Questions

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1. During the first stage of osteoarthritis, which of the following processes predominates?

(1) Loss of articular cartilage proliferative response.
(2) Release of mediators by chondrocytes that stimulate anabolic and catabolic responses.
(3) Decreased proteoglycan and aggrecan concentration and increased water content.
(4) Decline in chondrocyte anabolic response.
(5) Increased synthesis of matrix macromolecules.

2. A patient with a history of chronic lower back pain for several years reports decreased pain visual analog scores with the use of a transcutaneous electrical neuromuscular stimulation unit at home. This pain relief is most likely due to which of the following?

(1) Improved skeletal muscle strength and secondary spinal support.
(2) Neuromodulation through presynaptic inhibition in the dorsal horn of the spinal cord.
(3) Distraction sensory input.
(4) Enhancement of muscle metabolic activity with improved lactic acid excretion.
(5) Placebo effect.

3. Which of the following regions in the growth plate is commonly affected in a Salter–Harris type II injury?

(1) Reserve zone.
(2) Proliferative zone.
(3) Hypertrophic zone.
(4) Primary spongiosa.
(5) Epiphyseal zone.

4. During the cocking and acceleration phases of the overhand throw (pitch), there are several static and dynamic restraints to provide medial elbow support and prevent valgus instability. The dynamic structures found to be most important during these phases of the overhand throw are the flexor digitorum.

(1) Profundus and extensor carpi radialis longus.
(2) Profundus and extensor carpi radialis brevis.
(3) Superficialis and extensor carpi radialis longus.
(4) Superficialis and flexor carpi ulnaris.
(5) Superficialis and flexor carpi radialis.

5. During a knee arthroscopy on a 38-year-old patient with isolated medial knee pain and no lateral symptoms, a routine examination of the lateral compartment revealed a discoid lateral meniscus. The discoid lateral meniscus was not torn. On the basis of these findings, what is the most appropriate action?

(1) Complete lateral meniscectomy.
(2) Lateral meniscal repair.
(3) Saucerization of the lateral meniscus.
(4) Microfracture of the lateral femoral condyle.
(5) Do nothing surgically to the lateral meniscus.

6. An 11-year-old boy who is a Little League pitcher has a 3-month history of right elbow pain, made worse after several innings of pitching. The pain is in the posterior and medial aspect of the elbow joint but is without clicking or mechanical symptoms. There are no signs of infection or swelling, and range of motion is full. There is tenderness over the medial aspect of the elbow distal to the humeral epicondyle over the proximal olecranon. Valgus stress testing of the elbow is normal. What is the most likely diagnosis?

(1) Olecranon bursitis.
(2) Osteochondritis dissecans of the capitellum.
(3) Ulnar collateral ligament insufficiency.
(4) Medial epicondylitis.
(5) Olecranon stress fracture.

7. What is the most common physical finding in a patient with femoroacetabular impingement (FAI)?

(1) Increased external rotation.
(2) Increased abduction.
(3) Decreased external rotation.
(4) Decreased flexion and internal rotation.
(5) Decreased adduction.

8. Which of the following types of intra-articular pathology is associated with lateral meniscal cysts?

(1) Discoid meniscus.
(2) Posterolateral corner injury.
(3) Vertical meniscal tears.
(4) Middle third lateral meniscal tears.
(5) Popliteus tendon tears.

9. A 22-year-old male soccer player reports left hip and groin pain. He states that symptoms began before a preseason tournament but have worsened steadily for the

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past 2 weeks. He denies any recent fever or sickness and is otherwise healthy. Examination reveals tenderness over the symphysis pubis and pain with resisted rectus abdominus testing. Radiographs are negative. What is the next step in the proper management of this patient?

(1) Rest, NSAIDs, rehabilitation, and gradual return to play.
(2) Aspiration of the symphysis pubis followed by an appropriate course of antibiotics.
(3) Referral to a general surgeon for hernia evaluation.
(4) Rigid plating across the symphysis to address instability.
(5) MRI evaluation of the symphysis.

10. An otherwise healthy 25-year-old man underwent a right anterior cruciate ligament reconstruction with a bone–patellar tendon–bone allograft. Routine preimplantation cultures of the allograft taken by the surgeon were positive for coagulase-negative Staphylococcus spp. 5 days postoperatively. The patient has exhibited no evidence of clinical infection and his postoperative course has been uncomplicated during this time. What is the ideal method for management of this patient?

(1) Observation.
(2) Oral antibiotics for 6 weeks.
(3) Intravenous antibiotics for 6 weeks.
(4) Arthroscopic irrigation and debridement with graft retention.
(5) Arthroscopic irrigation and debridement with graft removal.

