the flexor pollicis longus [FPL]). Which tendon is the most radial and which tendons are the most dorsal?

A Radial: FPL; dorsal: FDP
B Radial: FPL; dorsal: FDS
C Radial: FDS; dorsal: FDP
D Radial: FDP; dorsal: FPL

ANSWER 5: **A.** Within the carpal tunnel, the FPL is the most radial structure. The FDP tendons are the most dorsal structures; the FDS tendons are volar (FDS to middle and ring digits are more volar to the FDS tendons to the index and small digits). See Figure 2-29.

Section 3 Spine

6 The most common level of cervical disc herniation is between C5 and C6. Which nerve root would be compressed? Think about a physical examination finding for an affected patient.

A C4
B C5
C C6
D C7

ANSWER 6: **C.** Cervical disc herniation at the level of C5 to C6 would affect the C6 nerve root, causing weakness in wrist extension (C6), decrease in thumb sensation, and decrease in brachioradialis reflex. EMG findings of long-term impingement at this level would produce fibrillations and sharp waves in the responses for the biceps (C5, C6), extensor carpi radialis longus (ECRL), and extensor carpi radialis brevis (ECRB).

7 The distance from C1 midline spinous process laterally to the vertebral artery is how many centimeters?

A 0.5 cm
B 1.0 cm
C 1.5 cm
D 2.0 cm
E 2.5 cm

ANSWER 7: **D.** The distance from the C1 spinous process to the vertebral artery laterally is 2 cm. For lateral dissections during C1-C2 fusions, keep this anatomic safe zone in mind.

8 The angle of lumbar lordosis ranges from 55 to 60 degrees, centered at L3. The majority of lordosis is present in what region within the lumbar spine?

A T12 to L3
B L1 to L2
C L2 to L4
D L4 to S1

ANSWER 8: **D.** Sixty-six percent of lumbar lordosis is present from L4 to the sacrum. The area between T12 through L3 accounts for only 25% of the lumbar lordosis.

9 What anatomic location is the most frequent site of back pain in children and adolescents?

A Transverse process
B Spinous process
C Pars interarticularis
D Pedicle

ANSWER 9: **C.** Back pain in children and adolescents is most commonly caused by a defect within

the pars interarticularis: spondylolysis.

10 During surgery with the anterior approach to the lumbar spine over the L5 vertebral body, injury to which plexus causes retrograde ejaculation and sexual dysfunction?

A Superior hypogastric plexus

B Inferior hypogastric plexus

ANSWER 10: **A.** Sexual dysfunction caused during surgery with the anterior approach to the lumbar spine is most likely caused by injury to the sympathetic superior hypogastric plexus (anterior to L5 vertebral body).

Section 4 Lower Extremity And Pelvis

11 Compressive injury to the peroneal division of the sciatic nerve can occur during total hip arthroplasty. Which thigh muscle would be affected?

A Rectus femoris

B Vastus lateralis

C Biceps femoris, long head

D Biceps femoris, short head

E Sartorius

ANSWER 11: **D.** Only one thigh muscle is innervated by the peroneal division of the sciatic nerve: the short head of biceps femoris. In EMG studies for peroneal nerve palsies, this muscle is examined to help distinguish the level of peroneal nerve injuries (above or below the fibular head). Abnormal EMG findings for the short head of biceps indicate that the peroneal nerve abnormality is at the level of the hip.

12 Patients with hip disease can have referred pain to the knee. What nerve is responsible for this referred pain?

A Lateral femoral cutaneous nerve

B Obturator nerve

C Femoral nerve

D Sciatic nerve

ANSWER 12: **B.** Irritation of the continuation of the obturator nerve branch from the adductor magnus can result in referral of pain from the hip to the knee.

13 To avoid intraarticular pin placement and decrease the risk of septic arthritis in the knee, hardware for ring fixator application in the proximal tibia should be inserted how far distal to the tibial articular surface?

A 5 mm

B 10 mm

C 15 mm

D 20 mm

E 25 mm

ANSWER 13: **C.** The knee is enclosed in a capsule that extends 15 mm distal to the subchondral surface of the tibial plateau. Avoiding intraarticular pin placement ensures that the knee capsular anatomy remains normal.

14 Where is a discoid meniscus most common, and what is the physical examination finding for this abnormality?

A Obesity

B Locked knee in extension

C Laxity

D Positive McMurray's sign

E Lack of full knee extension

ANSWER 14: **E.** A discoid meniscus is most common laterally when a lack of full knee extension is found on examination.

15 Stance phase is 60% of the gait cycle. During swing phase (40%), an EMG would show activity of the tibialis anterior, extensor digitorum longus, and extensor hallucis longus (from toe-off to heal strike). Are all three of these muscles located within the anterior compartment of the leg?

A Yes

B No

ANSWER 15: **A.** The anterior compartment of the leg contains the tibialis anterior, extensor hallucis longus, and the extensor digitorum longus. It is also the location of the anterior tibial artery and deep peroneal nerve.

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chapter 3 Review Questions

Section 11 Lower Extremity Problems: General

1 In between what two anatomic structures sits the “thorn” of dye labeled “A” in Figure 3-Q1?

- **A** The psoas tendon and the labrum
- **B** The epiphysis and the transverse acetabular ligament
- **C** The labrum and the capsule
- **D** The greater trochanter and the lesser trochanter

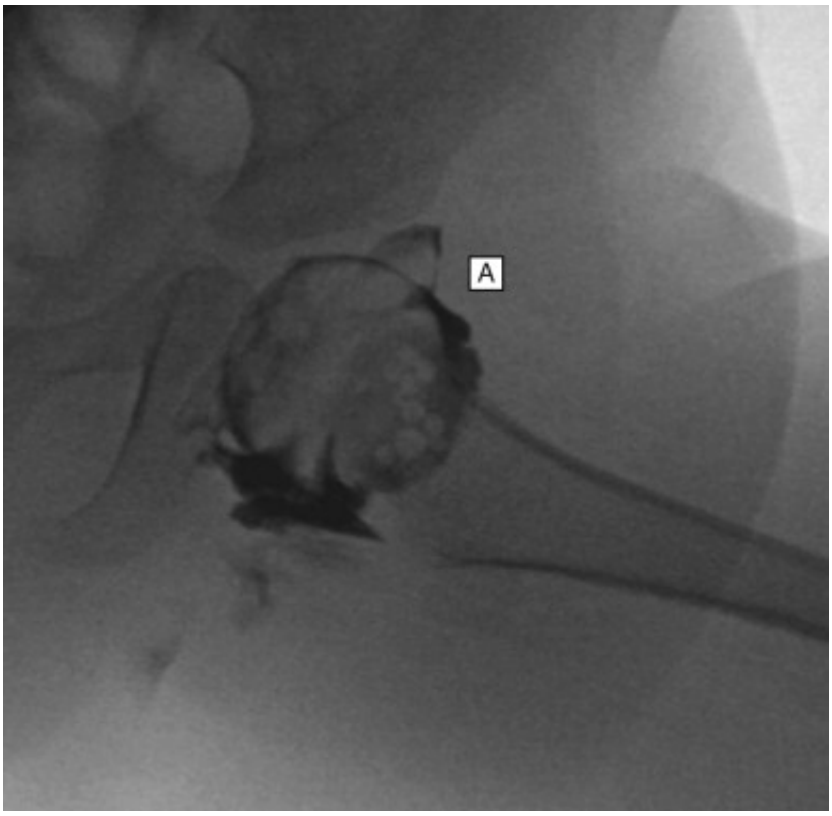

Figure 3-Q1 Fluoroscopic hip arthrogram of a reduced hip.

ANSWER 1: **C.** The “thorn sign” is potential space created by the insertion of the capsule upon the labrum. This is a sign that the hip is reduced and the labrum is no longer infolded creating a block to reduction.

2 In the hip dislocation illustrated in Figure 3-Q2, which obstacle to reduction is marked by the narrowing of the dye labeled “B”?

- **A** Transverse acetabular ligament
- **B** Pulvinar
- **C** In-folded labrum

D Inferior capsular restriction

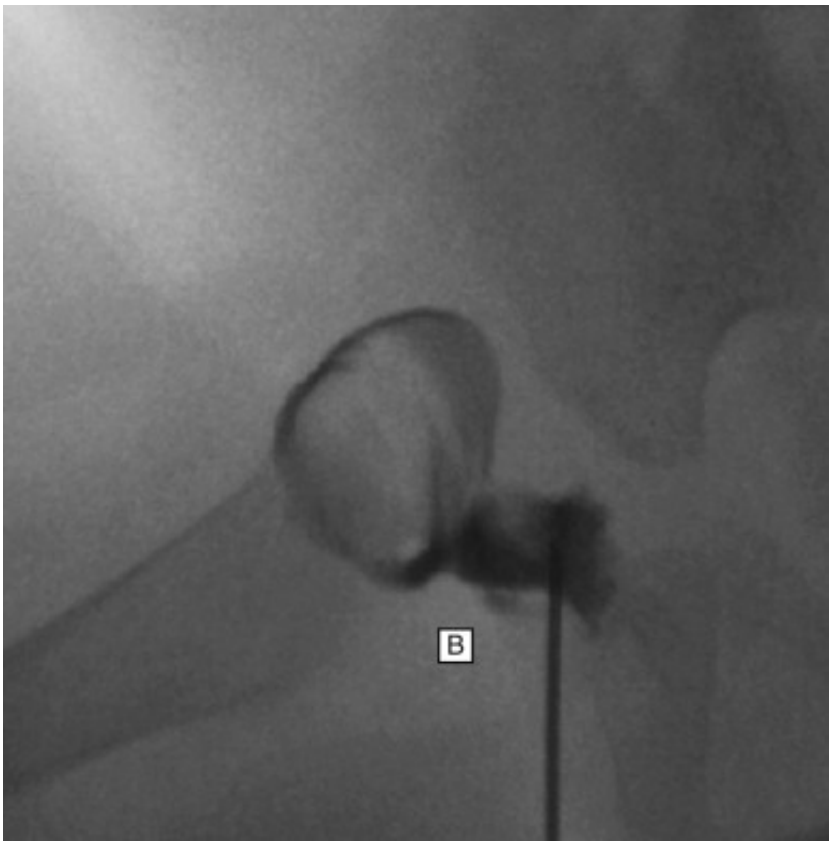

Figure 3-Q2 Fluoroscopic hip arthrogram of an unreduced hip.

ANSWER 2: **D.** The hourglass shape of the capsule is the consequence of the proximal femur not resting in the acetabulum and is one of the obstacles to reduction. Some authorities also believe that the constriction is caused by the psoas tendon. The obstacles to reduction include a tight transverse acetabular ligament, pulvinar, in-folded labrum, psoas tendon, and inferior capsular restriction.

3 Salter osteotomy is used to correct hip dysplasia by which mechanism?

A Externally rotating the femur to allow for better acetabular seating
B Expanding the femoral head to create a better acetabular fit
C A volume-reducing pelvic osteotomy to create a better acetabular fit
D A redirectional pelvic osteotomy that creates more anterior and lateral acetabular coverage
E A posterior volume-reducing pelvic osteotomy for better acetabular fit

ANSWER 3: **D.** Salter osteotomy is also called the innominate osteotomy because it involves a cut through the innominate bone. By hinging on the symphysis pubis, a redirectional force is applied to create anterior and lateral coverage, which is what is typically deficient with acetabular dysplasia.

4 Southwick osteotomy addresses the abnormal hip anatomy secondary to slipped capital femoral epiphysis by inducing:

A Varus positioning and internal rotation through a subtrochanteric osteotomy of the femur
B Valgus positioning and extension through a subcapital osteotomy of the femur
C Valgus positioning and extension through a subtrochanteric osteotomy

D Varus positioning and external rotation through a subtrochanteric osteotomy

E Valgus positioning and extension through a basocervical osteotomy

ANSWER 4: **C.** The residual deformity after SCFE consists of varus positioning and posterior displacement of the femoral head to the femoral neck, thus creating impingement on the anterior acetabulum. To correct this impingement, a valgus and extension osteotomy through the subtrochanteric region is used. The subtrochanteric osteotomy is used because of the low rate of avascular necrosis after osteotomy.

5 What are the four joints that have intraarticular components to the metaphysis?

A Shoulder, ankle, wrist, and hip
B Hip, elbow, shoulder, and ankle
C Wrist, thumb, ankle, and hip
D Knee, hip, elbow, and ankle
E Knee, wrist, elbow, and ankle

ANSWER 5: **B.** The hip, elbow, shoulder, and ankle are the only joints to have intraarticular components to the metaphysis. This is important to understand because osteomyelitis can spread from the metaphysis to become an intraarticular infection at these joints.

Section 14 Foot

6 The order of deformity correction for Ponsetti casting technique is

A Cavus, equinus, adductus, varus
B Varus, adductus, cavus, equinus
C Cavus, adductus, varus, equinus
D Equinus, adductus, varus, cavus

ANSWER 6: **C.** The mnemonic is “CAVE.” The cavus and adductus deformities are addressed with the first casting by oversupinating the foot. Lateral and dorsal pressure on the first ray and counterpressure on the lateral talus help correct the varus deformity as the forefoot is corrected. The equinus deformity is addressed by performing an Achilles tenotomy.

7 A 13-year-old boy presents with a chief complaint of recurrent bilateral lateral ankle sprains. Physical examination reveals that he has a significant cavus deformity with claw toes. In addition, you notice he has very skinny calves and wasting of his interosseus muscles in his hands. What diagnosis must be investigated?

A Polio
B Syrinx
C Charcot-Marie-Tooth disease
D Muscular dystrophy
E Early-onset Parkinson disease

ANSWER 7: **C.** Charcot-Marie-Tooth disease commonly manifests with foot complaints before any other manifestations. Upper and lower extremities can be affected. The most common foot deformity is cavus because of the muscle imbalance and relatively weak anterior tibialis.

Section 9 Pediatric Spine

8 A 13-year-old girl was sent to you in consultation from her primary care physician with regard to a brace for scoliosis. This patient had not previously received a diagnosis of scoliosis and is healthy. She is 2 years postmenarchal and plays on the basketball team in school. Her physical examination findings are unremarkable except for her right rib prominence. Her spine radiographs show a right thoracic scoliotic curve that measures 32 degrees, with a compensatory lumbar curve of 20 degrees. An image of her pelvis is shown in Figure 3-Q3. What is the next step in your management?

A Thoracolumbosacral orthosis brace worn 23 of 24 hours
B Charleston nighttime bending brace worn only during sleep
C Milwaukee brace worn 23 of 24 hours
D Observation and returning in 4 to 6 months with repeated spinal radiographs
E Plaster cast application

Figure 3-Q3 Posterior to anterior pelvis radiograph.

ANSWER 8. **D**. This child is not a candidate for brace management for scoliosis. Although brace management for scoliosis is controversial, the indications do not include patients who are skeletally mature. This patient is 2 years postmenarchal, and she is at Risser stage 4 of skeletal maturity. Both of those facts clearly show that she is past her peak height growth velocity and thus not a candidate for a brace.

References

1 Bowen JR, et al: Adolescent idiopathic scoliosis managed by a nighttime bending brace, Orthopedics 24(10):967–970, 2001.

2 Janicki JA, et al: A comparison of the thoracolumbosacral orthoses and providence orthosis in the treatment of adolescent idiopathic scoliosis: results using the new SRS inclusion and assessment criteria for bracing studies, J Pediatr Orthop 27(4):369–374, 2007.

9 An 11-year-old girl presents to your clinic with a diagnosis of scoliosis. Her physical examination findings are unremarkable besides her right thoracic prominence. Radiographic examination of her spine reveals a 40-degree right thoracic scoliotic curve. The family wants to know about risk for progression. You also obtain a hand radiograph to give the family more information (Figures 3-Q4 and 3-Q5). What is the risk that the curve will progress past 50 degrees?

A 100%
B 5%
C 50%
D 15%

E 75%

Figure 3-Q4 Bone age of 11-year-old girl w ith 40-degree scoliotic curve.

Figure 3-Q5 Closeup of same image as Figure 3-Q4.

ANSWER 9: **D.** According to her modified Tanner-Whitehouse maturity grade, the risk for progression is 15%.

Figures 3-Q4 and 3-Q5 show that the distal phalanx physes are closed and that the middle phalanx physes are open but capped. Capping refers to the position of the epiphysis in relation to the metaphysis. This method of maturity assessment was found to be the most reliable when compared to other traditional maturity assessment measures such as Risser sign and at age menarche.

Reference

1 Sanders JO, et al: Predicting scoliosis progression from skeletal maturity: a simplified classification during adolescence, J Bone Joint Surg Am 90:540–553, 2008.

2 Sanders JO, et al: Maturity assessment and curve progression in girls with idiopathic scoliosis, J Bone Joint Surg Am 89:64–73, 2007.

3 Sanders JO: Maturity indicators in spinal deformity, J Bone Joint Surg Am 89:14–20, 2007.

10 Idiopathic scoliosis is classified on the basis of age; infantile idiopathic scoliosis is characterized as onset of scoliosis at which of the following ages?

- **A** Before 2 years
- **B** Before 3 years
- **C** Before 4 years
- **D** Before 5 years

ANSWER 10: **B.** Idiopathic scoliosis is classified into three categories on the basis of age at onset. The infantile form begins before the age of 3 years; the juvenile form, between the ages of 3 and 10 years; and the adolescent form, at the age of 10 years or older. The most common type of scoliosis is, by far, the adolescent form, followed by the juvenile and infantile forms.

11 The indications for MRI in presumed adolescent idiopathic scoliosis include all of the following except:

- **A** Left thoracic curve
- **B** Rapid curve progression
- **C** Neurologic signs and symptoms
- **D** Left thoracolumbar/lumbar curve
- **E** Apical thoracic kyphosis

ANSWER 11: **D.** An MRI should be obtained to rule out neural axis abnormalities, which are not commonly observed in adolescent idiopathic scoliosis. Characteristics that are not common in adolescent idiopathic scoliosis patients include left thoracic curve (right thoracic curves are the most common), uncharacteristic rapid curve progression, neurologic signs and symptoms, and apical thoracic kyphosis; adolescent idiopathic scoliosis is characterized by apical thoracic hypokyphosis or lordosis. Left thoracolumbar/lumbar curves are very common curve patterns in adolescent idiopathic scoliosis and do not warrant an MRI.

12 The most common bacterial organism involved with delayed infection in adolescent idiopathic scoliosis is:

- **A** Staphylococcus aureus
- **B** Haemophilus influenzae
- **C** Staphylococcus epidermidis
- **D** Propionibacterium acnes
- **E** Both S. epidermidis and P. acnes

ANSWER 12: **E.** Infection after adolescent idiopathic scoliosis posterior surgery occurs in two forms: acute (usually less than 3 months after surgery) and delayed (more than 3 months after surgery). The acute infections are most commonly with the typical organisms that cause orthopaedic infections, including S. aureus. Delayed infections are with slow-growing, fastidious organisms, including S. epidermidis and P. acnes. Treatment for delayed infections includes removal of implants and a short course of antibiotics.

13 Risk factors for curve progression include:

- **A** Phase I ribs
- **B** Phase I rib and rib-vertebral angle difference of more than 20
- **C** Phase I rib and rib-vertebral angle difference of less than 20
- **D** Phase II rib
- **E** B and D

ANSWER 13: **D.** The risk for progression in infantile idiopathic scoliosis was studied by Mehta, who developed a classification of the relationship of the rib heads to the apical vertebra. A rib that does not overlap the apical vertebra is considered to be a phase I rib, and the next step is to determine the rib-vertebral angle difference. This is measured by calculating the angle between the convex rib axis and a line perpendicular to the axis of the apical vertebra and subtracting it from the concave rib (the rib-vertical angle difference). A phase II rib overlaps the apical vertebra and is predictive of progression in 80% of cases.

14 The developmental defect leading to congenital scoliosis occurs during what stage of gestation?

- **A** 4 to 6 weeks
- **B** 8 to 10 weeks
- **C** 12 to 15 weeks
- **D** 16 to 20 weeks

ANSWER 14: **A.** The spine develops during the fourth to sixth week of gestation, which is the critical time for normal development. Congenital scoliosis is thought to result from some perturbation of this development during that time period. The renal and cardiac systems develop during a similar time; therefore, patients with congenital scoliosis should undergo renal ultrasonography and some level of cardiac evaluation.

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REVIEW OF ORTHOPAEDICS SIXTH EDITION MILLER

chapter 4 Review Questions

Section 1 Knee

1 What is the most common association with failure after ACL reconstruction?

A Meniscal injury
B Tunnel malposition
C Female gender
D Graft choice
E Concomitant MCL injury

ANSWER: **B.** Objective failure of ACL repair has been defined by an increase of anterior tibial translation of more than 5 mm in comparison with the contralateral knee or by subjective instability with activities of daily living or desired athletic activities. Four general categories of failure exist: errors in surgical technique, graft failure, trauma, and failure to address coexisting laxity in secondary restraints (posterolateral corner). The most common cause of failure is error in surgical technique: 77% to 95% of all cases of ACL failures are attributed to technical error. Technical errors include inadequate notchplasty; poor graft selection, harvest, tensioning, or fixation; and incorrect tunnel placement. However, more than 70% of technical failures, and thus more than 50% of all ACL failures, are attributed to malpositioned tunnels. Improper positioning of the femoral or tibial tunnels results in excessive length changes in the graft as the knee moves through a range of motion, which results in either limited range of motion or excessive graft laxity. Anterior placement of the femoral tunnel is the most common technical error; it results in limited knee flexion and leads to impingement in extension and excessive tension in flexion. Posterior tibial tunnel placement results in limited extension and causes laxity in flexion. The challenge in ACL revision surgery is to address the bony deficiencies created by tunnel malposition and osteolysis. Battaglia and Miller (2005) described the use of press-fit allograft bone dowels to reconstitute bone stock and allow unimpeded placement of new tunnels. The emphasis is, again, on the proper tunnel placement because of the fact that 75% of all failed ACL reconstructions are a result of technical error, and of these, 70% are attributed specifically to the malpositioning of bone tunnels.

Battaglia TC, Miller MD: Management of bony deficiency in revision anterior cruciate ligament reconstruction using allograft bone dowels: surgical technique, Arthroscopy 21:767, 2005.

2 The popliteus attaches in which of the following relationships to the LCL on the femur?

A Posterior, superior, and superficial to the LCL attachment
B Posterior, inferior, and deep to the LCL attachment
C Anterior, inferior, and superficial to the LCL attachment
D Anterior, inferior, and deep to the LCL attachment
E Anterior, superior, and deep to the LCL attachment

ANSWER: **D.** The popliteus muscle originates from the posteromedial tibia and inserts inferior, anterior, and deep to the LCL insertion. The popliteofibular ligament connects the tendon to the fibular head. This anatomic arrangement is important to consider in posterolateral knee reconstruction techniques.

LaPrade RF, Ly TV, Wentorf FA, et al: The posterolateral attachments of the knee: a qualitative and quantitative morphologic analysis of the fibular collateral ligament, popliteus tendon, popliteofibular ligament, and lateral gastrocnemius tendon, Am J Sports Med 31:854–860, 2003.

Medvecky MJ, Noye FR: Surgical approaches to the posteromedial and posterolateral aspects of the knee, J Am Acad Orthop Surg 13:121–128, 2005.

3 What is the most reliable means of documenting a PCL injury?

- **A** Posterior drawer test
- **B** Quadriceps active test
- **C** Stress radiographs
- **D** KT-1000 arthrometer
- **E** Dial test

ANSWER: **C.** Hewett and colleagues (1997) found that stress radiographs were superior to the posterior draw testing and the KT-1000 arthrometer. Increased translation of 8 mm in comparison with the contralateral unaffected knee was indicative of a complete rupture. More recently, Sekiya and associates (2008) found in cadaver knees that a grade 3 on posterior drawer testing and more than 10 to 12 mm of posterior tibial translation on stress radiographs were correlated with concomitant PCL injury and posterolateral corner injury.

Hewett TE, Noyes FR, Lee MD: Diagnosis of complete and partial posterior cruciate ligament ruptures. Stress radiography compared with KT-1000 arthrometer and posterior drawer testing, Am J Sports Med 25:648–655, 1997.

Sekiya JK, et al: A clinically relevant assessment of posterior cruciate ligament and posterolateral corner injuries. Evaluation of isolated and combined deficiency, J Bone Joint Surg Am 90(8):1621–1627, 2008.

4 What is the typical pattern of bone bruising seen on MRI after ACL injury?

- **A** Anterior to the sulcus terminalis on the femur, posterolateral on the tibia
- **B** Near the sulcus terminalis on the femur, on the posterolateral aspect of the tibia
- **C** Posterior to the sulcus terminalis on the femur, posterolateral on the tibia
- **D** Anterior to the sulcus terminalis on the femur, posteromedial on the tibia
- **E** At the sulcus terminalis on the femur, posteromedial on the tibia

ANSWER: **B.** Bone bruises on MRI are found in 80% of patients after ACL rupture. They are characteristically found at the posterolateral tibia and near the sulcus terminalis on the femur as the lateral tibia subluxates anteriorly during ACL injury. The presence of the bone bruise may prolong recovery, as shown by Johnson and associates (1998), but further long-term studies are needed to define the natural history of these lesions.

Johnson DL, et al: Articular cartilage changes seen with magnetic resonance imaging–detected bone bruises associated with acute anterior cruciate ligament rupture, Am J Sports Med 26:409–414, 1998.

Rosen MA, Jackson DW, Berger PE: Occult osseous lesions documented by magnetic resonance imaging associated with anterior cruciate ligament ruptures, Arthroscopy 7(1):45–51, 1991.

Speer KP, et al: Osseous injury associated with acute tears of the anterior cruciate ligament, Am J Sports Med 20:382-389, 1992.

5 An 11-year-old boy sustains a type 3 tibial tubercle injury during a soccer game. What is the most likely cause of a block to closed reduction?

- **A** Medial meniscal entrapment
- **B** Lateral meniscal entrapment
- **C** Intermeniscal ligament entrapment
- **D** Fat pad entrapment
- **E** Concomitant ACL tear

ANSWER: **A.** Tibial eminence fractures have been classified by Meyers and McKeever (1959, 1970) as nondisplaced (type 1), partially displaced or hinged (type 2), and completely displaced (type 3). Kocher and colleagues (2003) found entrapment of the anterior horn of the medial meniscus in 36 of 80 patients with type 3 and type 2 fractures that did not reduce in extension.

Kocher MS, et al: Tibial eminence fractures in children: prevalence of meniscal entrapment, Am J Sports Med 31:404–407, 2003.

Meyers MH, McKeever FM: Fracture of the intercondylar eminence of the tibia, J Bone Joint Surg 41A:209–222, 1959.

Meyers MH, McKeever FM: Follow-up notes. Fracture of the intercondylar eminence of the tibia. J Bone Joint Surg Am 52A:1677–1684, 1970.

Section 2 Thigh, Hip, and Pelvis

6 Acute management of quadriceps contusions should consist of which of the following?

- **A** Immobilization in full extension for 24 hours
- **B** Immobilization in 90 degrees of flexion for 24 hours
- **C** Immobilization in 120 degrees of flexion for 24 hours
- **D** Immediate range of motion exercises in double-upright brace
- **E** Immediate range of motion exercises without bracing

ANSWER: **C.** Aronen and associates (2006) examined at 47 Naval Academy athletes splinted in 120 degrees of flexion for 24 hours after a quadriceps contusion; these patients returned to unrestricted activity and sports by 3.5 days (and only 1 case of myositis ossificans occurred). This outcome was an improvement over results of older studies such as Ryan and colleagues' (1991) at West Point. Return to activity was quicker, and there was a lower incidence of myositis ossificans (9% in Ryan et al's study).

Aronen JG, et al: Quadriceps contusions: clinical results of immediate immobilization in 120 degrees of knee flexion, Clin J Sport Med 16:383–387, 2006.

Ryan JB, et al: Quadriceps contusions: West Point update, Am J Sports Med 19:299–304, 1991.

7 Iliotibial band tightness is best tested by which of the following tests?

- **A** Duncan-Ely test
- **B** Flexion, abduction, and external rotation of the affected side
- **C** Standing adduction
- **D** Standing abduction
- **E** With the patient lying on the side and affected side up, the affected side is abducted and extended at the hip and then progressively brought into adduction (Ober test)

ANSWER: **E.** The Ober test is commonly used for measuring iliotibial band flexibility. The patient lies on the side with the pelvis and shoulders aligned vertically and with the knees flexed to 90 degrees. The examiner stabilizes the pelvis and moves the tested (top) leg into hip flexion, abduction, and extension. Then the leg is moved into an adducted position until it is stopped by soft tissue tension or rotation of the pelvis. If the leg remains in an abducted position (above the horizontal), the test result is considered positive, indicating iliotibial band tightness. The Duncan-Ely test is a measure of rectus femoris tightness and is often used in evaluating children with cerebral palsy.

Ferber R, Kendall KD, McElroy L: Normative and critical criteria for iliotibial band and iliopsoas muscle flexibility, J Athl Train 45(4):344–348, 2010.

Marks MC, et al: Clinical utility of the Duncan-Ely test for rectus femoris dysfunction during the swing phase of gait, Dev Med Child Neurol 45:763–768, 2003.

8 What is the most common external cause of snapping hip syndrome?

- **A** Iliotibial band tightness
- **B** Iliopsoas tendinitis
- **C** Labral tear
- **D** Femoral acetabular impingement
- **E** Rectus tightness

ANSWER: **A.** Patients presenting with hip pain and an audible or sensation of snapping of the hip during exercise may have snapping hip syndrome, or coxa saltans. The most common external cause of this syndrome is a tight iliotibial band. This usually responds to physical therapy and a stretching protocol. Provencher and colleagues (2004) demonstrated good and predictable results

with surgical Z-plasty of the iliotibial band in properly selected patients.

Provencher MT, Hofmeister EP, Muldoon MP: The surgical treatment of external coxa saltans (the snapping hip) by Z-plasty of the iliotibial band, Am J Sports Med 32:470–476, 2004.

9 In assessing a patient with femoroacetabular impingement, which radiographic view gives the most information about anterior femoral head coverage?

- **A** Standing anteroposterior view of the pelvis
- **B** Frog-lateral view
- **C** Cross-table lateral view
- **D** False profile view
- **E** Anteroposterior view with femurs in maximal internal rotation

ANSWER: **D.** The false profile view (faux profil) was originally described by Lequesne to assist in the diagnosis of early osteoarthritis and developmental dysplasia of the hip. It is obtained by having the patient stand next to a vertical radiograph cassette. The hip of interest is closest to the cassette. The ipsilateral foot is parallel to the cassette also. The pelvis is rotated 25 degrees backwards (the back of the patient is at a 65-degree angle with the cassette). This allows a profile of the anterosuperomedial edge of the acetabulum.

Lequesne MG, Laredo JD: The faux profil (oblique view) of the hip in the standing position. Contribution to the evaluation of osteoarthritis of the adult hip. Ann Rheum Dis 57:676–681, 1998.

Lequesne M, de Seze: [False profile of the pelvis. A new radiographic incidence for the study of the hip. Its use in dysplasias and different coxopathies], Rev Rhum Mal Osteoartic 28:643–652, 1961 [in French].

10 What is the most common internal cause of snapping hip syndrome?

- **A** Iliotibial band tightness
- **B** Iliopsoas tendinitis
- **C** Labral tear
- **D** Femoral acetabular impingement
- **E** Rectus tightness

ANSWER: **B.** Patients presenting with hip pain and an audible snapping or a snapping sensation in the hip during exercise may have snapping hip syndrome, or coxa saltans. The most common internal cause of this syndrome is a tight iliopsoas tendon. This usually responds to nonoperative treatment with physical therapy and guided stretching exercises. Surgical iliopsoas lengthening can yield good clinical results but has been associated with a high rate of complications (40%).

Hoskins JS, Burd TA, Allen WC: Surgical correction of internal coxa saltans: a 20-year consecutive study, Am J Sports Med 32:998–1001, 2004.

Schaberg JE, Harper MC, Allen WC: The snapping hip syndrome, Am J Sports Med 12:361–365, 1984.

Section 3 Leg, Foot, and Ankle

11 Which compartment is most commonly involved in chronic exertional compartment syndrome?

- **A** Anterior
- **B** Lateral
- **C** Deep posterior
- **D** Superficial posterior
- **E** All of the above

ANSWER: **A.** Chronic exertional compartment syndrome is a recurrence of elevated intramuscular pressures in athletes during exercise. Pain is associated with activity and disappears with rest. Diagnosis is usually based on history but can be confirmed with intracompartmental pressure measurements (>15 mm Hg during rest, >30 mm Hg 1 minute after exercise, or >20 mm Hg 5 minutes after exercise). The anterior compartment is most often affected.

Fasciotomies may be used to treat documented chronic exertional compartment syndrome in patients who do not respond to conservative treatment and activity modification.

Edmundsson D, Toolanen G, Sojka P: Chronic compartment syndrom also affects nonathletic subjects: a prospective study of 63 cases with exercise-induced lower leg pain, Acta Orthop 78:136–142, 2007.
Fraipont MJ, Adamson GJ: Chronic exertional compartment syndrome, J Am Acad Orthop Surg 11:268–276, 2003.

12 A 25-year-old professional ballet dancer presents with ankle pain that worsens with plantar flexion. The most likely cause is which of the following?

- **A** Anterior ankle impingement
- **B** Posterior ankle impingement
- **C** Split tear of the peroneus brevis
- **D** Split tear of the peroneus longus
- **E** Posterior talofibular ligament injury

ANSWER: **B.** Posterior ankle impingement syndrome includes several causes of posterior ankle pain in forced plantar flexion. Os trigonum disease is the most common cause. Fractures, subtalar disease, flexor hallucis longus tendinitis, and ankle cartilage disease may also be causes.

Maquirriain J: Posterior ankle impingement syndrome, J Am Acad Ortho Surg 13:365–371, 2005.

13 What is the structure most at risk with use of the anteromedial portal in ankle arthroscopy?

- **A** Deep peroneal nerve
- **B** Dorsalis pedis artery
- **C** Tibial nerve
- **D** Sural nerve
- **E** Saphenous vein

ANSWER: **E.** The greater saphenous vein and nerve are the closest neurovascular structures to the anteromedial portal. The greater saphenous nerve is on average 7.4 mm medial to the portal and 9 mm medial to the portal.

Feiwell LA, Frey C: Anatomic study of arthroscopic portal sites of the ankle, Foot Ankle 14:142–147, 1993.
Stetson WB, Ferkel RD: Ankle arthroscopy: I. Technique and complications, J Am Acad Orthop Surg 4:17–23, 1996.

14 Dorsiflexion and inversion ankle injuries are associated with osteochondral lesions in which portion of the talus?

- **A** Anterolateral
- **B** Posteromedial
- **C** Anteromedial
- **D** Posterolateral
- **E** Central

ANSWER: **A.** Osteochondral defects in the talus can occur with 4% to 7% of acute lateral ankle ligament ruptures. Lateral lesions are usually associated with inversion and dorsiflexion. Medial lesions are seen with inversion, plantar flexion, and rotation.

Berndt AL, Harty M: Transchondral fractures (osteochondritis dissecans) of the talus, J Bone Joint Surg Am 41:988–1020, 1959.
Van Dijk CH, van Bergen CJ: Advancements in ankle arthroscopy, J Am Acad Orthop Surg 16:635–646, 2008.

15 A college football linemen sustains a nondisplaced fracture of the fifth metatarsal at the metaphyseal-diaphyseal junction during training camp. Treatment should consist of which of the following?

- **A** Immobilization in a short leg cast
- **B** Immobilization in a short leg cast with external bone stimulator
- **C** Open reduction and internal fixation with autograft
- **D** Open reduction and internal fixation with compression plating
- **E** Open reduction and internal fixation with intramedullary screw fixation

ANSWER: **E.** Early fixation of acute Jones fractures in athletes has been preferred because affected athletes can return earlier to competition. Percutaneous intramedullary screw fixation is the preferred technique. Bone grafting and external bone stimulators are not necessary in the acute setting.

Mindrebo N, et al: Outpatient percutaneous screw fixation of the acute Jones fracture, Am J Sports Med 21(5):720–723, 1993.

Section 4 Shoulder

16 Which portion of the acromioclavicular capsule should be preserved during an arthroscopic distal clavicle resection to prevent late instability?

- **A** Anterosuperior
- **B** Posterosuperior
- **C** Anteroinferior
- **D** Posteroinferior

ANSWER: **B.** Several studies have stressed the importance of the acromioclavicular ligaments to preventing displacement and instability. Fakuda and associates (1986) found that with minimal displacements, the acromioclavicular ligaments were the primary restraint to superior (68%) and posterior (89%) translation. Klimkiewicz and colleagues (1999) showed that the superior and posterior acromioclavicular ligaments were the main restraints to preventing posterior instability of the clavicle.

Fakuda K, et al: Biomechanical study of the ligamentous system of the acromioclavicular joint, J Bone Joint Surg Am 68:434–440, 1986.

Klimkiewicz JJ, et al: The acromioclavicular capsule as a restraint to posterior translation of the clavicle: a biomechanical analysis, J Shoulder Elbow Surg 8(2):119–124, 1999.

17 For arthroscopic repair of a SLAP tear, the Port of Wilmington portal for SLAP is located where?

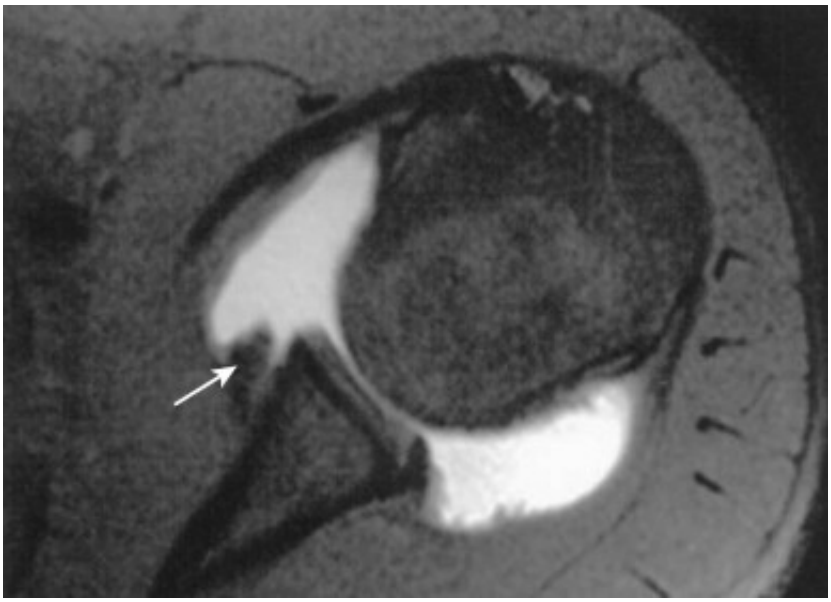
- **A** Anterior to the posterolateral corner of the acromion
- **B** Posterolateral to the acromioclavicular joint
- **C** Lateral to the coracoid process
- **D** Posterior to the anterolateral corner of the acromion
- **E** Posterior to the posterolateral corner of the acromion

ANSWER: **A.** The Port of Wilmington allows for the treatment of SLAP tears, especially those with a large posterior component. It is usually placed 1 cm anterior and 1 cm lateral to the posterolateral corner of the acromion. This placement usually allows for a 45-degree angle of access to the posterosuperior glenoid.

Meyer M, et al: Anatomic risks of shoulder arthroscopy portals: anatomic cadaveric study of 12 portals, Arthroscopy 23:529–536, 2007.

18 A 17-year-old baseball player presents after he slid awkwardly into second base and has continued shoulder pain. MRI shows evidence of what type of lesion?

- **A** HAGL lesion
- **B** PASTA lesion
- **C** ALPSA lesion
- **D** Kim lesion
- **E** SLAP tear



ANSWER: **C.** This magnetic resonance image shows evidence of a detached medial anteroinferior labral tear with migration medially by an intact periosteal sleeve, which is consistent with an anterior labroligamentous periosteal sleeve avulsion (ALPSA). This injury differs from a classic Bankart lesion, in which the scapular periosteum is also disrupted with the anteroinferior labral/anterior band of inferior glenohumeral ligamentous tear. The other options are explained as follows:

- A PASTA lesion is a partial articular supraspinatus tendon avulsion.
- A HAGL lesion is a humeral avulsion of the glenohumeral ligament.
- A SLAP tear is a superior labral tear in an anterior-to-posterior direction.
- A Kim lesion is an incomplete and concealed avulsion of the posteroinferior labrum in posterior or multidirectional posteroinferior instability of the shoulder.

Kim SH, et al: Kim's lesion: an incomplete and concealed avulsion of the posteroinferior labrum in posterior or multidirectional posteroinferior instability of the shoulder, Arthroscopy 20:712–720, 2004.

Sanders TG: Imaging of specific shoulder abnormalities, In DeLee JC, Drez D Jr, Miller MD, editors: DeLee and Drez's orthopaedic sports medicine, ed 3, Philadelphia, 2009, WB Saunders.

19 High-level collegiate and professional baseball pitchers often demonstrate what set of changes in range of motion in their dominant pitching arm in comparison with their nondominant arm?

A Increased external rotation, increased internal rotation, increased overall range of motion
B Increased external rotation, decreased internal rotation, decreased overall range of motion
C Increased external rotation, decreased internal rotation, equal overall ARC of motion
D Decreased external rotation, decreased internal rotation, decreased overall range of motion
E Decreased external rotation, increased internal rotation, increased overall range of motion
F Decreased external rotation, increased internal rotation, equal overall range of motion

ANSWER: **C.** Glenohumeral internal rotation deficit (GIRD) is defined as a loss of internal rotation in the throwing shoulder of athletes in comparison with the nonthrowing shoulder. It is usually associated with a concomitant increased amount of external rotation in the throwing shoulder that often leads to an equal total arc range of motion in comparison with the contralateral shoulder. Burkhart and associates (2003) proposed that posterior capsular tightness causes this deficit and can change the kinematics of the shoulder, leading to internal impingement and putting the shoulder at risk for instability and SLAP lesions.