11. Advantages of a resurfacing metal-on-metal hip arthroplasty over a large diameter metal-on-metal total hip arthroplasty include which of the following?

(1) Lower risk of femoral component loosening.
(2) Acetabular bone preservation.
(3) Lower reoperation rate.
(4) Femoral bone preservation.
(5) Lower wear rate.

12. Patients with fulminant disseminated intravascular coagulation (DIG) have which of the following findings?

(1) Patients frequently have elevated fibrinogen levels.
(2) Patients frequently have decreased D-dimer levels.
(3) Rapid infusion of intravenous heparin is generally curative.
(4) Prothrombin time is usually normal.
(5) Activated partial thromboplastin time is frequently elevated.

13. Effective management of heterotopic ossification (HO) following total hip arthroplasty should include which of the following?

(1) Indomethacin treatment for 10 days postoperatively.
(2) Immediate excision of established HO followed by radiation therapy or indomethacin treatment.
(3) Postoperative administration of ethylhydroxydiphosphonate.
(4) Preoperative administration of radiation therapy 1 week before surgery.
(5) Postoperative administration of radiation therapy.

14. At the time of revision total knee arthroplasty, the surgeon is trialing the knee and finds that it extends fully and is stable in flexion with a 23-mm trial spacer; however, the patella is impinging on the polyethylene spacer. No augments were used on the femur or the tibia because the components fit well without them. What is the most appropriate action at this time?

(1) Proceeding with implantation of the final components.
(2) Performing Z-lengthening of the patellar tendon.
(3) Increasing the size of the femoral component and using posterior femoral augments to decrease the size of the flexion gap.
(4) Increasing the size of the femoral component and using augments both distally and posteriorly to lower the joint line and decrease the size of the flexion gap.
(5) Placing distal femoral augments on the femoral component to lower the joint line.

15. A 68-year-old woman is undergoing a cementless medial/lateral tapered femoral placement during a total hip arthroplasty and the surgeon notices a small crack forming in the anteromedial femoral neck with final implant insertion. The most appropriate management should include which of the following?

(1) Placement of a cerclage cable around the femoral neck above the lesser trochanter.
(2) Removal of the implant, placement of a cable around the femoral neck above the lesser trochanter, and reinsertion of the implant.
(3) Removal of the press-fit implant and cementing of the same femoral stem.
(4) Final seating of the cementless femoral component without additional measures.
(5) Removal of the cementless femoral component and placement of a revision modular taper-fluted femoral stem.

16. A 12-year-old child with Duchenne's muscular dystrophy has a 40° scoliotic deformity. Before surgery, the orthopedic surgeon should

(1) Wait for further progression.
(2) Request a hematology consult.
(3) Request a neurology consult.
(4) Request a cardiology consult.
(5) Implement a 6-month trial of bracing.

17. A 12-year-old boy with a family history of neurofibromatosis has anterolateral bowing of the left tibia. He has no pain and is ambulatory. Radiographs show a

narrowed medullary canal but intact cortices. Treatment should consist of which of the following?

(1) Ankle–foot orthosis with anterior shell.
(2) Vascularized fibular graft.
(3) Intramedullary nailing of the left tibia.
(4) Amputation.
(5) Physical therapy.

18. A 6-year-old child is seen in the emergency department after falling from the monkey bars. Examination reveals tenderness of the right humerus and an inability to dorsiflex the wrist. No other injuries are identified. Radiographs show a minimally displaced and angulated (10° of varus angulation) fracture of the distal one-third of the humeral shaft. Initial management should consist of which of the following?

(1) Immediate exploration of the radial nerve and cast application.
(2) Immediate exploration of the radial nerve, with percutaneous Kirschner-wire fixation.
(3) Immediate exploration of the radial nerve with open reduction and plate fixation.
(4) Monitoring of radial nerve function and application of a sling and swathe.
(5) Monitoring of radial nerve function and external fixation.

19. A 5-year-old boy is seen in the emergency department with a 2-day history of refusing to walk. Examination shows that he has a temperature of 102.2°F (39°C) and limited range of motion of the right hip. The anteroposterior pelvic radiograph is normal. The white blood cell count is normal but the C-reactive protein level and the erythrocyte sedimentation rate are elevated. What is the next step in management?

(1) Intravenous antibiotics.
(2) Oral antibiotics.
(3) Ibuprofen.
(4) Observation and repeat evaluation in 2 weeks.
(5) Aspiration of the right hip.

20. A 10-year-old boy is hit by a car and sustains open left tibia and fibula fractures with a bone protruding through a 7-cm laceration, multiple deep and superficial abrasions over the anterior leg, and road gravel present in the wounds. His foot is warm and well-perfused with normal sensation, and he has no pain with passive range of motion in the toes. Optimal treatment should consist of

(1) Irrigation and debridement of the fractures and application of an external fixator.
(2) Irrigation and debridement of the fractures and a reamed intramedullary nail.
(3) Irrigation and debridement of the fracture and percutaneous Kirschner-wire fixation.
(4) Submuscular plating.
(5) Reduction and a short leg cast.