Burkhart SS, Morgan CD, Kibler WB: The disabled throwing shoulder: spectrum of pathology, part I: pathoanatomy and biomechanics, Arthroscopy 19:404–420, 2003.

20 Radiographs after an injury to the right shoulder reveals exactly 90% increased coracoclavicular distance in comparison with the uninjured side. This injury would be classified as what type of acromioclavicular separation?

A I
B II
C III
D IV
E V

ANSWER: **C.** The Rockwood expanded classification of acromioclavicular dislocations includes 6 types (I to VI). Type I is a sprain without disruption of either the acromioclavicular or coracoclavicular ligaments. Type II is a rupture of the acromioclavicular ligaments without disruption of the coracoclavicular ligaments. Type III is a disruption of both the acromioclavicular and coracoclavicular ligaments with separation between the observed heights of the acromion and clavicle. Type IV is a disruption of both the acromioclavicular and coracoclavicular ligaments with posterior displacement of the clavicle into and possibly through the trapezius muscle. Type V is a disruption of both the acromioclavicular and coracoclavicular ligaments along with disruption of the muscular attachments around the acromioclavicular joint, resulting in 100% to 300% observed displacement between the acromion and clavicle. Type VI is an inferior dislocation of the clavicle below the coracoid process and posterior to the conjoint tendons.

Rockwood CA Jr, Williams GR Jr, Young DC: Disorders of the acromioclavicular joint. In Rockwood CA Jr, et al, editors: The shoulder, ed 3, Philadelphia, 2004, WB Saunders.

Section 5 Elbow

21 What nerve is most commonly injured during a repair of a distal biceps tendon rupture?

A Ulnar nerve
B Median nerve
C Posterior interosseous nerve
D Superficial radial nerve
E Lateral antebrachial cutaneous nerve

ANSWER: **E.** Neuropraxia of the lateral antebrachial cutaneous nerve is the most common nerve injury reported with repair of distal biceps tendon ruptures. This nerve pierces the fascia between the brachialis and biceps muscles at the level of the antecubital fossa and runs parallel to the cephalic vein within the subcutaneous fat. Knowledge of this anatomy can help minimize this complication during distal biceps tendon repair.

Beldner S, et al: Anatomy of the lateral antebrachial cutaneous and superficial radial nerves in the forearm: a cadaveric and clinical study, J Hand Surg Am 30:1226–1230, 2005.

Kelly EW, Morrey BF, O'Driscoll SW: Complications of repair of the distal biceps tendon with the modified two-incision technique, J Bone Joint Surg Am 82:1575–1581, 2000.

22 Which portion of the ulnar collateral ligament is most important in preventing valgus instability in overhead throwers?

A Anterior band
B Posterior band
C Transverse band
D A and B
E All of the above

ANSWER: **A.** The anterior band of the ulnar or medial collateral ligament is the primary restraint to valgus stress at the elbow. Additional restraint is provided by the flexor pronator mass, radiocapitellar articulation and the elbow joint capsule. With the elbow in full extension, the ulnohumeral articulation

and anterior joint capsule provide significant stability against valgus stress.

Davidson PA, et al: Functional anatomy of the flexor pronator muscle group in relation to the medial collateral ligament of the elbow, Am J Sports Med 23:245–250, 1995.

23 What is the most common transient nerve palsy after elbow arthroscopy?

- **A** Median nerve
- **B** Radial nerve
- **C** Lateral antebrachial cutaneous nerve
- **D** Posterior interosseous nerve
- **E** Ulnar nerve

ANSWER: **E.** The most common transient nerve palsy after elbow arthroscopy is an ulnar nerve palsy. Superficial radial nerve, posterior interosseous nerve, medial antebrachial cutaneous nerve, and anterior interosseous nerve palsies have also been reported. Careful attention to portal placement and traction during the case can help minimize the risk of these neuropraxias.

Dumonski ML, Arciero RA, Mazzocca AD: Ulnar nerve palsy after elbow arthroscopy, Arthroscopy 22(5):577.e1–577.e3, 2006.

Kelly EW, Morrey BF, O'Driscoll SW: Complications of elbow arthroscopy, J Bone Joint Surg Am 83:25–34, 2001.

24 Degenerative changes seen in pitcher's elbows are most commonly seen in what anatomic location?

- **A** Posteromedial olecranon osteophytes
- **B** Posterolateral olecranon osteophytes
- **C** Anteromedial olecranon osteophytes
- **D** Anterolateral olecranon osteophytes

ANSWER: **A.** Excessive valgus stress seen in the throwing elbows of pitchers can result in posteromedial olecranon impingement, which causes pain, osteophyte formation, loose bodies, and loss of range of motion. These osteophytes can be removed surgically to help with symptoms and range of motion; however, care should be taken not to resect more than just the osteophytes secondary to placing increased valgus stress on the medial collateral ligament.

Wilson FD, et al: Valgus extension overload in the pitching elbow, Am J Sports Med 11:83–88, 1983.

Kamineni S, Hirahara H, Pomianowski S, et al: Partial posteromedial olecranon resection: a kinematic study, J Bone Joint Surg Am 85:1005–1011, 2003.

25 Posterolateral rotatory elbow instability is caused by deficiency of which of the following ligaments?

- **A** Radial portion of the lateral collateral ligament
- **B** Ulnar portion of the lateral collateral ligament
- **C** Annular ligament
- **D** Anterior band of the ulnar collateral ligament
- **E** Posterior band of the ulnar collateral ligament

ANSWER: **B.** Posterolateral rotatory elbow instability is caused by a deficiency in the ulnar portion of the lateral collateral ligament of the elbow. This can be tested by supinating the forearm and applying a valgus moment along with axial compression while the elbow is brought from extension to flexion. Flexion of more than 40 degrees reduces the radiocapitellar joint.

O'Driscoll SW, Bell DF, Morrey BF: Posterolateral rotatory instability of the elbow, J Bone Joint Surg Am 73:440–446, 1991.

Section 7 Head and Spine

26 A 16-year-old football quarterback comes to the sideline complaining of dizziness and headache and has some difficulty remembering the previous series of plays. No loss of consciousness has been noted. This is the first time this has happened. When can he return to play?

A Next play
B Next series
C After 1 week
D After evaluation by a physician or neuropsychologist documenting the resolution of symptoms
E Not until next season

ANSWER: **D.** Dizziness, headache, and loss of memory are all symptoms of a concussive event. Other effects of a concussion can include changes in emotions, disposition, or sleep. Headache is the most frequent symptom, and loss of consciousness is reported in fewer than 10% of cases. No athlete should be allowed to return to play the same day as a concussive event. Athletes should return to play only after resolution of symptoms both at rest and with exertion and after clearance by a health care professional with experience in evaluating concussions.

Aubry M, et al: Concussion In Sport (CIS) group. Summary and agreement statement of the 1st International Symposium on Concussion in Sport: Vienna 2001, Clin J Sports Med 12(1):6–11, 2002.
Halstead ME, Walter KD; Council on Sports Medicine and Fitness: Sport-related concussion in children and adolescents, Pediatrics 126:597–616, 2010.

27 A 19-year-old collegiate football player has an episode of transient quadriplegia and neck pain. The order of cervical spine stabilization should be which of the following?

A Stabilize head, remove the helmet, apply a cervical collar, transport on backboard with pads on
B Stabilize head, remove the facemask but leave the helmet, remove pads, transport on backboard
C Stabilize head, remove the facemask but leave the helmet, transport on backboard with pads on
D Stabilize head, remove the facemask but leave the helmet, apply a cervical collar, and, if patient is able to now move, then transport in wheelchair

ANSWER: **C.** The proper handling of on-field cervical spine injuries is critical. Cervical spine stabilization in football players should first include stabilizing the head to ensure control over the cervical spine alignment at all times. The facemask can be removed to allow for access to the player's airway as necessary. The helmet and shoulder pads should remain on until radiographic clearance is obtained.

Waninger KN: Management of the helmeted athlete with suspected cervical spine injury, Am J Sports Med 32:1331–1350, 2004.

Section 8 Medical Aspects of Sports Medicine

28 Which of the following does not have a commonly available test for athletic competitions?

A Testosterone
B Dehydroepiandrosterone
C Androstenedione
D Amphetamines
E Human growth hormone (HGH)

ANSWER: **E.** Growth hormone is a naturally occurring hormone secreted by the pituitary gland that has anabolic and lipolytic effects that can contribute to an increase in lean body mass and reduction in fat mass. It has been banned by the World Anti-Doping Agency. It is difficult to detect when taken exogenously because HGH is normally secreted in a pulsatile manner with exercise and reaches peak levels immediately after exertion when testing often takes place. Recombinant HGH and cadaveric HGH are nearly identical to pituitary HGH and thus are difficult to distinguish. Blood testing is necessary to detect HGH because less than 0.1% is excreted unchanged in urine.

Holt RI, Sonksen PH: Growth hormone, IGF-1, and insulin and their abuse in sport, Br J Pharmacol 154:542–556, 2008.

29 Multiple members of a high school wrestling team have developed skin lesions with erythematous base and draining pustules. They should be treated with which of the following?

A Intravenous vancomycin

B Intravenous cephazolin (Kefzol) until culture results are finalized
C Trimethoprim-sulfamethoxazole (Bactrim) and rifampin
D Rifampin
E Oral cephalexin (Keflex) until cultures are finalized.
ANSWER: **C.** The emergence of methicillin-resistant Staphylococcus aureus (MRSA) in athletics has become a significant problem. The majority of those affected by community-acquired MRSA infections, such as athletes, lack the known risk factors for MRSA infections often seen in hospital and health care settings. Team physicians should be highly attentive to this issue for any athlete presenting with skin outbreaks, including pustules and abscesses, and other team members and staff should also be examined. Multiple antibiotics are often needed to treat these infections; trimethoprim-sulfamethoxazole (Bactrim) has shown good action against community-acquired MRSA strains and can often be combined with rifampin. To prevent development of multidrug resistance, rifampin should never be used as sole therapy.

Rihn JA, Michaels MG, Harner CD: Community-acquired Staphylococcus aureus: an emerging problem in the athletic population, Am J Sports Med 33:1924–1929, 2005.

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REVIEW OF ORTHOPAEDICS SIXTH EDITION MILLER

chapter 5 Review Questions

Section 1 Hip Dysplasia—adult Presentation

1 A 30-year-old female recreational tennis player complains of left hip pain. She has hip dysplasia with a measured lateral center edge (CE) angle of 18 degrees. Femoral neck α-angle is normal. Her joint space on radiographs is congruent and shows a maintained joint space. Gadolinium magnetic resonance imaging (MRI) shows a tear of the anterior-superior labrum. The patient has failed to respond to nonoperative treatment. Which of the following is the best surgical treatment option?

- **A** Hip arthroscopy with acetabular labral débridement
- **B** Hip arthroscopy with femoral neck osteoplasty and acetabular labral débridement
- **C** Anterior surgical dislocation of the hip, femoral neck osteoplasty, and acetabular labral débridement
- **D** Anterior surgical dislocation of the hip, femoral neck osteoplasty, and acetabular labral repair
- **E** Periacetabular osteotomy and open acetabular labral repair

ANSWER 1: **E.** A lateral CE angle of 18 degrees indicates a shallow socket dysplasia. The acetabular labrum in developmental dysplasia of the hip provides significant stability and should not be removed. With a normal α-angle, a femoral osteoplasty is not needed. The best option to correct the dysplastic deformity is a periacetabular osteotomy.

2 Which of the following hip deformities is most likely to cause a chondral flap tear of the acetabulum?

- **A** Lateral CE angle of 20 degrees
- **B** Anterior CE angle of 20 degrees
- **C** Hip α-angle of 52 degrees
- **D** Acetabular roof index of −5 degrees
- **E** Acetabular roof index of 5 degrees

ANSWER 2: **C.** Cam type of femoral acetabular impingement is most likely to cause a chondral flap tear. Cam impingement is best described by the α-angle (normal <40 degrees). The cam with hip flexion rotates underneath the labrum and impinges upon the articular surface of the acetabulum. This can cause chondral flap tears.

Section 3 Hip Arthritis Treatment

3 The anterior portal of a hip arthroscopy places which of the following structure at greatest risk for injury?

- **A** Ascending branch of the lateral circumflex femoral artery
- **B** Ascending branch of the medial circumflex femoral artery
- **C** Femoral nerve
- **D** Lateral femoral cutaneous nerve
- **E** Superior gluteal nerve

ANSWER 3: **D.** The anterior hip portal provides visualization of the anterior and inferior regions of the hip joint. Anatomically, the anterior portal is closest the lateral femoral cutaneous nerve.

4 What is the preferred position for hip arthrodesis?

- **A** 5 degrees of hip flexion, 0 degrees of abduction, 15 degrees of external rotation

B 5 degrees of hip flexion, 0 degrees of abduction, 5 degrees of external rotation
C 5 degrees of hip flexion, 15 degrees of abduction, 15 degrees of external rotation
D 20 degrees of hip flexion, 15 degrees of abduction, 15 degrees of external rotation
E 20 degrees of hip flexion, 0 degrees of abduction, 5 degrees of external rotation

ANSWER 4: **E.** Hip fusion position is 20 to 25 degrees of flexion to allow for limb swing through. Abduction is zero. There is an increased risk for back and ipsilateral knee pain when the fusion is in abduction. External rotation is between zero and 10 degrees.

Section 4 Osteonecrosis of the Hip

5 A 38-year-old woman with systemic lupus erythematosus complains of disabling right hip pain. She has osteonecrosis of the femoral head as a result of a hypercoagulable state. She has stage 4 (modified Ficat) involvement. She has failed all conservative treatment. The best treatment is which of the following?

A Core decompression
B Curettage of femoral head with vascularized fibular strut placement
C Bipolar hemiarthroplasty
D Hip fusion
E Total hip arthroplasty (THA)

ANSWER 5: **E.** Stage 4 (modified Ficat) osteonecrosis indicates a crescent with subchondral collapse and degenerative joint disease. The best treatment is THA because this procedure provides the best pain relief and function. A hip fusion is best indicated for a young male laborer. Bipolar arthroplasty has a higher risk for groin pain and also can cause significant osteolysis.

Section 5 Total Hip Arthroplasty

6 Which of the following factors improves the performance of cemented femoral stems in THA?

A Stiffer stem materials
B Nonvacuum hand mixing of polymethylmethacrylate (PMMA)
C Calcar collar contact
D Sharper corners
E Decreased thickness of the cement mantle

ANSWER 6: **A.** A stiffer stem imparts less bending forces to the cement mantle. This decreases the chance for cement cracking. Sharp corners and a thin cement mantle both increase the risk for cement mantle cracks. Hand mixing of cement, as opposed to vacuum mixing, leaves voids in the cement, which can also lead to cement cracks over time.

7 A 34-year-old man is scheduled to undergo a THA. History reveals that he underwent radiation therapy for a pelvic malignancy 1 year ago. A cementless acetabular component should be avoided in this situation because of the increased risk for which of the following?

A Osteolysis
B Acetabular fracture
C Aseptic loosening
D Infection
E Recurrent tumor

ANSWER 7: **C.** For cementless THA components to have successful bone ingrowth, the host bone must be viable. Irradiation of the pelvis significantly reduces the viability of host bone. If a cementless implant is inserted, it is likely to fail because of lack of bone ingrowth. In this clinical scenario, a cemented acetabular cup is recommended.

8 Which of the following terms best describes a decrease in physiologic stress in the proximal femur caused by a stiffer structure that shares its load?

A Stress shielding
B Bone resorption
C Bone hypertrophy
D Bone atrophy
E Pressure adaptation

ANSWER 8: **A.** Stress shielding describes the condition of proximal bone density loss resulting from insertion of a stiff femoral stem. Stem stiffness is the main determinant of stress shielding. It is seen mainly with cementless stems of large diameter. Because the stiff femoral stem takes most of the mechanical load, the surrounding bone sees less stress. As a result, bone density loss occurs in the proximal region of the femur.

Section 6 Revision THA

9 During a revision of a failed total hip femoral component for osteolysis, the new implant should bypass the most distal cortical defect by a minimum of how many cortical diameters?

A 0
B 1
C 2
D 3
E 4

ANSWER 9: **C.** The revision stem should bypass the most distal cortical defect by two cortical diameters. This reduces the bending forces at the defect area. If the stem is less than two cortical diameters distal, the risk for periprosthetic tip fracture is increased.

10 Which of the following is the most common complication following a hip revision with isolated polyethylene (PE) exchange for osteolysis?

A Infection
B Nerve injury
C Heterotopic ossification
D Dislocation
E Loosening of the acetabular component

ANSWER 10: **D.** Patients who undergo an isolated modular bearing change generally feel well, are full weight bearing, and are generally more active than patients who have a more extensive revision. Because of this, patients who undergo a modular bearing change tend to be less adherent to hip precautions during the healing phase and are more prone to dislocation.

11 During THA, profuse bleeding is noted following predrilling for placement of an acetabular component screw. The drill most likely penetrated too deep in which of the following?

A Posterior-superior acetabular quadrant
B Posterior-inferior acetabular quadrant
C Anterior-superior acetabular quadrant
D Anterior-inferior acetabular quadrant
E Ischial body

ANSWER 11: **C.** The anterior-superior quadrant is known as the “zone of death.” Deep penetration in this zone with screws or a drill risks injury to the external iliac artery and vein. The safe zone for acetabular screw placement is the posterior-superior quadrant.

12 An acetabular reinforcement cage is most often indicated for which of the following conditions?

A Contained cavitary defect

B Deficient anterior wall
C Pelvic discontinuity
D Osteolysis with an intact acetabular rim
E Medial wall defect

ANSWER 12: **C.** In revision THA, a porous-coated hemispheric cup with screws is the preferred option. It can be used with almost all cavitary deficiencies. A hemispheric cup requires at least two thirds of the rim to be intact. When a hemispheric cup cannot be adequately secured to bone, then a reinforcement cage is recommended. A pelvic discontinuity is an absolute indication for a reinforcement cage.

Section 7 Osteolysis IN THA

13 Which of the following design features of cementless femoral stems best limits osteolysis of the distal femur when used in THA?

A Fills the diaphysis of the femur
B Fills the metaphysis of the femur
C Collared
D Modular proximal body
E Circumferential porous coating

ANSWER 13: **E.** Osteolysis occurs anywhere within the effective joint space. PE particles travel anywhere within the effective joint space by the simple rule of path of least resistance. PE particles will move along any smooth surface no matter how tight the implant fill. Circumferential porous coating tends to “seal” the implant-bone interface. This protects against pumping of PE particles to the stem tip region.

14 Which of the following is an inhibitor of particle-induced osteolysis?

A Interleukin-6
B Osteoprotegerin
C Tumor necrosis factor-α
D Receptor activator of nuclear factor kB (RANK)
E Receptor activator of nuclear factor kB ligand (RANKL)

ANSWER 14: **B.** In the process of PE particle–induced osteolysis, PE particles are ingested by macrophage cells, which in turn produce proinflammatory cytokines. These cytokines stimulate the osteoblast to produce RANKL. RANKL in turn attaches to RANK receptor on the osteoclast, which activates osteoclastogenesis. Osteoprotegerin binds to RANKL to inhibit this cascade.

15 Wear particles of ultra-high–molecular-weight PE (UHMWPE) that are generated by total hip implants predominantly have which of the following diameters?

A Less than 1 μm
B 5 to 10 μm
C 10 to 50 μm
D 100 to 200 μm
E 500 to 750 μm

ANSWER 15: **A.** The particles of UHMWPE generated by THA implants in normal wear conditions are generally submicron in size. These submicron-sized particles are ingested by the macrophages, which then liberate proinflammatory cytokines that stimulate the osteolysis cascade. Highly cross-linked PE products generally produce smaller PE particles than standard PE products.

Section 8 Periprosthetic tha Fracture

16 An 82-year-old man fell and sustained a fracture of his cemented Moore hemiarthroplasty. The fracture is around the stem tip region and extends halfway up around the prosthesis. History reveals that the patient reports groin pain after activity. Treatment should now consist of which of the following?

A Allograft strut with cerclage cables
B Combined plate and allograft strut with cerclage cables
C Cemented bipolar revision
D Cemented revision THA
E Cementless revision total hip arthroplasty

ANSWER 16: **E.** When more than 25% of a cement mantle is disrupted in a periprosthetic stem tip fracture, the cement construct is considered compromised. The recommended solution is insertion of a cementless extensively coated long femoral stem. Groin pain indicates acetabular degeneration. Therefore cup arthroplasty is recommended at the time of stem revision (i.e., revision THA).

Section 10 THA—Miscellaneous

17 A patient who received low-molecular-weight heparin after undergoing THA 1 day ago had normal neurologic function and a hematocrit level of 32.5%. On the third postoperative day, he reports severe hip pain, is unable to dorsiflex his foot, and has a hematocrit level of 22.0%. Radiographs show the implant in good position. These developments are most likely caused by which of the following?

A Limb overlengthening
B Hematoma
C Infection
D Deep venous thrombosis
E Acute radiculopathy

ANSWER 17: **B.** Excess anticoagulation after THA can cause a tense hematoma in the hip that is large enough to compress the sciatic nerve and cause a footdrop. Treatment includes reversal of the anticoagulation regimen and immediate evacuation of the hematoma. Acute radiculopathy is less likely and presents with more pronounced radicular signs and less hip pain.

18 In acetabular exposure during a THA, the surgeon places a retractor behind the transverse acetabular ligament. Which of the following nerves can be damaged?

A Superior gluteal
B Inferior gluteal
C Femoral
D Obturator
E Ilioinguinal

ANSWER 18: **D.** The transverse acetabular ligament is located in the most inferior portion of the acetabulum and connects between the cotyloid pads. A retractor is commonly placed inferior to the transverse ligament to aid in exposure. Deep placement of the retractor can damage the obturator nerve, artery, or vein.

19 The process of thrombosis (as indicated by elevation of markers of thrombotic generation and fibrin formation) is initiated at which of the following points during THA?

A Hip dislocation
B Hip reduction
C Acetabular reaming
D Femoral head removal
E Femoral canal preparation

ANSWER 19: **E.** Preparation of the femoral canal (either cement or cementless technique) is the part of the THA procedure that is associated with thrombogenesis. Mechanical distortion of surrounding vessels is thought to play a role in the process.

20 Which of the following is the most frequent complication following primary THA?

A Infection
B Dislocation
C Metal hypersensitivity
D Component loosening
E Thromboembolic disease

ANSWER 20: **E.** The most common complication following primary THA is thromboembolic disease. Some form of approved deep venous thrombosis prophylaxis is recommended in all patients undergoing primary THA.

Section 11 THA—Joint Stability

21 Which of the following factors related to the position or type of components after THA is most likely to lead to a positive Trendelenburg sign?

A Small-diameter head
B Increased offset
C Decreased offset
D Lengthening of the leg
E Medialization of the hip center

ANSWER 21: **C.** Reduced hip offset brings the femur closer to the pelvis. A decreased hip offset increases joint reaction force and reduces the hip abductor moment. If offset is significantly diminished, the patient may walk with a gluteus medius lurch. When standing, the patient will display a positive Trendelenburg sign.

22 Failure to restore the femoral offset during routine THA may result in which of the following?

A Trochanteric bursitis
B Increased bone-to-bone impingement
C Decreased joint reaction force
D Increased component-to-component impingement
E Improved abductor moment

ANSWER 22: **B.** Reduced hip offset brings the femur closer to the pelvis. With hip flexion and rotation, the greater trochanter can impinge upon the pelvis, resulting in hip levering and instability. Trochanteric bursitis results from excess hip offset. A decreased hip offset increases joint reaction force and reduces the hip abductor moment.

23 Which of the following clinical scenarios is a contraindication for use of a constrained acetabular liner?

A Patient with a cup in 40 degrees of abduction and 25 degrees of anteversion
B Patient with a cup in 60 degrees of abduction and 10 degrees of retroversion
C Neurologic decline
D Absent abductor mechanism
E Use in combination with an acetabular reconstruction cage

ANSWER 23: **B.** Insertion of a constrained acetabular liner is used for recurrent THA dislocation when the hip abductor complex is weakened by mechanical disruption or by neurologic compromise. Component malposition is an absolute contraindication for insertion of a constrained insert. A constrained liner is often used in acetabular cage reconstruction because the abductor complex is frequently attenuated.

24 Which of the following is the rationale for using a larger-diameter femoral head in THA?

A Lower incidence of dislocation
B Lower incidence of PE component dissociation from the metal shell
C Lower manufacturing cost
D Lower rate of volumetric PE wear

E Lower rate of acetabular component loosening

ANSWER 24: **A.** A large-diameter femoral head has a higher primary arc range and higher excursion distance, and thus is more stable. Large-diameter heads are used to reduce dislocation risk. Volumetric wear is related to the square of the radius of the femoral head. Therefore volumetric wear is increased with large-diameter heads. Head diameter has no effect on the PE cup locking mechanism.

Section 12 THA—ARTICULAR Bearing Technology

25 What is the most significant disadvantage of ceramics in joint arthroplasty?

A Low wear resistance
B Low elastic modulus
C Low toughness
D Weak under compressive load
E High surface roughness

ANSWER 25: **C.** Ceramic implants for joint arthroplasty can be polished to supersmooth surfaces, which can minimize bearing wear. Ceramics have a high elastic modulus, but their Achilles' heel is their low toughness. Thus ceramic implants are prone to fracture. Ceramic heads should never be directly applied to a used Morse taper, because there is an increased risk for burst fracture. Instead, an internal metal jacket should be applied inside the ceramic head.

26 Which of the following features improves fluid film lubrication in a metal-on-metal THA?

A Smaller-diameter femoral head, a completely congruent fit between the socket and the head, and sufficient roughness to allow for some microseparation between the head and the socket
B Smaller-diameter femoral head, a slight clearance between the socket and the head, and no surface roughness
C Larger-diameter femoral head, a completely congruent fit between the socket and the head, and no surface roughness
D Larger-diameter femoral head, a slight clearance between the socket and the head, and minimal surface roughness
E Larger-diameter femoral head, a slight clearance between the socket and the head, and sufficient surface roughness to allow for some microseparation between the head and the socket

ANSWER 26: **D.** Fluid film state first requires the bearing to be in motion (bearing must have sufficient angular velocity). In the fluid film state the two surfaces are separated by the fluid film and do not touch. Larger head diameter and minimal surface roughness (i.e., superpolishing) increase the chance for fluid film state. The bearing design must allow fluid to ingress and egress with motion. Therefore there should be a slight clearance between the bearing surfaces.

27 Which of the following methods of terminal PE sterilization results in the greatest number of remaining free radicals within the PE?

A Gas plasma
B Ethylene oxide
C γ-Irradiation alone
D γ-Irradiation and annealing
E γ-Irradiation and remelting

ANSWER 27: **C.** Gas plasma and ethylene oxide sterilization do not generate free radicals. γ-Irradiation generates free radicals. Heat treatment with annealing reduces free radicals but not completely. Heat treatment with remelting eliminates almost all free radicals.

28 PE sterilization by γ-irradiation in an inert (i.e., oxygen-free packaging) environment results in which of the following?

A Oxidation on the shelf before implantation

B Oxidation that occurs only after subsurface surface damage
C No residual free radicals
D No oxidation because all free radicals have cross-linked
E In vivo oxidation after implantation

ANSWER 28: **E.** PE sterilization in an inert environment drives free radicals to cross-link. However, free radicals remain in the PE after irradiation because free radicals in the crystalline regions do not cross-link. In vivo the PE is exposed to oxygen and can oxidize. On-the-shelf oxidation will not occur if the inert package prevents oxygen diffusion into the package.

29 Use of a metal-on-metal bearing compared with the use of a metal-on-cross-linked PE bearing of the same diameter will result in which of the following?

A Smaller wear particles
B Increased volumetric wear
C Increased linear wear
D Decreased incidence of dislocation
E Lower serum metal ion concentration

ANSWER 29: **A.** A metal-on-metal bearing generates very small particles that can ionize and enter the bloodstream. These particles are much smaller than the particles generated by PE wear. Linear and volumetric wear are lower in a well-mated metal-on-metal bearing than in a metal-on-cross-linked PE. Because the head diameters are the same, range of motion and stability are the same for the two bearings.

30 Particulate wear debris from metal-on-metal articulations results in which of the following biologic responses?

A Eosinophilic granuloma formation
B Macrophage stimulation from submicron particles
C Macrophage stimulation from nanometer-sized debris
D Lymphocyte stimulation from nanometer-sized particles
E No response because metallic particles are inert

ANSWER 30: **D.** Metal-on-metal articulations generate very small particles (nanometer size) that can ionize and enter the bloodstream. Locally at the hip, metal particles are processed by the T-cell lymphocyte. In a high-wear state (e.g., poor bearing mating), the T-cell response can elicit a significant inflammatory response, resulting in osteolysis and pseudotumor formation.

31 Metal-on-metal bearings for THA or resurfacing should be avoided in which of the following clinical situations?

A A history of significant alcohol use
B A known latex sensitivity
C A history of hepatitis
D Thalassemia
E A history of renal insufficiency

ANSWER 31: **E.** Metal-on-metal articulations generate very small particles (nanometer size) that can ionize and enter the bloodstream. Systemically, the cobalt and chromium ions are mainly eliminated by renal excretion. In renal failure, the ions are not eliminated and can build up to high serum levels. In a patient with potentially declining renal function, a metal-on-metal articulation is contraindicated.

32 Stripe wear in ceramic-on-ceramic hip arthroplasty indicates which of the following problems?

A Damage to the liner at the time of its insertion into the shell
B Damage to the femoral head because of lift-off separation of the femoral head during gait
C Wear of the acetabular liner because of third-body wear
D Wear of the Morse taper portion of the femoral head because of corrosion
E Backside wear of the acetabular liner

ANSWER 32: **B.** Stripe wear on a ceramic-on-ceramic bearing is an arcuate area of roughness on the ceramic head resulting from repetitive subclinical subluxation. The ceramic head loads upon the edge of the acetabular socket. In this high-load scenario, the femoral head is roughened, creating the stripe line. Stripe wear is detected by microscopic examination.

33 Which of the following bearing-surface combinations has shown the lowest in vivo wear rates in THA?

- **A** Cobalt-chromium alloy femoral head on cobalt-chromium alloy socket
- **B** Cobalt-chromium alloy femoral head on PE socket
- **C** Titanium femoral head on PE socket
- **D** Ceramic femoral head on ceramic socket
- **E** Ceramic femoral head on PE socket

ANSWER 33: **D.** Of all the bearing couples currently available, the ceramic-on-ceramic bearing couple has the lowest wear rates clinically. A well-mated metal-on-metal bearing couple has the next best wear rate. The worst bearing couple is a titanium alloy head on a PE socket. Titanium heads are easily scratched and can exhibit significant wear.

Section 14 Knee Arthritis TREATMENT

34 Which of the following is a contraindication to using a varus-producing distal femoral osteotomy for valgus gonarthrosis?

- **A** Prior medial meniscectomy
- **B** Patellofemoral arthritis
- **C** 110 degrees of knee flexion
- **D** A 10-degree flexion contracture
- **E** Lateral tibial osteophyte formation

ANSWER 34: **A.** When performing a varus-producing distal femoral osteotomy, the medial compartment must be free of arthritis and must be healthy enough to endure the increased mechanical loads for a long duration. A medial meniscectomy increases point loading forces upon the articular cartilage, resulting in accelerated wear. This effect is exacerbated with a varus-producing knee osteotomy.

35 A unicompartment knee arthroplasty is contraindicated in which of the following clinical scenarios?

- **A** Anteromedial osteoarthritis
- **B** Lateral compartment osteoarthritis
- **C** A clinically correctable varus deformity
- **D** Advanced age
- **E** Inflammatory arthritis

ANSWER 35: **E.** A unicompartment knee arthroplasty is most often used for medial compartment disease but can be used in the lateral compartment in select cases. For either compartment, the deformity must be correctable to normal alignment on clinical examination. Inflammatory arthritis is a contraindication, because this disease process continues to cause debility in the other compartments.

36 Which of the following findings is considered a contraindication to a mobile-bearing unicompartmental knee arthroplasty?

- **A** A range of flexion of 105 degrees
- **B** A flexion deformity of 10 degrees
- **C** A correctable varus deformity of 5 degrees
- **D** Absence of the anterior cruciate ligament (ACL)
- **E** Osteophytes in the patellofemoral compartment

ANSWER 36: **D.** A mobile-bearing unicompartment knee arthroplasty is more prone to bearing complications when the ACL is deficient. An absent ACL causes dyskinetic sagittal plane sliding. Because

the PE bearing is not fixed to the tibia or femur, it is affected significantly by an absent ACL. Patellofemoral arthrosis is not a contraindication if the patient does not experience clinical pain in this area.

Section 15 total knee arthroplasty

37 During a posterior cruciate ligament (PCL)-sacrificing total knee arthroplasty (TKA) with anterior referencing, 8 mm of distal femur is resected. It is noted that the flexion gap is tight and the extension gap appears stable. Which of the following is the most appropriate next step in management?

A Cut more proximal tibia.
B Cut more distal femur.
C Recess the PCL.
D Decrease the size of the femoral component.
E Decrease the tibial PE insert thickness.

ANSWER 37: **D.** Following McPherson's rule, this problem involves an asymmetric gap. Therefore look first to adjusting the femur. Removing distal femur affects the extension gap. Decreasing the femoral component size increases the flexion gap and resolves the imbalance. When using a posterior stabilized knee system, the PCL is already sacrificed as part of the surgical technique.

38 After a standard primary TKA, the tourniquet is deflated, and the patella shows lateral maltracking. A lateral retinacular release is performed. Pulsatile bleeding is encountered. The arterial source most likely is from which of the following?

A Inferior lateral genicular
B Anterior recurrent tibial
C Superior lateral genicular
D Superior medial genicular
E Inferior medial genicular

ANSWER 38: **C.** The superior lateral genicular artery is the peripatellar arterial branch most likely to be cut during a lateral retinacular release. The incidence of patellar osteonecrosis increases when this arterial branch is transected in conjunction with a medial arthrotomy.

39 A primary cruciate TKA is stable with a 10-mm trial in flexion yet lacks 10 degrees of extension. Which of the following is the most appropriate treatment?

A Increase the tibial slope.
B Recess the PCL from the femur.
C Augment the tibia.
D Perform a posterior capsular release.
E Augment both the tibia and the distal femur.

ANSWER 39: **D.** Following McPherson's rule, this problem involves an asymmetrical gap. Therefore look first to adjusting the femur. Recessing the PCL affects the flexion gap. Releasing the posterior capsule will allow the knee to achieve full extension. The posterior release should be performed with the knee in flexion, because the popliteal artery is more posterior from the knee joint in flexion

40 A patient undergoing primary TKA with a valgus knee remains tight laterally in full extension and is stable in flexion. Release of which of the following structures will help balance the joint?

A Illiotibial band
B Popliteus
C Posterior lateral capsule
D PCL
E Lateral collateral ligament

ANSWER 40: **A.** In a valgus knee deformity, the concave side is the lateral side. This is the side where releases are needed. In extension, the iliotibial band becomes taut, and it is the structure to be released first. The popliteus becomes taut in flexion. The lateral collateral ligament affects both flexion and extension.

The PCL and posterior capsule are involved in sagittal plane balance.

41 Which of the following surgical techniques will improve a flexion-extension mismatch in a revision TKA when the knee is stable in extension and loose in flexion?

- **A** Remove additional tibial bone.
- **B** Insert a full-block tibial augment.
- **C** Use distal femoral augmentation.
- **D** Downsize the femoral component.
- **E** Upsize the femoral component, and add posterior femoral augmentation.

ANSWER 41: **E.** Following McPherson's rule, this problem involves an asymmetric gap. Therefore look first to adjust the femur. Distal femoral augmentation affects the extension gap. Downsizing the femoral component increases the flexion gap and makes the problem worse. Upsizing the femoral component reduces the flexion gap and resolves the imbalance

42 A TKA is performed with the use of an indwelling femoral nerve catheter for postoperative pain control. In the recovery room, the patient is unable to dorsiflex the toes or ankle. Treatment should consist of which of the following?

- **A** Remove compressive dressings, and flex the knee.
- **B** Stop anesthetic infusion into the femoral nerve catheter, and reexamine the patient in 1 hour.
- **C** Observe and repeat neurovascular examination in 1 hour.
- **D** Return to the operating room for peroneal nerve exploration.
- **E** Apply an ankle-foot orthosis.

ANSWER 42: **A.** In this case, the patient has a peroneal nerve palsy. A femoral nerve block does not affect peroneal nerve function. The first treatment for postoperative peroneal nerve palsy is to remove the compressive dressings and flex the knee. A peroneal nerve exploration is performed later (usually 3 months) if the nerve palsy has not resolved and electromyogram/nerve conduction velocity studies show nerve compression at the knee.

43 During primary TKA, which of the following is the maximum distance the joint line can be raised or lowered before poor motion, joint instability, and increased chance of revision occur?

- **A** 4 mm
- **B** 8 mm
- **C** 12 mm
- **D** 16 mm
- **E** 20 mm

ANSWER 43: **B.** Alteration of the joint prosthetic joint line by more than 8 mm can adversely affect joint function. The rotational axis of the knee requires alignment of the collateral ligaments with a restored joint line. Significant alteration of the joint line creates kinematic conflict with collateral ligament function.

44 A patient who underwent a posterior stabilized total knee arthroplasty 2 years ago has a range of motion of 0 to 60 degrees. The implants are well fixed, and the knee is well aligned on anteroposterior radiographs. Lateral radiographs show that the femoral component is appropriately sized and the tibial component is in 5 degrees of anterior tilt. Treatment should consist of which of the following?

- **A** Revision of the femoral component
- **B** Revision of the tibial component
- **C** Closed knee manipulation under anesthesia
- **D** Open quadricepsplasty
- **E** Open lysis of adhesions with insertion of a thinner tibial PE insert

ANSWER 44: **B.** The first rule in revision TKA is to revise any implant component that is loose or malpositioned. Therefore the tibial component with an anterior slope should be revised first. An anterior tibial slope limits flexion. If after tibial component revision, the knee is still tight in flexion, then downsizing of the femoral component would be the next best step.

45 In TKA, which of the following deformities is more likely to cause a peroneal nerve palsy?

- **A** Valgus deformity
- **B** Valgus thrust deformity
- **C** Valgus-flexion deformity
- **D** Varus-flexion deformity
- **E** Flexion contracture of 20 degrees

ANSWER 45: **C.** Correction of a combined valgus deformity with a flexion contracture is the deformity most likely to develop a peroneal nerve palsy. The mechanism of the palsy is nerve entrapment by tight fascial structures over the nerve at the knee. If the nerve palsy does not resolve within the TKA recovery period, peroneal nerve decompression at the knee is advocated.

Section 16 TKA Design

46 Which of the following is considered the preferred total knee design for a patient with a history of a patellectomy who on clinical examination has no clinical lag?

- **A** PCL retaining
- **B** PCL substituting
- **C** Rotating hinge
- **D** Constrained high post
- **E** Unicondylar

ANSWER 46: **B.** A cruciate-retaining TKA is less likely to resist anterior femoral translation in a knee with a patellectomy. This can lead to anterior femoral subluxation in flexion. The cam and post design of a PCL-substituting TKA will limit anterior femoral translation. Rotating hinge and constrained high-post designs will also work but are too constrained to be used just for a patellectomy condition.

47 Compared to a nonconstrained posterior stabilized prosthesis, a constrained high-post TKA restricts what type of movement?

- **A** Varus/valgus
- **B** Varus/valgus and rotational
- **C** Varus/valgus, rotational, and anteroposterior
- **D** Rotational and anteroposterior
- **E** Rotational

ANSWER 47: **B.** A constrained high-post TKA is used to accommodate for knee ligament attenuation/deficiency of the medial collateral ligament or lateral collateral ligament. A constrained high-post TKA limits varus/valgus movement and significantly limits rotation. When using a constrained high-post TKA, medullary stems are recommended. Stem support helps to distribute the increased varus/valgus and rotational forces to host bone.

48 Osteolysis after TKA can be minimized through prosthetic design features such as which of the following?

- **A** Modular PE inserts
- **B** Use of tibial posts on the tibial insert
- **C** Monolithic metal-backed tibial components
- **D** Metal-backed patellar components
- **E** Using ram bar extruded PE that is machined

ANSWER 48: **C.** Modularity allows backside wear and increases PE debris formation. A monolithic metal-backed tibial component is manufactured as a solid unit and does not allow backside wear to occur. A tibial post is an additional surface that is subject to PE wear. A metal-backed PE patella significantly reduces PE thickness and increases risk for PE wear. Direct compression molding provides better wear than ram bar extruded PE.

Section 18 Patellar Tracking in TKA

49 During primary TKA the anteroposterior axis of the distal femur (vertical line) and epicondylar axis (horizontal line) are drawn on the femur for referencing for femoral component rotation. How is the epicondylar axis oriented in relationship to the posterior condylar line (line between the most posterior aspect of the posterior femoral condyles)?

- **A** Parallel
- **B** Approximately 3 degrees internally rotated
- **C** Approximately 3 degrees externally rotated
- **D** Approximately 6 degrees internally rotated
- **E** Approximately 6 degrees externally rotated

ANSWER 49: **C.** To create a rectangular flexion gap, the femur should be externally rotated 3 degrees relative to the posterior condylar line. This 3-degree external rotation line is parallel to the epicondylar axis and is parallel to the line that is perpendicular to the anteroposterior axis. All are used as check references to ensure proper femoral component rotation. Internal rotation of the femoral component is to be avoided.

50 Which of the following factors minimizes patellar maltracking in TKA?

- **A** Medialization of the femoral component
- **B** Medialization of the patellar component
- **C** Internal rotation of the femoral component
- **D** Internal rotation of the tibial component
- **E** Joint line elevation

ANSWER 50: **B.** Medialization of the patellar component results in a net decrease in Q angle and helps patellar tracking. Femoral component medialization and internal rotation of the tibial component both increase net Q angle and adversely affect patellar tracking. Internal rotation of the femoral component results in an asymmetric flexion gap and creates a net lateral tilt of the patella. Joint line elevation can result in baja impingement with pain.

51 In the normal knee, which of the following is the average orientation of the joint line relative to the mechanical axis of the limb?

- **A** Perpendicular
- **B** 3 degrees of varus
- **C** 3 degrees of valgus
- **D** 5 to 7 degrees of valgus
- **E** 5 to 7 degrees of varus

ANSWER 51: **B.** In the normal knee, the average orientation of the proximal tibia is 3 degrees of varus relative to the tibial mechanical axis. When performing a TKA, the tibia is cut perpendicular to the mechanical axis. Thus, to maintain a rectangular flexion gap (i.e.. balanced gap), the femoral component must be externally rotated 3 degrees.

52 Following TKA with resurfacing of the patella, a patient has lateral subluxation of the patella. Which of the following issues with the components is a cause of this complication?

- **A** Lateral placement of the tibial tray
- **B** Reduced composite thickness of the patella
- **C** External rotation of the femoral component
- **D** Internal rotation of the femoral component
- **E** External rotation of the tibial component

ANSWER 52: **D.** Internal rotation of the femoral component creates an asymmetric flexion gap and adversely affects patellar tracking. External rotation and lateral placement of the tibial component will improve net Q angle, which helps patellar tracking. A reduced patellar composite thickness decreases retinacular tension, which also helps with patellar tracking.

Section 19 Catastrophic Wear in TKA

53 When performing a TKA using modular components, which of the following is the minimum recommended thickness of an UHMWPE insert for a tibial component?

A 3 to 5 mm
B 6 to 8 mm
C 10 to 12 mm
D 13 to 15 mm
E Greater than 15 mm

ANSWER 53: **B.** To keep TKA bearing contact stress below the yield strength of UHMWPE (12 to 20 mPA), the thickness of the UHMWPE insert should be between 6 and 8 mm. By keeping the thickness of the PE insert in this range, the chance of catastrophic wear is reduced.

Section 20 Shoulder Arthroplasty

54 Which of the following is a contraindication to performing a reverse total shoulder arthroplasty (TSA)?

A Nonfunctional rotator cuff
B Deltoid denervation
C Proximal humerus bone loss
D Failed prior hemiarthroplasty
E Anterior superior glenohumeral instability

ANSWER 54: **B.** A reverse TSA requires a functional deltoid muscle. Paresis of the deltoid is an absolute contraindication. A reverse TSA is designed to function without a rotator cuff, even in the extreme case of anterior superior subluxation where the coracoacromial arch has been disrupted. Bone loss can be accommodated with revision-style implants.

55 Which of the following findings is an absolute contraindication for placement of a standard TSA?

A Asymmetric posterior glenoid wear
B Inflammatory arthritis
C Central glenoid wear
D Irreparable supraspinatus tear
E Loose previously placed glenoid component

ANSWER 55: **D.** A standard (i.e., not reverse) TSA requires both a functioning rotator cuff and deltoid muscle. Loss of the supraspinatus tendon results in superior migration of the prosthetic humeral head against the acromion. This places excess stress upon the superior glenoid component, resulting in early glenoid failure. In a rotator cuff–deficient shoulder, a standard TSA is contraindicated.

56 A 60-year-old man who underwent a standard (i.e., not reverse) TSA on the right side 12 weeks ago now reports that he is unable to tuck his shirt behind his back using the right hand. Examination reveals weakness with a belly-press test on the right side. What is the most likely diagnosis?

A Excessive glenoid retroversion
B Excessive humeral head retroversion
C Inadequate postoperative therapy
D Subscapularis insufficiency
E Axillary nerve injury with deltoid dysfunction

ANSWER 56: **D.** Subscapularis rupture (i.e., pull-off) from the humerus is the most common complication encountered after standard TSA. It generally results from aggressive physical therapy with passive external rotation stretching. Loss of the attachment causes weakness in shoulder internal rotation (positive belly-press test). Treatment is surgical repair of the detached tendon and anterior capsule.

Section 21 Periprosthetic Joint Infection

57 In synovial fluid analysis before revision TKA, what is the minimum threshold for white blood cell (WBC) count that is considered strongly indicative of infection?

- **A** 100 cells/μL
- **B** 500 cells/μL
- **C** 2500 cells/μL
- **D** 10,000 cells/μL
- **E** 25,000 cells/μL

ANSWER 57: **C.** In evaluation of a painful hip or knee arthroplasty before revision surgery, an aspiration for infection is recommended. The minimum WBC count that would be suspicious for infection is 2500 cells/μL. Additional tests should include aspiration cultures, a serum quantitative C-reactive protein determination, and Westergran sedimentation rate.

58 In the second-stage reimplantation for an infected TKA, a medial gastrocnemius flap rotation is planned to cover an attenuated anteromedial soft tissue envelope. Which of the following arteries provides the vascular pedicle for a medial gastrocnemius rotational flap?

- **A** Femoral
- **B** Medial sural
- **C** Posterior tibial
- **D** Peroneal
- **E** Superior genicular

ANSWER 58: **B.** The medial sural artery is the main arterial supply for the medial gastrocnemius flap. The lateral sural artery is the main arterial supply for the lateral gastrocnemius flap. During muscle flap rotation, all fascial structures around the vascular pedicle must be released to prevent the medial sural artery from being compressed.

59 A 70-year-old woman with rheumatoid arthritis underwent primary TKA 3 months ago. She presents with pain, swelling, warmth, and limited knee range. Aspiration of the joint reveals methicillin-sensitive Staphylococcus aureus. Which of the following is the most appropriate next step in management?

- **A** Surgical débridement, modular bearing change, followed by 6 weeks of intravenous antibiotics
- **B** Surgical débridement and direct exchange arthroplasty
- **C** Two-stage exchange reimplantation
- **D** Immediate knee arthrodesis
- **E** Amputation

ANSWER 59: **C.** A prosthetic joint infection of greater than 3 weeks' duration is considered a chronic infection. The implant is covered with a bacterial biofilm. The only way to eradicate the biofilm is to remove the prosthetic implants and radically débride the knee. A two-stage reimplantation is the best option to maintain function. A single-stage exchange is not indicated in immune-compromised hosts.

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chapter 6 Review Questions

Section 1 Biomechanics of the Foot and Ankle

1 Dysfunction of the posterior tibial tendon compromises heel rise secondary to failure of which of the following?

A Eversion of the hindfoot that unlocks the transverse tarsal joints
B Inversion of the hindfoot that unlocks the transverse tarsal joints
C Eversion of the hindfoot that locks the transverse tarsal joints
D Inversion of the hindfoot that locks the transverse tarsal joints

ANSWER 1: **D.**

2 Which of the following is the primary stabilizer of the longitudinal arch?

A Plantar fascia
B Intrinsic musculature
C Bony architecture of the midfoot (Roman arch)
D Interosseous ligaments
E Dorsal ligament

ANSWER 2: **D.**

Section 2 Physical Examination of the Foot and Ankle

3 Plantar flexion of the first ray will create which of the following deformities?

A Pes planus
B Skewfoot
C Cavovarus
D Equinovarus
E Equinovalgus

ANSWER 3: **C.**

4 The most appropriate next surgical treatment for a 5-degree plantar flexion contracture of the ankle that resolves with knee flexion is which of the following?

A Ankle fusion
B Posterior tibial tendon transfer to the dorsum
C Achilles lengthening
D Gastrocnemius recession
E Split anterior tibial tendon transfer

ANSWER 4: **D.**

Section 3 Radiographic Evaluation of the Foot and Ankle

5 The stress radiograph (Figure Q6-1) demonstrates incompetence of which ankle ligament?

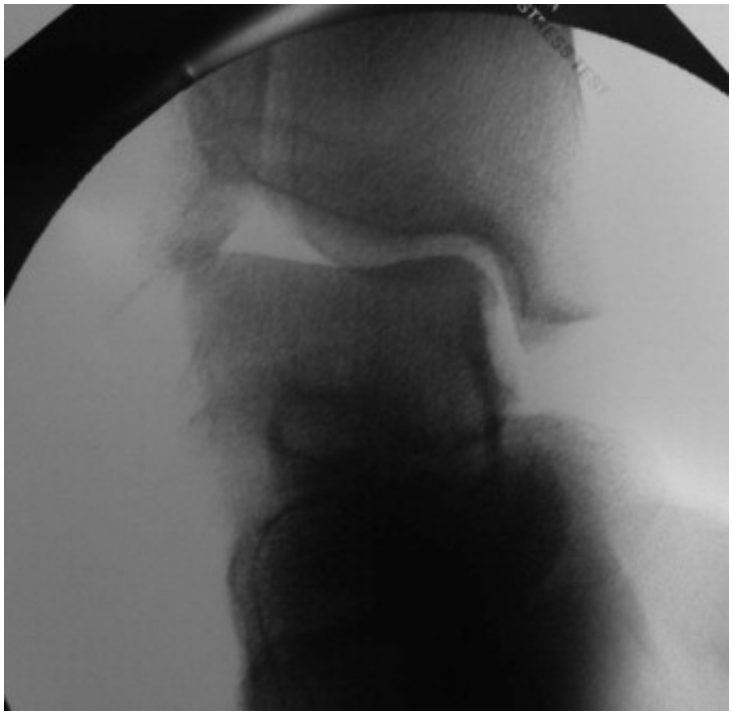

Figure Q6-1 Stress radiograph.

- **A** Anterior inferior tibiofibular ligament
- **B** Anterior talofibular ligament
- **C** Posterior talofibular ligament
- **D** Posterior tibiofibular ligament
- **E** Calcaneofibular ligament

ANSWER 5: **E.**

Section 4 Adult Hallux Valgus

6 A 35-year-old patient with a history of cerebral palsy that is active and ambulatory presents with complaints of hallux valgus deformity. Hallux valgus angle is 25 degrees with an intermetatarsal angle of 12 degrees. The patient used orthotics and wide–toe box shoes without relief. The most appropriate surgical management is which of the following?

- **A** Distal metatarsal osteotomy with soft tissue release
- **B** Proximal metatarsal osteotomy with distal soft tissue release
- **C** First metatarsophalangeal arthrodesis
- **D** First tarsometatarsal realignment arthrodesis with a distal soft tissue release (Lapidus procedure)
- **E** Distal metatarsal osteotomy with a medial closed-wedge phalangeal osteotomy (Akin) and distal soft tissue release

ANSWER 6: **C.**

7 The most appropriate surgical management of a patient with hallux valgus that presents with a hallux valgus angle of 35 degrees, intermetatarsal angle of 16 degrees, and a distal metatarsal articular angle of 15 degrees is which of the following?

- **A** Distal metatarsal osteotomy with distal soft tissue release
- **B** First metatarsophalangeal arthrodesis

C Proximal metatarsal osteotomy and proximal phalanx medial closed-wedge osteotomy with distal soft tissue release

D Proximal metatarsal osteotomy and distal medial closed-wedge metatarsal osteotomy with distal soft tissue release

E First tarsometatarsal realignment arthrodesis with a distal soft tissue release (Lapidus procedure)

ANSWER 7: **D.**

8 The risk of hallux varus following correction of hallux valgus is NOT increased by which of the following?

A Excessive release of the intersesamoid ligament

B Resection of the fibular sesamoid

C Excessive lateral release

D Overresection of the medial eminence

E Overcorrection of the intermetatarsal angle

ANSWER 8: **A.**

Section 5 Juvenile and Adolescent Hallux Valgus

9 The most common complication following correction of juvenile hallux valgus is which of the following?

A Hallux varus

B Recurrent hallux valgus

C First metatarsophalangeal (MTP) degenerative disease

D Avascular necrosis

E Physeal arrest

ANSWER 9: **B.**

Section 6 Hallux Varus

10 Figure Q6-2, A (preoperative) and B (postoperative) demonstrate a patient who underwent a prior correction of a hallux valgus deformity who is dissatisfied because of the shoe-wear difficulty. Examination reveals a fixed deformity that is not passively correctible without pain within the first MTP joint. She has attempted the use of wide–toe box shoes without relief. The next most appropriate step is which of the following?

Figure Q6-2 Hallux varus **(A)** preoperative and **(B)** postoperative.

A Ankle-foot orthosis
B Split extensor hallucis longus tendon transfer deep to the intermetatarsal ligament to the metatarsal neck
C Extensor hallucis brevis tendon transfer deep to the intermetatarsal ligament to the metatarsal neck
D First MTP arthrodesis
E Distal metatarsal osteotomy with lateral capsular plication

ANSWER 10: **D.**

Section 7 Lesser-Toe Deformities

11 Plantar translation of the metatarsal head during a distal metatarsal osteotomy results in which of the following complications?

A Claw toe
B Hammer toe
C Mallet toe
D Crossover toe
E Floating toe

ANSWER 11: **E.**

12 Correction of a flexible claw-toe deformity is best treated with which of the following?

A Extensor lengthening with a proximal interphalangeal (PIP) arthroplasty

B Flexor tenotomy and pinning of the MTP joint
C MTP capsulotomy, extensor lengthening, and PIP arthrodesis
D Flexor-to-extensor tendon transfer with extensor lengthening
E Distal metatarsal osteotomy

ANSWER 12: **D.**

13 The most reliable operative treatment for the deformity shown in Figure 6-49 is which of the following?
A Dorsal closed-wedge osteotomy of the metatarsal head
B Arthrodesis of the MTP joint
C Excision of the distal metatarsal head
D Oblique distal metatarsal osteotomy (Weil)
E Shortening diaphyseal osteotomy of the metatarsal

ANSWER 13: **A.**

Section 8 Hyperkeratotic Pathologies

14 After failure of conservative management, surgical treatment of a discrete intractable plantar keratosis of the second metatarsal should consist of which of the following?
A Distal metatarsal osteotomy (Weil)
B Shortening diaphyseal osteotomy
C Fibular metatarsal plantar condylectomy
D Tibial metatarsal plantar condylectomy
E Excision of the distal metatarsal head

ANSWER 14: **C.**

15 The most reliable surgical treatment of the fifth metatarsal deformity demonstrated in Figure 6-57 is which of the following?
A Fifth metatarsal head condylectomy
B Distal fifth metatarsal osteotomy
C Diaphyseal fifth metatarsal osteotomy
D Proximal fifth metatarsal osteotomy
E Excision of the fifth metatarsal head

ANSWER 15: **B.**

Section 9 Sesamoids

16 Excision of both tibial and fibular sesamoid results in which of the following deformities?
A Clawed hallux
B Hallux varus
C Hallux valgus
D Hallux rigidus
E Hallux elevates

ANSWER 16: **A.**

17 A 19-year-old woman who recently started training for a marathon is complaining of plantar forefoot pain. On physical examination she has significant tenderness to direct palpation of the fibular sesamoid and mild pain with passive dorsiflexion of the first MTP joint. The most appropriate initial treatment is which of the following?
A Fibular sesamoidectomy

B Activity modification and boot immobilization
C Observation
D Magnetic resonance imaging (MRI) with contrast
E Corticosteroid injection into first MTP joint

ANSWER 17: **B.**

Section 10 Accessory Bones

18 Fracture of the os trigonum would most likely cause which of the following symptoms?
A Pain with resisted eversion of the ankle
B Pain with resisted ankle dorsiflexion
C Pain with resisted plantar flexion of the hallux
D Pain with palpation of the base of the fifth metatarsal
E Pain with resisted inversion of the plantar-flexed ankle

ANSWER 18: **C.**

Section 11 Neurologic Disorders

19 A 71-year-old woman suffered a stroke 2 years ago. Despite physical therapy and bracing with an ankle-foot orthosis, she developed a spastic equinovarus deformity that significantly limits her ability to ambulate. The most appropriate next step in management for long-term functional improvement is which of the following?
A Botulinum toxin injections
B Gastrocnemius recession
C Open tendo-Achilles Z-lengthening
D Percutaneous tendo-Achilles lengthening and split anterior tibialis tendon transfer to midfoot
E Tibialis posterior transfer to midfoot through interosseous membrane

ANSWER 19: **D.**

20 A patient with Charcot-Marie-Tooth disease has excellent correction of hindfoot varus after Coleman block testing. The most likely cause of the patient's foot deformity is which of the following?
A Relative unopposed pull of the peroneus longus over the tibialis anterior
B Relative unopposed pull of the peroneus brevis over the tibialis anterior
C Relative unopposed pull of the peroneus longus over the tibialis posterior
D Relative unopposed pull of the peroneus brevis over the intrinsic muscles
E Relative unopposed pull of the tibialis posterior over the gastrocnemius-soleus complex

ANSWER 20: **A.**

Section 12 Arthritic Disease

21 A 50-year-old man who sustained a calcaneus fracture 2 years ago treated in a cast is currently complaining of lateral hindfoot pain, stiffness, and difficulty with walking on uneven surfaces. He also complains of anterior ankle pain and has tenderness to palpation in the sinus tarsi and anterior ankle joint line. He has failed conservative treatment of bracing and injections. Radiographs show significant flattening of the Böhler angle. The most appropriate surgical treatment is which of the following?
A Lateral wall exostectomy
B Bone-block distraction subtalar arthrodesis
C In situ subtalar arthrodesis

D Anterior distal tibia and dorsal talus exostectomy
E Lateral wall, anterior distal tibia, and dorsal talus exostectomy

ANSWER 21: **B.**

22 A 62-year-old retired man presents with worsening stiffness and pain with activity at the first MTP joint. Examination reveals pain throughout range of motion of the first MTP joint. Radiographs are shown in Figure 6-81. What is the most appropriate surgical treatment?
A Keller arthroplasty
B Dorsal cheilectomy
C Interpositional arthroplasty with synthetic graft
D Hemiarthroplasty with implant
E First MTP arthrodesis

ANSWER 22: **E.**

23 A 67-year-old woman had the procedure shown in Figure 6-87 performed 25 years ago secondary to post-traumatic arthritis from a pilon fracture. She is now complaining of significant midfoot and hindfoot pain with any excessive activity. What is the most likely explanation for this patient's symptoms?
A Nonunion
B Retained hardware
C Limb length inequality
D Adjacent joint arthritis
E Inappropriate position of the ankle joint at time of previous surgery

ANSWER 23: **D.**

Section 13 Postural Disorders

24 A 59-year-old patient who developed a significant flatfoot deformity that was refractory to conservative treatment underwent surgery to correct the deformity. One component of the surgery was a lateral column lengthening through the anterior process of the calcaneus, as shown in Figure 6-91. This component of the procedure corrected which aspect of the deformity?
A Hindfoot valgus
B Forefoot abduction
C Equinus contracture
D Inversion weakness
E Forefoot supination

ANSWER 24: **B.**

25 The most appropriate orthotic to accommodate for a pes cavovarus foot deformity is which of the following?
A Lateral heel wedge, depressed first ray
B Medial heel wedge, depressed first ray
C Medial heel wedge, longitudinal arch support
D Lateral heel wedge with rigid Morton extension
E University of California—Berkeley Laboratory (UCBL) orthosis

ANSWER 25: **A.**

Section 14 Tendon Disorders

26 A 22-year-old soccer player sustains an injury while sliding into another player in which his ankle was forced into dorsiflexion and eversion. After an appropriate course of bracing and physical therapy, he continues to

complain of posterolateral ankle pain, with occasional snapping sensation. Which structure was most likely injured?

A Calcaneofibular ligament
B Anterior talofibular ligament
C Superior peroneal retinaculum
D Inferior peroneal retinaculum
E Anterior inferior tibiofibular ligament

ANSWER 26: **C.**

27 For the same patient described in question 26, what is the most appropriate surgical management?

A Modified Brostrom-Gould lateral ankle ligament reconstruction
B Peroneal tendon synovectomy, superior peroneal retinaculum repair, and fibular groove deepening
C Percutaneous screw fixation of the syndesmosis
D Ankle arthroscopy and peroneus longus tendon repair
E Surgical intervention is not indicated.

ANSWER 27: **B.**

Section 15 Heel Pain

28 A 40-year-old woman presents with a 6- week history of plantar medial heel pain that is worse with first step down in the morning and after standing from a seated position. She has tried intermittent nonsteroidal anti-inflammatory drugs (NSAIDs) without relief. Which of the following is the most appropriate initial treatment strategy?

A Corticosteroid injection
B Physical therapy focusing on eccentric strengthening of the Achilles
C Low-energy extracorporeal shock wave therapy
D Gel heel inserts and daily Achilles and plantar fascia–specific stretching exercises
E Custom orthotics

ANSWER 28: **D.**

29 A 55-year-old software engineer presents with persistent posterior heel burning and pain related to activity, despite the use of backless shoes. He has failed physical therapy. Which of the following is the most appropriate next step in management?

A Corticosteroid injection
B Endoscopic retrocalcaneal decompression of the prominent Haglund deformity
C Gastrocnemius recession
D Resection of Haglund deformity, Achilles tendon débridement and reattachment, and flexor hallucis longus transfer
E Percutaneous longitudinal tenotomies of the distal Achilles

ANSWER 29: **D.**

Section 16 the Diabetic Foot

30 Which one of the following is NOT predictive of poor wound healing in a patient with a diabetic ulcer?

A Ankle-brachial index (ABI) of 0.65
B ABI of 1.30
C Absolute toe pressure 25 mm Hg
D Transcutaneous oxygen pressure of 30 mm Hg

E Albumin level 1.5

ANSWER 30: **A.**

31 A 47-year-old patient with poorly controlled diabetes reports a 4-week history of worsening foot and ankle swelling and redness that is worst at the end of the day but appears improved when he first wakes up in the morning. His primary care physician placed him on a 10-day course of oral antibiotics with no improvement. Which of the following is the most appropriate next step in management?

A Admission to the hospital, course of intravenous antibiotics
B MRI
C Ankle joint aspiration
D Urgent incision and drainage
E Radiographs and total-contact cast application

ANSWER 31: **E.**

Section 17 Trauma

32 A 20-year-old male sustains a closed right ankle injury in all-terrain vehicle accident. He presents to the emergency department with significant swelling and deformity and is neurovascularly intact. Upon orthopaedic evaluation in the emergency department, he has persistent deformity despite attempts at reduction and has developed plantar foot numbness. Radiographs are shown in Figure 6-124, C. Which of the following is the most appropriate next step in management?

A Conscious sedation and urgent closed reduction attempt in the emergency department
B Spanning ankle external fixation
C Open reduction with internal fixation through medial approach
D Open reduction with internal fixation through dual medial and lateral approach
E Computed tomography (CT) scan and admission for neurovascular checks

ANSWER 32: **D.**

33 Prognosis following displaced Lisfranc fracture-dislocations is best predicted by which of the following?

A Amount of displacement
B Time to surgical intervention
C Articular involvement
D Fixation with transarticular screws
E Anatomic reduction

ANSWER 33: **E.**

34 Which one of the following is NOT a goal of open reduction with internal fixation of calcaneus fractures?

A Restoration of calcaneal height
B Decreasing calcaneal width
C Restoring heel varus
D Posterior facet articular reduction
E Relocation of peroneal tendon dislocation

ANSWER 34: **C.**

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chapter 7 Review Questions

I Anatomy

1 Which of the following is not included in the contents of the carpal tunnel?
- **A** Flexor pollicis longus tendon
- **B** Flexor digitorum superficialis tendons
- **C** Flexor digitorum profundus tendons
- **D** Median nerve
- **E** Flexor carpi radialis tendon

ANSWER 1: **E**

2 Which of the following extensor mechanism structures links digital DIP and PIP extension?
- **A** Sagittal band
- **B** Central slip
- **C** Oblique retinacular ligament
- **D** Transverse retinacular ligament
- **E** Lateral band

ANSWER 2: **C**

3 Clinical findings in a patient with intrinsic tightness would include which of the following?
- **A** Increased DIP flexion when MCP joints are held in extension
- **B** Increased PIP flexion when MCP joints are held in extension
- **C** Decreased PIP flexion when MCP joints are held in extension
- **D** Decreased DIP flexion when PIP joints are held in flexion
- **E** Increased MCP flexion when the wrist is held in extension

ANSWER 3: **C**

II Distal Radius Fractures

4 A 35-year-old male sustains a comminuted distal radius fracture. A closed reduction is performed, and he is placed in a splint. Before leaving the emergency room, he complains of severe pain and paresthesias in the ipsilateral hand and digits that is uncontrolled by pain medication. What is the most appropriate next step in treatment?
- **A** Immediately remove the splint and admit him for observation overnight
- **B** Loosen the splint and ask him to return to the clinic in 2 days for a repeat clinical examination
- **C** Keep the splint in place and discharge him to home with instructions to elevate and ice his upper extremity
- **D** Take him to the operating room for an emergent carpal tunnel release
- **E** Increase his pain medication regimen

ANSWER 4: **D**

5 A female patient sustains a distal radius fracture while skiing. After evaluation and closed reduction, the

orthopedist decides to proceed with non-operative management. After a period of immobilization, what should the patient be advised regarding therapy for her wrist?

A To return to her pre-injury functional status, she must begin therapy immediately
B She may perform home exercises on her own because these are shown to be more beneficial than formal therapy
C There is no need for her to perform therapy or home exercises, because neither modality has any proven benefit in regaining wrist motion after injury
D There is no functional difference in outcomes between home exercises or formal therapy
E A trial of formal therapy followed by home exercises is proven to be superior to home exercises alone

ANSWER 5: **D**

6 What is the most common tendon rupture after fixation of a distal radius fracture with a volar locked plate?

A Extensor pollicis longus
B Extensor carpi radialis brevis
C Flexor carpi radialis
D Flexor pollicis longus
E Brachioradialis

ANSWER 6: **D**

III Carpal Fractures and Instability

7 What is the most common mechanism of injury for fractures of the scaphoid?

A Forced wrist hyperextension and radial deviation
B Forced wrist flexion with radial deviation
C Forced wrist hyperextension and ulnar deviation
D Axial load on a flexed wrist
E Isolated forced radial deviation

ANSWER 7: **A**

8 Which of the following has the highest sensitivity in detecting an occult scaphoid fracture?

A Physical examination
B Computed tomography scan
C Clenched fist radiographs, performed 4 weeks apart
D Bone scan
E Magnetic resonance imaging

ANSWER 8: **E**

9 Why is the volar approach commonly utilized for fixation of scaphoid fractures?

A The volar approach is technically easier for most surgeons
B Compared with a dorsal approach, the cosmetic deformity is improved with the volar approach
C Patients have less postoperative wrist pain
D The volar approach potentially avoids vascular disruption to the scaphoid

ANSWER 9: **D**

10 A collegiate field hockey player presents to your clinic with persistent pain over the ulnar side of his palm after an injury during a recent game. In addition to standard radiographs of his hand and wrist, which view(s) should be requested to evaluate a potential cause of his pain?

A Clenched fist view
B Carpal tunnel view

C Dynamic views of radial and ulnar deviation of the wrist

D Pronated wrist view
E Single digital view of the small finger

ANSWER 10: **B**

11 What approximate percentage of perilunate dislocations are missed during initial emergency room evaluations?
A 10%
B 25%
C 50%
D 100%
E 0%

ANSWER 11: **B**

IV Metacarpal and Phalangeal Injuries

12 Which of the following best describes the “intrinsic-plus” position of the hand?
A Wrist in neutral, MCP joints in flexion, IP joints in flexion
B Wrist in flexion, MCP joints in extension, IP joints in flexion
C Wrist in extension, MCP joints in extension, IP joints in flexion
D Wrist in extension, MCP joints in flexion, IP joints in neutral
E Wrist in flexion, MCP joints in flexion, IP joints in neutral

ANSWER 12: **D**

13 After injury to the thumb MCP joint ulnar collateral ligament, what is the significance of a Stener lesion?
A Represents a boney avulsion that will likely necessitate pin fixation for stability
B Represents displacement of the torn ulnar collateral ligament superficial to adductor aponeurosis, which can prevent proper ligament healing back to the insertion site and will likely necessitate surgical intervention
C Represents an area of a chronic nonunion that will likely necessitate open reduction and screw fixation
D Represents an incidental radiographic finding that has no clinical relevance
E Represents avulsion of the radial collateral ligament and indicates a grossly unstable thumb MCP joint

ANSWER 13: **B**

14 A 22-year-old football players sustains a Bennett's fracture at the base of his thumb. Which muscle provides the predominant deforming force?
A Abductor pollicis longus
B Opponens pollicis longus
C Extensor digitorum communis
D Abductor pollicis brevis
E Adductor pollicis

ANSWER 14: **A**

V Tendon Injuries and Overuse Syndromes

15 Simultaneous core and epitendinous suture repair within 7 to 10 days of injury is the standard of care for

flexor tendon lacerations at least greater than what percentage of the tendon width?

A 5%
B 25%
C 30%
D 50%
E 75%

ANSWER 15: **D**

16 Which of the following is not a proven advantage of early, protected range of motion following flexor tendon repair?

A Increased tendon excursion
B Decreased formation of adhesions
C Increased repair strength
D Decreased postoperative stiffness
E Decreased postoperative pain

ANSWER 16: **E**

17 In the treatment of De Quervain's syndrome, non-operative modalities, including corticosteroid injections, have been found to be useful in greater than what percentage of patients?

A 50%
B 25%
C 10%
D 80%
E 95%

ANSWER 17: **D**

VI Distal Radioulnar Joint, Triangular Fibrocartilage Complex, and Wrist Arthroscopy

18 The components that comprise the triangular fibrocartilage complex include all except which of the following?

A Dorsal radioulnar ligaments
B Extensor carpi ulnaris subsheath
C Volar radioulnar ligaments
D An articular disk
E Extensor digitorum minimi subsheath

ANSWER 18: **E**

19 What is the preferred surgical procedure for ulnocarpal impaction syndrome caused by abutment of the ulnar head into the proximal carpal row?

A Wrist arthroscopy with débridement of the triangular fibrocartilage complex
B Ulnar shortening osteotomy
C Distal ulnar hemi-resection or interposition arthroplasty
D Radial shortening osteotomy
E Wrist arthrodesis

ANSWER 19: **B**

20 What is the most common complication following wrist arthroscopy?

A Infection
B Iatrogenic cartilage injury
C Chronic wrist swelling

D Injury to the posterior interosseous nerve
E Injury to superficial sensory nerves

ANSWER 20: **E**

VII Nail and Fingertip Injuries

21 A 30-year-old male patient sustains a complete amputation of the pulp of his index finger without evidence of bone involvement or fracture. What is the most appropriate surgical treatment option for this patient?
A Cross-finger flap
B Volar V–Y flap
C Full thickness skin grafting
E Reattachment of the pulp tissue
E DIP joint disarticulation and primary closure of remaining tissue

ANSWER 21: **A**

22 For which of the following clinical situations would a Moberg advancement flap be a viable option?
A Complete transverse fingertip amputation of the index finger
B Transverse or volar oblique fingertip amputation of the thumb
C Dorsal skin loss of the thumb, just proximal to the IP joint
D Dorsal oblique soft tissue loss of the long finger
E Complete amputation of the thumb at the MCP joint

ANSWER 22: **B**

VIII Soft Tissue Coverage and Microsurgery

23 When compared with split-thickness skin grafts, full-thickness skin grafts provide all of the advantages except which of the following?
A Improved durability
B Decreased contraction
C Improved sensibility
D Improved availability of grafts
E Improved cosmesis

ANSWER 23: **D**

24 Which of the following are not relative contraindications to digital replantation?
A Single-digit amputation
B Level of amputation within Zone II flexor tendon sheath
C Segmental amputations
D Multiple-digit amputations
E Prolonged warm ischemia beyond 12 hours

ANSWER 24: **D**

25 A construction worker sustains traumatic amputations to the thumb and index finger of his dominant hand while using a table saw. Replantation is performed. What is the most common cause of early (within 12 hours) failure of the replanted digits?
A Arterial thrombosis
B Venous congestion
C Infection
D Irreversible nerve damage

E Skin necrosis

ANSWER 25: **A**

26 Which of the following is most predictive factor of digit survival following replantation?

A Age of patient
B Mechanism of injury
C Level of amputation
D Number of digits amputated
E Choice of perioperative antibiotics

ANSWER 26: **B**

IX Vascular Disorders

27 Excluding the carpal tunnel, how many compartments can be found within the hand?

A 4
B 6
C 8
D 10
E 12

ANSWER 27: **D**

28 Volkmann ischemic contracture is a classic complication of untreated acute compartment syndrome in the forearm. Which are the most vulnerable muscles affected in this phenomenon?

A Flexor digitorum superficialis and palmaris longus
B Flexor carpi ulnaris and flexor digitorum superficialis
C Flexor pollicis longus and flexor digitorum profundus
D Flexor pollicis longus and flexor digitorum superficialis
E Flexor digitorum profundus and flexor digitorum superficialis

ANSWER 28: **C**

29 What is the major distinction between Raynaud's phenomenon and Raynaud's disease?

A The presence or absence of a known underlying cause
B The age of onset of vasospastic symptoms
C Variations in success rates of treatment modalities
D The necessity of smoking cessation for symptom management
E Variations in gender predilection

ANSWER 29: **E**

X Compression Neuropathy

30 What is the most common cause of carpal tunnel syndrome in children?

A Juvenile diabetes
B Metabolic abnormality in lysosome storage
C Anatomic structural variant with persistent median artery
D Double-crush phenomenon from congenital spinal stenosis
E Obesity

ANSWER 30: **B**

31 Which of the following muscles is not innervated by the posterior interosseous nerve?

A Extensor indicis proprius
B Extensor carpi ulnaris
C Extensor digitorum minimi
D Extensor digitorum communis
E Extensor carpi radialis longus

ANSWER 31: **E**

32 Cheiralgia paresthetica occurs secondary to a compressive neuropathy of which of the following structures?
A Median nerve
B Ulnar nerve at Guyon's canal
C Superficial sensory branch of the radial nerve
D Anterior interosseous nerve
E Posterior interosseous nerve

ANSWER 32: **C**

XI Nerve Injuries and Tendon Transfers

33 The brachial plexus can be found exiting between which two muscles?
A Scalenus medius and levator scapulae
B Scalenus medius and scalenus posterior
C Scalenus anterior and scalenus medius
D Teres major and teres minor
E Serratus anterior and scalenus posterior

ANSWER 33: **C**

34 A 15-year-old male is involved in a traumatic motor vehicle crash and is noted to have severe right upper extremity weakness suggestive of a brachial plexus injury. On physical examination, he is found to have miosis, ptosis, and anhidrosis of the right eye. These findings suggest all but which of the following?
A Pre-ganglionic level of plexus injury
B Injury to the T1 nerve root
C Post-ganglionic level of plexus injury
D Guarded prognosis for recovery
E Lower trunk plexus injury

ANSWER 34: **C**

XII Arthritis

35 Which of the following pharmacologic agents utilized in the treatment of rheumatoid arthritis antagonizes the TNF-alpha pathway?
A Doxycycline
B Anakinra
C Rituximab
D Etanercept
E Hydroxychloroquine

ANSWER 35: **E**

36 In rheumatoid arthritis, attrition of which tendon over a volar scaphoid osteophyte can lead to rupture, otherwise known as Mannerfelt syndrome?
A Flexor pollicis longus

B Flexor digitorum profundus to the long finger
C Flexor digitorum superficialis to the index finger
D More than one of the above

ANSWER 36: **D**

37 A 65-year-old male patient presents to the office with chronic digital joint pain for which he takes oral medication. Physical examination demonstrates areas of tophi nodules, and radiographic changes demonstrate periarticular erosions. An aspiration of a symptomatic joint in this patient would likely reveal which of the following?

A Gram-positive cocci in clusters
B Gram-positive cocci in chains
C Negatively birefringent monosodium urate crystals
D Positively birefringent calcium pyrophosphate dehydrate crystals
E Normal joint fluid

ANSWER 37: **C**

XIII Idiopathic Osteonecrosis of the Carpus

38 What is the first line of treatment for patients diagnosed with early-stage Kienbock's disease?

A Core decompression
B Allograft replacement
C Cast immobilization
D Vascularized bone grafting
E Scaphoid excision and four-corner fusion

ANSWER 38: **C**

39 A 19-year-old female gymnast presents with persistent dorsal wrist pain with radiographic evidence of ulnar-negative variance. Magnetic resonance imaging confirms a diagnosis of stage IIIA Kienbock's disease, and the decision is made to proceed with a joint-leveling procedure. What is the preferred surgical intervention in this scenario?

A Radial shortening osteotomy
B Ulnar lengthening with bone grafting
C Distal radial ulnar joint arthrodesis
D Core decompression of the radius and ulna
E Proximal row carpectomy

ANSWER 39: **E**

XIV Dupuytren Disease

40 Dupuytren disease has not been associated with which of the following?

A Tobacco use
B Epilepsy
C Chronic pulmonary disease
D Human immunodeficiency virus
E Occupation

ANSWER 40: **E**

41 What is the predominant cell type found histologically in contracted Dupuytren fascia?

A Neutrophil

B Myofibroblast
C Fibroblast
D Chondrocyte
E Osteoblast

ANSWER 41: **B**

42 What is the most common complication after partial palmar fasciectomy?
A Infection
B Complex regional pain syndrome (CRPS)
C Hematoma formation
D Recurrence
E Digital neurovascular injury

ANSWER 42: **D**

XV Hand Tumors

43 What is the second most common soft tissue tumor of the hand?
A Ganglion cyst
B Mucous cyst
C Giant cell tumor of tendon sheath
D Schwannoma
E Epidermal inclusion cyst

ANSWER 43: **C**

44 A 40-year-old female patient presents to the office with the insidious onset of wrist pain and swelling over a period of 2 months. Imaging reveals an eccentric lytic lesion in the metaphysis and epiphysis of the distal radius, which is consistent with a benign aggressive pathology. Biopsy is performed that demonstrates numerous osteoclast-like, multinucleated giant cells. What is the likely diagnosis and preferred treatment for this lesion?
A Squamous cell carcinoma—amputation above level of the wrist
B Giant cell tumor—wide excision with curettage and bone grafting
C Unicameral bone cyst—observation with repeat radiographs in 2 months
D Lung cancer metastasis—wide excision with curettage and bone grafting
E Enchondroma—observation with repeat radiographs in 2 months

ANSWER 44: **B**

45 What is the most common sarcoma of the hand?
A Chondrosarcoma
B Epithelioid sarcoma
C Osteosarcoma
D Liposarcoma
E Malignant fibrous histiocytoma

ANSWER 45: **B**

XVI Hand Infections

46 What is the most common organism isolated in cases of chronic paronychia infections?
A Staphylococcus aureus
B Candida albicans

C Eikenella corrodens
D Streptococcus species
E Pasteurella multocida

ANSWER 46: **B**

47 All of the following are classic signs of septic flexor tenosynovitis except which of the following?
A Flexed, resting posture of digit
B Fusiform swelling of the digit
C Pain with passive digit flexion
D Tenderness of flexor tendon sheath
E Pain with passive digit extension

ANSWER 47: **C**

48 Mortality following the onset of necrotizing fasciitis has been clearly correlated with which of the following factors?
A Age of patient
B Virulence of the causative organism
C Time from presentation to initiation of treatment
D Immune system status
E Proximity of involved area to the chest wall

ANSWER 48: **C**

XVII Congenital Hand Differences

49 Madelung deformity has been hypothesized to be linked to a genetic disorder that demonstrates which pattern of inheritance?
A Autosomal recessive
B X-linked dominant
C Autosomal dominant
D X-linked recessive
E Sporadic mutation

ANSWER 49: **B**

50 What is the most common congenital hand difference?
A Camptodactyly
B Thumb hypoplasia
C Postaxial polydactyly
D Clinodactyly
E Syndactyly

ANSWER 50: **E**

51 An 8-month-old female presents to the office with bilateral type III radial dysplasia. The parents want to explore possible surgical options that could correct the deformity. Which of the following is a strong contraindication to centralization of the carpus on the distal ulna?
A Inadequate elbow range of motion
B Associated VACTERL syndrome
C Small stature
D Absent thumb
E Decreased wrist range of motion

ANSWER 51: **A**

XVIII Elbow

52 Which of the following structures is the primary restraint to valgus stress within functional elbow range of motion?

- **A** Transverse bundle of the medial (ulnar) collateral ligament
- **B** Radial head
- **C** Lateral ulnar collateral ligament
- **D** Ulnohumeral articulation
- **E** Anterior bundle of the medial (ulnar) collateral ligament

ANSWER 52: **E**

53 What is most commonly involved structure implicated in lateral epicondylitis?

- **A** Lateral ulnar collateral ligament
- **B** Extensor carpi radialis longus
- **C** Origin of brachioradialis
- **D** Extensor digitorum communis
- **E** Extensor carpi radialis brevis

ANSWER 53: **E**

54 What nerve is at most risk during a single-incision approach to repair of a distal biceps tendon rupture?

- **A** Lateral antebrachial cutaneous nerve
- **B** Medial antebrachial cutaneous nerve
- **C** Anterior interosseous nerve
- **D** Median nerve
- **E** Radial nerve

ANSWER 54: **A**

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chapter 8 Review Questions

1 Which of the following incomplete spinal cord injury syndromes has the WORST prognosis for recovery?

- **A** Anterior cord syndrome
- **B** Posterior cord syndrome
- **C** Central cord syndrome
- **D** Brown-Séquard syndrome
- **E** Nerve root injury syndrome

ANSWER 1: **A.**

2 What is the most likely diagnosis in a patient with paresthesias in the thumb and index finger and weakness of elbow flexion and wrist extension?

- **A** Carpal tunnel syndrome
- **B** Radial tunnel syndrome
- **C** C5 radiculopathy
- **D** C6 radiculopathy
- **E** C7 radiculopathy

ANSWER 2: **D.**

3 A 43-year-old man presents 2 years after undergoing anterior cervical discectomy and fusion (ACDF) for cervical radiculopathy. He has had complete resolution of his arm pain but has a 2-month history of neck pain. Radiograph demonstrates a fibrous nonunion. What should you now recommend?

- **A** Revision ACDF
- **B** Total disc arthroplasty
- **C** Physical therapy for cervical strengthening and over-the-counter analgesics
- **D** CT myelography
- **E** Posterior fusion with lateral mass plating

ANSWER 3: **C.**

4 A patient reports progressive hand clumsiness and unsteadiness with walking. Examination reveals a positive Hoffmann sign and atrophy of the hand intrinsics. MRI reveals multilevel cervical spondylosis and stenosis. Lateral flexion and extension radiographs show mild cervical kyphosis in the neutral position, with restoration of lordosis on extension. Which of the following procedures is most likely to result in poor long-term results?

- **A** Anterior cervical discectomy with fusion at the involved levels
- **B** Anterior and posterior decompression with circumferential fusion
- **C** Anterior corpectomy and fusion with a fibula strut
- **D** Laminectomy and bilateral foraminotomies
- **E** Laminectomy and posterior fusion with lateral mass plating

ANSWER 4: **D.**

5 A 66-year-old woman with rheumatoid arthritis has atlantoaxial instability and basilar invagination. What MRI findings would suggest the need for cervical fusion?

- **A** Cervical medullary angle of 120 degrees
- **B** C1-C2 motion of 6 mm on flexion radiograph

C Cord diameter in flexion of 10 mm

D Posterior atlanto–dens interval of 15 mm

E Erosion of the tip of the odontoid

ANSWER 5: **A.**

6 If a 75-year-old man, with no prior history of back or leg pain, were to undergo an MRI of the lumbar spine, what is the chance that the study would demonstrate disc degeneration and/or bulging?

A 20%

B 35%

C 50%

D 70%

E 90%

ANSWER 6: **E.**

7 Which radiographic picture is most likely to be seen in a man with a left-sided Trendelenburg gait?

A Central disc herniation at L3-L4

B Left paracentral disc herniation at L3-L4

C Left paracentral disc herniation at L4-L5

D Left paracentral disc herniation at L5-S1

E Left far lateral disc herniation at L4-L5

ANSWER 7: **C.**

8 Flexion-distraction injuries of the thoracolumbar spine are most frequently associated with injury to what organ system?

A Cardiac system

B Central nervous system

C Vascular system

D Gastrointestinal system

E Pulmonary system

ANSWER 8: **D.**

9 Which of the following conditions is an indication for fusion when a laminectomy for spinal stenosis is performed?

A Prior laminectomy at an adjacent level

B Degenerative spondylolisthesis at the level of the laminectomy

C Removal of 25% of each facet joint at surgery

D Low back pain

E Foraminal stenosis at the level of the laminectomy

ANSWER 9: **B.**

10 In patients undergoing fusion with instrumentation for adult scoliosis, which of the following is the most likely site for a pseudarthrosis to be discovered?

A T5-T6

B T7-T8

C L1-L2

D L4-L5

E L5-S1

ANSWER 10: **E.**

11 A 42-year-old man presents with right lower extremity pain in an S1 radicular pattern for 6 weeks. He relates that he underwent a right-sided L5-S1 discectomy with successful relief of similar pain 5 years ago. Which

of the following imaging studies would offer the greatest amount of information?

A Lumbar MRI with gadolinium
B CT
C CT with contrast myelography
D Lumbar lateral flexion-extension radiographs
E SPECT

ANSWER 11: **A.**

12 Four weeks after an otherwise successful lumbar microdiscectomy, with complete relief of his preoperative sciatica, a 36-year-old man presents with the sudden onset of severe back and buttock pain. Examination and laboratory studies are unremarkable with the exception of an erythrocyte sedimentation rate of 90 mm/hr. What is the most appropriate step in management at this time?

A A short course of oral steroids
B MRI with gadolinium
C Anteroposterior and lateral flexion/extension radiographs
D Open biopsy of the surgical disc space
E Anterior débridement and interbody fusion

ANSWER 12: **B.**

13 What is the most common presenting symptom in an adult with vertebral osteomyelitis?

A Fever
B Night sweats
C Unexplained weight loss
D Dizziness
E Back pain

ANSWER 13: **E.**

14 A 56-year-old man with type II diabetes presents with a 3-month history of constant thoracolumbar back pain. He is getting worse despite nonoperative treatment. If you suspect a pyogenic spine infection, what is the most accurate test for diagnosis?

A Plain radiograph
B CT with intravenous contrast
C SPECT
D MRI
E Differential technetium-99m and gallium scanning

ANSWER 14: **D.**

15 A 22-year-old woman has had posterior neck discomfort for the past 6 months. SPECT reveals increased activity at the C7 spinous process. CT demonstrates multifocal involvement of the spinous process lamina and facet of C7 and a CT-directed needle biopsy reveals osteoblastoma. What is the best course of action?

A Observation
B En bloc excision
C Curettage
D Radiation therapy
E En bloc excision followed by radiation therapy

ANSWER 15: **B.**

16 A 62-year-old woman has pain in her back and right anterior thigh. MRI suggests a neoplastic lesion at L2. All other metastatic workup, including bone scan and CT of the chest, abdomen, and pelvis, is negative except for the lesion at L2. History reveals that she was treated for breast cancer without known metastatic disease 12 years ago and is thought to be free of disease. What is the next most appropriate step in management?

A CT-guided biopsy

B Vertebroplasty
C En bloc resection and anterior fusion
D Radiation therapy
E Repeat MRI in 3 months

ANSWER 16: **A.**

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chapter 9 Review Questions

1 Which of the following factors portends the worst prognosis in a patient with an osteosarcoma of the distal femur?

- **A** Age
- **B** Location in the proximal femur
- **C** Grade
- **D** Discontinuous tumor
- **E** Size

ANSWER 1: **D.** Discontinuous tumor (or skip metastases) elevates a patient's cancer status to stage III (AJCC system). The order of prognostic factors in the staging system (from most unfavorable) are as follows:

- Presence of metastases (stage IV)
- Discontinuous tumor (stage III)
- Tumor grade (low grade: stage I; high grade: stage II)
- Size (grade T1: ≤8 cm; grade T2: >8 cm)

2 Which of the following genetic abnormalities may occur in a patient with an osteosarcoma?

- **A** Activating mutation of GSα surface protein
- **B** Balanced chromosomal translocation (11;12)
- **C** Balanced chromosomal translocation (X;18)
- **D** Missense mutation in EXT1
- **E** Missense nutation in retinoblastoma tumor suppressor gene

ANSWER 2: **E.** Clinicians should remember the most common genetic mutations in patients with bone and soft tissue tumors. These are the most commonly tested:

- Fibrous dysplasia: activating mutation of GSα surface proteins
- Ewing sarcoma: balanced chromosomal translocation (11;22)
- Synovial sarcoma: balanced chromosomal translocation (X;18)
- Multiple hereditary exostoses: missense mutation in EXT1 and EXT2 genes
- Osteosarcoma: missense mutation in the retinoblastoma tumor suppressor gene

3 Which of the following tumors has the most favorable prognosis?

- **A** Osteosarcoma
- **B** Ewing tumor
- **C** Dedifferentiated chondrosarcoma
- **D** Parosteal osteosarcoma
- **E** Sarcoma in Paget disease

ANSWER 3: **D.** The other four responses are high-grade tumors; parosteal osteosarcoma is a low-grade tumor. The low-grade lesions are as follows:

- Parosteal osteosarcoma
- Adamantinoma

- Well-differentiated osteosarcoma
- Grade 1 chondrosarcoma
- Chondrosarcoma in patients with multiple hereditary exostoses
- Chordoma

The high-grade tumors are:

- Osteosarcoma
- Ewing tumor
- Dedifferentiated chondrosarcoma
- Sarcoma in Paget disease
- Malignant fibrous histiocytoma

4 Which of the following tumors has the worst prognosis?

A Parosteal osteosarcoma
B Periosteal osteosarcoma
C Adamantinoma
D Chondrosarcoma occurring in multiple exostoses
E Osteosarcoma

ANSWER 4: **E.** The low-grade lesions are as follows:

- Parosteal osteosarcoma
- Adamantinoma
- Well-differentiated osteosarcoma
- Grade 1 chondrosarcoma
- Chondrosarcoma in patients with multiple hereditary exostoses
- Chordoma

The high-grade tumors are as follows:

- Osteosarcoma
- Ewing tumor
- Dedifferentiated chondrosarcoma
- Sarcoma in Paget disease
- Malignant fibrous histiocytoma

5 Which of the following would be the correct treatment for a well-differentiated osteosarcoma of the proximal tibia?

A Preoperative chemotherapy, followed by wide-margin surgical resection
B Curettage, cement fixation and external beam irradiation
C Chemotherapy and bisphosphonates
D External beam irradiation
E Wide-margin surgical resection alone

ANSWER 5: **E.** Well-differentiated osteosarcoma is a low-grade lesion. Low-grade lesions are treated with wide-margin surgical resection alone. The low-grade lesions are as follows:

- Parosteal osteosarcoma
- Adamantinoma
- Well-differentiated osteosarcoma
- Grade 1 chondrosarcoma
- Chondrosarcoma in patients with multiple hereditary exostoses

- Chordoma

6 Which of the following is the correct treatment for a stage II osteosarcoma of the distal femur?

A Wide-margin surgical resection alone
B Preoperative external beam irradiation, wide-margin surgical resection, postoperative chemotherapy
C Preoperative chemotherapy and wide-margin surgical resection
D Chemotherapy and bisphosphonates
E External beam irradiation and chemotherapy

ANSWER 6: **C.** Stage II osteosarcoma is a high-grade tumor with an 80% to 90% risk of pulmonary metastases. Patients are treated with neoadjuvant chemotherapy, followed by wide-margin surgical resection The amount of tumor necrosis in the specimen is highly correlated with the prognosis. When the amount of tumor cells killed is greater than 95%, the prognosis is excellent.

7 Which of the following is the genetic anomalies occurs in patients with Ewing tumor?

A Missense mutation retinoblastoma tumor suppressor gene
B Missense mutation in RUNX2 (CBFA1)
C Activating mutation of fibroblast growth factor receptor III (FGFR3)
D Balanced chromosomal translocation (11;22)
E Balanced chromosomal translocation (X;18)

ANSWER 7: **D.** Patients with Ewing tumor have a very characteristic balanced chromosomal alteration; a translocation between chromosomes 11 and 22. The gene fusion product is EWS-FLI1. One should know the other responses as well. These are the most commonly tested:

- Fibrous dysplasia: activating mutation of GSα surface protein
- Achondroplasia: activating mutation of FGFR3
- Cleidocranial dysplasia: missense mutation in RUNX2 (CBFA1)
- Synovial sarcoma: balanced chromosomal translocation (X;18)
- Multiple hereditary exostoses: missense mutation in EXT1 and EXT2 genes
- Osteosarcoma: missense mutation in retinoblastoma tumor suppressor gene

8 Which of the following is the primary cellular abnormality in Paget disease?

A Resting osteoblasts (lining cells)
B Osteoblasts
C Osteocytes
D Osteoclasts
E Plasma cells

ANSWER 8: **D.** Paget disease is disease of the osteoclast. This condition is probably caused by a slow virus. The osteoclast becomes infected with the virus particles, and marked bone resorption occurs. In Paget disease, the serum alkaline phosphatase level is markedly increased, as are the urine collagen breakdown products. The serum calcium level is normal!

9 Which of the following laboratory studies is most likely to yield abnormal results in patients with Paget disease?

A Serum protein electrophoresis
B C-reactive protein, erythrocyte sedimentation rate
C Serum alkaline phosphatase
D Serum prostatic antigen
E Serum calcium level

ANSWER 9: **C.** Paget disease is disease of the osteoclast. This condition is probably a slow virus. The osteoclast becomes infected with the virus particles and marked bone resorption occurs. Remember in Paget disease that the serum alkaline phosphatase level is markedly increased as are the urine collagen breakdown products. The serum calcium level is normal!

10 Which of the following bone conditions carries the greatest risk for development of a bone sarcoma?
- **A** Enchondroma
- **B** Osteochondroma
- **C** Multiple hereditary exostoses
- **D** Enchondromatosis
- **E** Maffucci syndrome

ANSWER 10: **E.** A number of bone disease carry a very low risk for development of a malignancy. The lesions with very low risk (<1%) include the following:

- Osteochondroma
- Enchondroma
- Paget disease
- Fibrous dysplasia
- Bone infarct

Several conditions carry a higher risk:

- Multiple hereditary exostoses: 10%
- Ollier disease (enchondromatosis): 30%
- Maffucci syndrome: 100%

11 A patient has multiple hereditary exostosis and develops a grade 1 chondrosarcoma in an exostosis of the scapula. Which of the following would be the correct treatment?
- **A** Preoperative chemotherapy and wide-margin surgical resection
- **B** Preoperative external beam irradiation and wide-margin surgical resection
- **C** Wide-margin surgical resection alone
- **D** Chemotherapy and bisphosphonates
- **E** External beam irradiation and bisphosphonates

ANSWER 11: **C.** Patients with multiple exostoses have a 10% risk for developing a low-grade chondrosarcoma. The treatment of low-grade chondrosarcoma is wide-margin surgical resection. No chemotherapy or radiation is used. Patients with multiple hereditary exostoses often have a characteristic genetic defect: missense mutations in the tumor suppressor genes EXT1 and EXT2. The EXT1 mutation confers a higher risk for the development of a chondrosarcoma within an exostosis.

12 Which of the following genetic abnormalities occurs in patients with a synovial sarcoma?
- **A** Activating mutation of FGFR3
- **B** Missense mutation in EXT1
- **C** Balanced chromosomal translocation t(11;22)
- **D** Balanced chromosomal translocation t(X;18)
- **E** Missense mutation in retinoblastoma tumor suppressor gene

ANSWER 12: **D.** Many patients with synovial sarcoma have a characteristic balanced translocation between chromosomes X and 18. The gene fusion products are SYT-SSX1 and SYT-SSX2. One should know the other

responses as well. These are the most commonly tested:

- Fibrous dysplasia: activating mutation of GSα surface protein
- Achondroplasia: activating mutation of FGFR3
- Cleidocranial dysplasia: missence mutation RUNX2 (CBFA1)
- Multiple hereditary exostoses: missense mutation EXT1 and EXT2 genes
- Osteosarcoma: missense mutation retinoblastoma tumor suppressor gene

13 A 55-year-old man has a 10-cm soft tissue mass. Biopsy reveals a high-grade malignant fibrous histiocytoma. The most likely site of metastases would be which of the following?

A Bone
B Lymph nodes
C Liver
D Lungs
E Kidney

ANSWER 13: **D.** The most site of metastases in bone and soft tissue tumors is the pulmonary system. A computed tomographic (CT) scan is performed to detect any pulmonary nodules. If pulmonary nodules are found, the patient's tumor status is elevated to stage IV.

14 Which of the following soft tissue sarcomas is most likely to have mineral deposits within the tumor?

A Fibrosarcoma
B Malignant fibrous histiocytoma
C Liposarcoma
D Synovial sarcoma
E Epithelioid sarcoma

ANSWER 14: **D.** Synovial sarcoma often has mineral deposition within the tumor. Radiographs may show these mineral deposits in 20% to 30% of affected patients.

15 Which of the following describes the histologic appearance of synovial sarcoma?

A Spindle cells with moderate pleomorphism
B Spindle cells, storiform pattern, pleomorphism
C Spindle cells, epithelial cells
D Giant cells, pleomorphism
E Nest of cells, pigment

ANSWER 15: **C.** Synovial sarcoma is a biphasic tumor. In synovial sarcoma, there are fibrosarcoma-like spindle cells and nests of epithelial cells. The other responses refer to other conditions:

- Spindle cells, moderate pleomorphism: sarcoma
- Spindle cells, storiform pattern, pleomorphism: malignant fibrous histiocytoma
- Giant cells, pleomorphism: malignant fibrous histiocytoma
- Nests of cells, pigment: clear cell sarcoma

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chapter 10 Review Questions

1 A 32-year-old man sustained a traumatic injury at T12 to L1. He is able to ambulate by means of

A A walker
B A four-pronged cane
C A self-propelled wheelchair
D Crutches
E Bilateral KAFOs

ANSWER 1: **C.** Patient is a paraplegic and has full use of upper extremities. He is unable to walk, so assistive devices are of no value.

2 What surgical consideration is most critical for successful patient function after a transfemoral amputation?

A Use of a laterally based myocutaneous flap
B An anteriorly based skin flap
C Performing an adductor myodesis
D Performing an iliotibial band tenodesis
E Application of a rigid plaster dressing

ANSWER 2: **C.** Adductor myodesis has been shown to maintain femoral alignment and assist in prosthetic socket fitting. Nonsurgical management does not control the femur.

3 A 42-year-old man recently underwent a transfemoral amputation as a result of a traumatic event. The patient had been able to walk at a very fast pace and desires to remain very active. What type of prosthetic knee joint is most appropriate?

A Hydraulic with microprocessor
B Pneumatic
C Constant friction
D Polycentric
E Manual locking

ANSWER 3: **A.** The hydraulic knee with a microprocessor unit allows patients to vary their gait and provides a stable system to enhance patient safety. The other knee mechanisms provide stability without allowing for changes in cadence.

4 A 38-year-old man underwent a transtibial amputation 18 months ago and notes that from initial contact to foot flat, the knee remains extended, and the front of the foot does not touch the ground until midstance. What is the most likely cause?

A The foot is too anterior.
B The prosthetic heel is too rigid.
C The heel on the shoe is too high.
D Socket flexion is excessive.
E The knee flexors are being used excessively.

ANSWER 4: **A.** Increased displacement of the prosthetic foot anteriorly results in prolonged knee extension during the initial stance phase. In contrast, a rigid heel leads to premature knee flexion.

5 The expected functional outcome of a patient with a complete spinal cord injury at the C5 neurologic level is independent with regard to:

A Transfer from bed to chair

B Mobility in an electric wheelchair

C Bowel and bladder care

D Bathing

E Dressing

ANSWER 5: **B.** The patient has minimal proximal upper limb movement at the C5 level, and so there is no distal function to self-propel. An electric wheelchair is the best method for limited independence. All other activities require assistance from an attendant.

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REVIEW OF ORTHOPAEDICS SIXTH EDITION MILLER

chapter 11 Review Questions

Section 1 Care of the Multiply Injured Patient

I Principles of Trauma Care

1 Initial radiologic imaging of the trauma patient includes:

- **A** Chest radiograph + anteroposterior view of pelvis
- **B** Abdominal series
- **C** CT of abdomen and pelvis
- **D** Anteroposterior cervical spine radiograph
- **E** Chest radiograph, anteroposterior view of pelvis, and CT of cervical spine

ANSWER 1: **E.** CT of the cervical spine has replaced the lateral cervical spine radiograph in the standard trauma series for spine clearance. Radiography of the pelvis and chest remain the standard. The other examinations may be indicated based on the clinical scenario.

2 Urgent actions by the orthopaedic surgeon to help with resuscitation of a trauma patient include:

- **A** Placing central lines
- **B** Pinning metacarpal fractures
- **C** Reducing open fractures and applying splints
- **D** Ordering CT for extremity injuries
- **F** Performing detailed neurovascular examinations

ANSWER 2: **C.** Reduction and splinting of fractures will allow control of bleeding as well as pain control, which assists with overall resuscitation.

3 Which of the following is NOT a principle of damage control orthopedics?

- **A** Early definitive treatment of long bone fractures to prevent further injury from occurring
- **B** Placement of external fixators for long bone fractures
- **C** Staged management of polytrauma patients to reduce the incidence of a second hit
- **D** Delaying definitive fixation during days 2 to 5 after severe traumatic event
- **E** Monitoring of inflammatory parameters to try and predict safer times to return to the operating room

ANSWER 3: **A.** This is referred to as early total care. There is significant controversy over which method is more appropriate, and further study is needed to determine the best course of action in a given situation. The other answers are all components of damage control orthopedics.

4 When can a femoral external fixator placed for polytrauma be safely converted to intramedullary nail fixation?

- **A** Within 1 week
- **B** Within 3 days
- **C** Within 3 weeks
- **D** At any time as long as the pin sites are clean
- **E** Never

ANSWER 4: **C.** Current studies indicate safe conversion of femoral fixators within 3 weeks and tibial fixators within 7 to 10 days, if pin sites are clean; otherwise, staged removal with treatment of the pin sites can safely be performed.

5 A Mangled Extremity Severity Score (MESS) of 8 indicates:

- **A** Amputation should be performed.
- **B** Amputation should not be performed.
- **C** The likelihood of successful reconstruction is zero.
- **D** The limb is severely injured, but both reconstruction or amputation may be reasonable treatments.
- **E** No decision on treatment may be made until the Injury Severity Score (ISS) is known.

ANSWER 5: **D.** The MESS provides a numerical value to a severely injured lower extremity. Although scores greater than 7 are associated with a higher likelihood of amputation, each case is unique and all scoring systems are merely tools to assist in the complex determination of limb viability.

II Care of Injuries to Specific Tissues

6 A 45-year-old man involved in a motorcycle crash is brought to the emergency department with a displaced, closed, proximal third tibia fracture. What is the most sensitive clinical finding of compartment syndrome?

- **A** Compartment pressure reading of 40 mm Hg with Stryker monitor
- **B** Severe pain on passive stretch of muscles within a compartment
- **C** Decreased pulse in the affected area
- **D** Parasthesias in the affected limb
- **E** Inability to dorsiflex ankle

ANSWER 6: **B.** Pain on passive stretch is thought to be the most sensitive finding in awake patients. Pressure of 40 mm Hg may be significant, but this is not an absolute and depends on diastolic blood pressure with a ΔP of less than 35 being accepted as significant. The other answers are late findings of compartment syndrome.

7 You note he has diminished pulses in his right ankle, the next step is to?

- **A** Obtain vascular surgery consultation
- **B** Obtain an urgent angiogram
- **C** Obtain an MR/CT angiogram
- **D** Check ankle brachial index and compare to his uninjured side
- **E** Use tourniquet to control suspected arterial injury

ANSWER 7: **D.** Ankle-brachial index measurements have been shown to be sensitive for the diagnosis of significant vascular injury without any morbidity. If the ankle-brachial index on the injured side is less than 0.9, vascular surgery consultation and possible further diagnostic workup is indicated. Also, fracture reduction may take the stretch off a tented vessel and restore adequate pulses, but this was not given as a choice.

8 What is the most likely type of nerve injury attributed to a low-velocity gunshot wound to the extremities?

- **A** Laceration
- **B** Crush injury
- **C** Stretch injury
- **D** Contusion
- **E** Entrapment in fracture.

ANSWER 8: **D.** Nerve palsies from gunshot wounds are most likely due to the concussive effect of the shock wave as the missile passes through the tissue. In general, nerve injuries associated with fractures are most likely due to stretch of the nerve.

9 A 27-year-old woman is thrown from a horse and sustains a transverse midhumerus fracture. She is unable

to actively extend her wrist or index/long fingers or thumb and notes numbness in her first dorsal web space. What is the most likely cause of her nerve dysfunction?

A Laceration by fracture fragment
B Direct blow from landing on the ground
C Crush injury from impact with the ground
D Vascular injury from interruption of the blood supply
E Stretch injury from the fracture displacement

ANSWER 9: **E.** Although certain fracture patterns in the humerus (spiral distal third—the Holstein-Lewis pattern) are more likely to be associated with nerve injuries, the mechanism for most nerve palsies associated with fractures is stretch.

10 External fixation is used most often for which of the following?

A Definitive treatment of grade 1 open tibia fractures
B Definitive treatment of pediatric femur fractures
C Temporization of open fractures or fractures with soft tissue compromise
D Treatment of unstable elbow injuries
E Definitive treatment of polytraumatized adults

ANSWER 10: **C.** Although used for all the situations given, external fixation is primarily used for temporization of fractures and occasionally for definitive treatment.

Section 2 Upper Extremity

11 What percentage of midshaft clavicle fractures treated closed will be expected to have symptomatic malunions/nonunions?

A 5%
B 30%
C 15%
D 2%
E 75%

ANSWER 11: **C.** Whereas most clavicle fractures heal with some displacement, a recent prospective study found a 15% symptomatic mal/nonunion rate with detailed evaluation and physical testing.

12 Which risk factor is NOT associated with a symptomatic malunion/nonunion after closed treatment of a midshaft clavicle fracture?

A Female sex
B Shortening of 2.5 cm
C Central comminution
D 100% displacement
E Smoking

ANSWER 12: **D.** Most midshaft clavicle fractures will displace 100%, but the other factors were noted to be significant in determining the likelihood of a symptomatic malunion.

13 For proximal humerus fractures, which pattern is NOT a reason to perform ORIF?

A Displaced three-part fracture in a 67-year-old tennis player
B Displaced four-part fracture in a 45-year-old laborer
C Femoral head splitting four-part fracture in a 70-year-old retired homemaker
D Two-part fracture with 1.5 cm greater tuberosity displacement in a 30-year-old administrator
E Irreducible three-part fracture-dislocation in a 40-year-old female recreational athlete

ANSWER 13. **C.** The head-splitting fracture variant typically calls for arthroplasty because the likelihood of successful ORIF is low, especially in a lower demand patient. The other scenarios would all be reasonable to attempt ORIF.

14 A 30-year-old woman presents with a closed midshaft humerus spiral fracture after she fell off her bike. The fracture is in 15 degrees of varus and 15 degrees of extension. She is comfortable but has a weakness in her wrist and finger extensors but normal sensation in her first dorsal web space. Which of the following is an appropriate management option?

- **A** Operative fixation to return to recreational bike riding as fast as possible
- **B** Operative fixation to explore her nerve and remove any compressive forces on it
- **C** Figure-eight strap and early range of motion
- **D** Sarmiento fracture brace and repeat radiography in 1 week
- **E** Shoulder spica cast to immobilize potential deforming forces

ANSWER 14: **D.** Closed fractures of the humerus can often be successfully treated with closed management in a functional (Sarmiento) brace. In the presence of nerve palsy, operative exploration has not yielded improved results and most palsies will fully resolve with closed management. A and B would not be indicated initially, and C and E are not appropriate orthoses for humeral shaft fractures.

15 For operative treatment of humeral shaft fractures, an advantage of compressive plating over intramedullary nailing is:

- **A** Decreased incision length and blood loss
- **B** Increased union rate
- **C** Shorter operative time
- **D** Decreased infection risk
- **E** Easier patient positioning on the operative table.

ANSWER 15: **B.** Union rates and number of secondary operations are improved with plating. Nailing has the advantage of smaller incisions/blood loss and decreased operating times. Infection risk and positioning have not been shown to have a significant difference.

16 What three injuries make up the “terrible triad” of the elbow?

- **A** Olecranon, lateral collateral ligament, radial head
- **B** Olecranon, lateral collateral ligament, medial collateral ligament
- **C** Medial collateral ligament, lateral collateral ligament, radial head
- **D** Coronoid, lateral collateral ligament, radial head
- **E** Coronoid, lateral collateral ligament, capitellum

ANSWER 16: **D.** Although other structures may be injured as well, the presence of these three combined injuries (typically as the result of a fracture-dislocation) indicates an unstable elbow that will require surgical stabilization and is associated with worse functional outcomes.

Section 3 Lower Extremity and Pelvis

17 Decision making for operative management of a 3-mm displaced transverse acetabular fracture may be aided by:

- **A** Patient is a 24-year old male high level recreational athlete
- **B** Measuring roof arcs to determine location of fracture line
- **C** Presence of associated femoral shaft fracture
- **D** Presence of positive spur sign on Judet views
- **E** Lack of protrusio on anteroposterior radiograph

ANSWER 17: **B.** Roof arcs are useful for determining which fractures involve the weight bearing dome of the acetabulum and are particularly helpful if displacement is borderline for operative fixation. Although options A, C, and E are useful information, none is as sensitive in determining need for surgery of the acetabulum. Option D is a radiologic finding in associated both-column fractures.

18 Proper technique for insertion of cannulated screws to treat valgus impacted femoral neck fractures includes which of the following?

- **A** Spread of at least 15 mm between pins
- **B** Starting point at or above the level of the lesser trochanter
- **C** Use of fully threaded screws to prevent backing out
- **D** Tips of the screws within 2.5 mm of the subchondral surface
- **E** Use of at least four screws for increased strength

ANSWER 18: **B.** For start points below the lesser trochanter, stress risers for subsequent subtrochanteric fractures will develop. None of the other options is considered necessary or highly recommended in all cases.

19 Knee dislocations can be associated with which of the following?

- **A** Vascular injuries
- **B** Ligamentous injuries
- **C** Low-energy mechanisms
- **D** Fractures
- **E** All of the above

ANSWER 19: **E.** Knee dislocations are often the result of complex forces acting across the joint. They can occur with low-energy mechanisms, particularly in obese patients. There is an increased risk for vascular injury with an associated dislocation, and by definition a ligament must tear for the knee to dislocate. Although less common then ligamentous injury, bony injuries, especially compression and avulsion fractures, do occur.

20 The Lauge-Hansen classification of ankle fractures is useful because it:

- **A** Indicates operative versus nonoperative treatment
- **B** Defines injury pattern based on direction of force and thus is helpful for reduction and to predict injury patterns
- **C** Is not applicable for open fractures
- **D** Is highly predictive of syndesmotic injury
- **E** Grades soft tissue injury and thus delineates a safe surgical window

ANSWER 20: **B.** The Lauge-Hansen classification is based on cadaver studies applying force in the described directions and evaluation of which structures fail, in what order, and with what pattern. Thus, it is helpful for identifying reduction techniques and also associated injuries. It does not routinely predict soft tissue injury or syndesmotic injury or determine operative versus nonoperative management.

21 Principles of talar neck fracture management include:

- **A** Anatomic reduction if more than minimal displacement
- **B** Avoiding varus reduction by accounting for medial comminution if present
- **C** Obtaining rigid fixation when possible
- **D** Delayed weight bearing for 10 to 12 weeks to allow revascularization to occur
- **E** All of the above

ANSWER 21: **E.** Talar neck fractures are associated with higher-energy injuries and can be difficult to treat successfully owing to the retrograde flow of blood from head through neck to body potentially being disrupted with fracture (higher grades of fracture associated with higher rates of avascular necrosis). Varus is the most common malunion position owing to medial comminution and the difficulty in obtaining stable fixation on the medial side.

Section 4 Spine

22 A 28-year-old woman with a radiograph consistent with a C6-7 jumped facet after an all-terrain vehicle rollover presents to the emergency department. She complains of neck pain and stiffness but is neurologically intact and able to follow commands. The most appropriate next step in her care is to:

A Perform MRI to evaluate for disc herniation
B Obtain a CT myelogram to evaluate nerve roots
C Apply traction via Gardner-Wells tongs or halo with slow addition of weight
D Plan for open reduction and stabilization
E Plan for closed reduction under general anesthesia with Gardner-Wells tongs or halo

ANSWER 22: **C.** Awake and neurologically intact patients can be treated with traction doing concurrent neurologic checks. MRI is indicated for an obtunded patient or in the case of failure to reduce with traction. General anesthesia may be required for reduction but could not monitor neurologic status so would be precluded by MRI.

23 When regarding C5 fractures, which are the most common mechanisms of injury?
A Compressive-flexion
B Distractive-flexion
C Lateral-flexion
D A and B
E A and C

ANSWER 23: **D.** Compressive-flexion, distractive-flexion, and compressive extension are the most common pattern of C3-7 cervical injuries. Distractive-extension and lateral flexion are the least common. Vertical compression is moderately common.

24 Which of the following are NOT true concerning T12 burst fractures?
A They may be treated nonoperatively.
B They always involve anterior, posterior, and middle columns.
C Neurologic deficit is a relative indication for operative stabilization.
D Surgical approaches are mostly posterior but may include anterior as well.
E Kyphosis greater than 30 degrees after orthosis application is an indication for surgical stabilization.

ANSWER 24: **B.** By definition, a burst fracture involves the anterior and middle columns and may also involve posterior. The other choices are all true.

Section 5 Pediatric Trauma

25 Corner fractures are:
A The most common facture type seen in child abuse
B Fractures at the junction of the metaphysis and physis
C Pathognomonic for child abuse
D B and C
E A, B, and C

ANSWER 25: **D.** Long bone fractures are noted to be more common injuries with child abuse but are not pathognomonic and can certainly occur without willful abuse.

26 An 8-year-old boy presents to the emergency department with a Salter-Harris type IV fracture of the distal femur from a football tackle. The fracture has 3 mm of displacement and 15 degrees of angulation in the sagittal plane. Because of his young age you know he has excellent potential to remodel. The BEST treatment option would include:
A Long-leg cast
B Percutaneous pinning in situ
C Open reduction and internal fixation with distal femoral locking plate
D Open reduction and internal fixation of the metaphyseal component but not the epiphyseal component to avoid potential growth arrest
E Open reduction and internal fixation of both components with plates and or screw fixation

ANSWER 26: **E.** Intraarticular fractures in kids are treated with similar attention as those in adults. Attention must be paid to the physeal region, but anatomic reduction and stability are required. Because children have thick periosteum and faster, more consistent healing, large rigid implants are not typically necessary (and will likely compromise physis) so C is not the best answer.

27 A 10-year-old boy with a spiral midshaft femur fracture from a sledding injury presents to the emergency department for evaluation. He is 48 inches tall and weighs 120 pounds. The BEST option for treatment would be:

- **A** Long-leg cast
- **B** Traction then long-leg cast
- **C** Retrograde flexible intramedullary nails
- **D** Rigid straight, antegrade intramedullary nail
- **E** Submuscular plating

ANSWER 27: **E.** Flexible intramedullary nails are contraindicated with weight more than 100 pounds and especially in spiral fracture patterns owing to the risk of malunion with deformation of the nails. Rigid, straight antegrade nails are contraindicated because of an increased risk of femoral head avascular necrosis with a start point in the piriformis fossa. Long-leg casts are not typically used for 10-year-olds because of high malunion rates. A trochanteric start (proximal bend) rigid nail would be a reasonable option but was not given as a choice.

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chapter 12 Review Questions

1 Which of the following pairings of a Latin legal phrase with the English meaning is correct?

A Respondeat superior: “The one who writes their answer is the best”
B Ad quod damnum: “Marketing improperly will curse you”
C Locum tenens: “Insane by actions”
D Res ipsa loquitur: “The thing speaks for itself”
E E pluribus unum: “A solo practitioner who leaves a group”
ANSWER 1: **D.**

2 You are the senior resident in the hospital dealing with the third patient to present with a hip fracture to your emergency room on a Saturday evening. Upon discussing the options with the family, the son, who is a prominent malpractice attorney in the community, demands that you call the attending adult reconstructive surgeon to perform a total hip arthroplasty for the patient, who is his active 70-year-old father. When the surgeon arrives from an industry-sponsored dinner lecture on the benefits of metal-on-metal bearings, you see that he is slurring his words, is unsteady on his feet, and appears unusually giddy. Select the most proper response:

A Carefully assist the adult reconstructive surgeon to ensure that no medical errors occur
B Offer to perform a closed reduction internal fixation of the hip fracture while the adult reconstructive surgeon supervises
C Discuss the situation with the trauma attending physician, who agrees to allow the PGY-2 to assist the impaired surgeon in this surgery
D Discuss your concerns with the impaired surgeon and refuse to assist during the case as long as he is impaired
E Prevent the impaired surgeon from operating and ensure that the department chairman and or senior hospital staff are notified
ANSWER 2: **E.**

3 The most ethical arrangement with industry includes which of the following?

A A consulting agreement in which a surgeon is paid for discussing his preferences in a total knee arthroplasty design
B Payment for royalties in which a company pays a usage-based fee for the license to use a patent created by the orthopaedic surgeon
C An agreement in which a surgeon is provided a travel stipend to attend an education-related event after performing a specific number of total knee procedures with a company's new implant
D A formal consulting agreement, proactively created, that provides a well-defined reimbursement for performing a set number of knee replacements with a company's most evidence-based implant
E An arrangement in which a company helps the surgeon to develop a special new procedure in which both the implant manufacturer and the surgeon share in a special “procedure patent” that is licensed to surgeons willing to attend a course to become proficient
ANSWER 3: **B**

4 The Emergency Medical Treatment and Active Labor Act (EMTALA):

A Forces orthopaedic surgeons to take calls
B Forces hospitals to see any patient who visits their emergency room
C Obligates orthopaedic surgeons to see all patients, regardless of patients’ ability to pay
D Mandates definitive treatment for all problems that are presented at the emergency room

E Prevents the community hospital from “dumping” a multitrauma patient at the Level I hospital after stabilization
ANSWER 4: **B**

5 During a busy week at an understaffed major university, a junior resident performs a common surgical procedure on a middle-age indigent fiddle player. The resident has performed the case five times before without problems. During this patient's procedure, however, complications arise, and although the junior resident calls her chief resident to the operating room for help, an unanticipated outcome results. The attending surgeon was never called. Despite multiple procedures at a later date by the attending hand surgeon, restoration of complete function is impossible. The fiddle player, unable to play, seeks legal help. In reviewing the case, multiple expert witnesses find that despite excellent care by the attending surgeon during the follow-up surgeries, the initial surgical care provided by the junior resident fell below the standard of care for a board-certified fellowship-trained hand surgeon. The most likely result is:

A A malpractice suit naming the attending hand surgeon under the principle of respondeat superior

B A malpractice suit naming the supervising chief resident or attending surgeon, or both, for failing to provide adequate help

C Dismissal of the junior resident from the case because the junior resident was in a training capacity

D Dismissal of the suit, because the junior resident provided care commensurate with her level of training

E Settlement for the fiddle player from the malpractice insurance company on behalf of the chief resident and reporting of the junior resident to the National Practitioner's Databank, because the standard of care for residents and fellows is exactly the same as for board-certified surgeons
ANSWER 5: **E**

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REVIEW OF ORTHOPAEDICS SIXTH EDITION MILLER

chapter 13 Review Questions

1 A research study includes chart reviews of patients who underwent a partial knee arthroplasty, and these reviews are compared with those of osteotomy recipients who were of the same age and weight and had the same level of arthritis. This study would best be described as:

- **A** Double-blind, placebo-controlled, randomized prospective trial
- **B** Retrospective, matched, case-controlled observational study
- **C** Retrospective, case series, observational study
- **D** Case series review
- **E** Case report

ANSWER 1: **B.** This description is of a case-control study in which patients are matched on the basis of age, weight, and level of arthritis. There is no intervention, so it is not a clinical trial. A case series is an observational design for a particular patient population. A case report is an observational design describing an occurrence of a unique medical finding or outcome.

2 "Validity" describes whether a clinical instrument or test:

- **A** Produces measurements that represent reality or the true measurement
- **B** Produces consistent scores in similar situations
- **C** Produces a result that is statistically significant
- **D** Produces similar results with repeated measurements
- **E** Produces the proper reimbursement for the work performed

ANSWER 2: **A.** The validity of a clinical instrument or test is the ability to accurately represent truth or reality. Validity is established by comparison with a "gold standard." Reliability is the ability to consistently describe a particular characteristic with repeated measurements and in similar situations. Validity and reliability are not related to determining statistical significance.

3 In epidemiology studies, "incidence" is:

- **A** The proportion of individuals with a disease right now
- **B** The rate of the new occurrences of a disease per unit of time
- **C** The proportion of a sample population with a disease under study
- **D** Variability occurring between successive observations by the same surgeon
- **E** Variability occurring between observations by different surgeons

ANSWER 3: **B.** Incidence is the proportion of new injuries or disease cases within a specified time interval. Therefore, a follow-up period is needed to calculate rate as a measure of new cases per unit time. Prevalence is the proportion of existing injuries or disease cases within a particular population at a particular moment in time. Reliability is the variability in observations by the same rater (intrarater reliability) or multiple raters (interrater reliability).

4 During clinical follow-up, a subjective pain rating from two unmatched groups of patients with chronic patellofemoral joint pain is collected. One of the groups received a surgical intervention, and the other received conservative management. The purpose of the study is to compare subjective pain rating between the two groups. Which of the following statistical tests is most appropriate?

A Repeated-measures ANOVA
B Spearman rho correlation coefficient
C Independent-samples t-test
D Paired-samples t-test
E Logistic regression

ANSWER 4: **C.** Statistical comparison between two groups is performed with an independent-samples t-test. The paired-samples (also referred to as dependent-samples) t-test is appropriate for within-subject comparisons or for matched-group comparisons. Repeated-measures ANOVA is used to compare sequential measurements recorded in the same subjects. The Spearman rho correlation coefficient is used to calculate relationships among two categorical or nonnormally distributed continuous data. Logistic regression is used for prediction with categorical data.

5 A statistical test is associated with a P value of 0.04. What is the interpretation of this value?
A There is 4% chance of being wrong when the test is described as “statistically significant.”
B There is 4% chance of being correct when the test is described as “statistically significant.”
C The type II error is excessive.
D The study has insufficient statistical power.
E There is a 96% chance that the test is clinically important.

ANSWER 5: **A.** P (probability) values describe the probability that a test statistic occurred by chance. If the test statistic occurred by chance, then it would be “wrong” to say the relationship was real or “statistically significant.” It is generally acceptable to commit this error (type I error) 5% of the time or less (indicated by P = 0.05). If P = 0.04, then there is a 4% chance of committing a type I error, so it is acceptable to say the test is “statistically significant.” P values do not describe statistical power, rate of type II errors, or clinical importance.