Answers

1: Preferred response: 3

Discussion: Articular cartilage degeneration and ensuing osteoarthritis can be divided into three stages. In the first stage, the water content increases and proteoglycan aggregation and aggrecan concentration are both decreased. Increased water content tends to decrease the stiffness of the matrix, rendering cartilage tissue more susceptible to further mechanical damage. In the second stage, chondrocytes detect tissue damage and respond by releasing mediators to increase proliferation. Clusters or clones of proliferating chondrocytes are the hallmark of the response to articular degeneration. In the third stage, both the proliferative response and anabolic activity are decreased. In this stage, the loss of articular cartilage is more evident and leads to clinical signs of degenerative joint disease.

References: Einhorn TA, O'Keefe RJ, Buckwalter JA, editors. Orthopaedic Basic Science: Foundations of Clinical Practice. 3rd ed. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2007. pp. 161–174.

Buckwalter JA, Mankin HJ, Grodzinsky AJ. Articular cartilage and osteoarthritis. *Instr Course Lect* 2005; **54**:465–480.

2: Preferred response: 2

Discussion: Transcutaneous electrical neuromuscular stimulation units deliver superficial electrical stimulation. This electrical stimulation induces analgesia through inhibitory effects at the spinal cord level. The stimulation of small myelinated afferent fibers causes presynaptic inhibition of the nociceptive transmission through unmyelinated C fibers, thus decreasing the transmission of pain stimuli. An additional benefit may be obtained from the endogenous release of endorphins in the stimulated tissues.

References: Cheing GL, Hui-Chan CW. Transcutaneous electrical nerve stimulation: nonparallel antinociceptive effects on chronic clinical pain and acute experimental pain. *Arch Phys Med Rehabil* 1999; **80**:305–312.

King EW, Audette K, Athman GA, *et al*. Transcutaneous electrical nerve stimulation activates peripherally located alpha-2A adrenergic receptors. *Pain* 2005; **115**:364–373.

3: Preferred response: 3

Discussion: A type II injury consists of a fracture along the hypertrophic zone of the growth plate with an attached metaphyseal bony fragment. The hypertrophic zone is the metaphyseal fragment and is located on the compressive or concave side, whereas the periosteum is torn on the tensile or convex side. The reserve and proliferative zones remain with the epiphysis, and the circulation is usually preserved.

Reference: Buckwalter JA, Einhorn TA, Simon SR, editors. Orthopaedic Basic Science: biology and biomechanics of the musculoskeletal system. 2nd ed.

Rosemont, IL: American Academy of Orthopaedic Surgeons; 2000. pp. 77–109.

4: Preferred response: 4

Discussion: Biomechanical analysis has demonstrated that local dynamic stability of the elbow is provided by the flexor digitorum superficialis and the flexor carpi ulnaris, especially during the cocking and acceleration phases of the overhand throw. This provides dynamic joint compression across the elbow joint and may be protective to the static restraints such as the ulnar collateral ligament. It also emphasizes the need to strengthen distant muscles in the forearm to assist with elbow biomechanics and potentially prevent injury.

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

Garrick JG, ed. Orthopaedic Knowledge Update: sports medicine 3. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2004 pp. 101–111.

5: Preferred response: 5

Discussion: The most appropriate action is to note this finding in the surgical report but do nothing surgically in the lateral compartment. Multiple studies have shown that asymptomatic discoid lateral menisci seen on routine knee arthroscopies for other pathology need not be addressed surgically. They do not cause problems later in life and do not need to be treated prophylactically.

References: Smith CF, Van Dyk GE, Jurgutis J, *et al.* Cautious surgery for discoid menisci. *Am J Knee Surg* 1999; **12**:25–28.

Kelly BT, Green DW. Discoid lateral meniscus in children. *Curr Opinion Pediatr* 2002; **14**:54–61.

6: Preferred response: 5

Discussion: The patient has an olecranon stress fracture that is an overuse injury from pitching. The repetitive forceful contraction of the triceps coupled with varus and valgus torques about the elbow are believed to cause the separation of the olecranon epiphysis from the adjacent epiphyseal plate, as reported by Torg and Moyer. This may persist into late adolescence; Charlton and Chandler described five throwing athletes between the ages of 16 and 20 years with delayed closure of the olecranon epiphysis and inability to throw. The ulnar collateral ligament was intact in all. The patients in their study underwent open reduction and internal fixation with a tension band wire, screw fixation, and autogenous bone graft in some of the cases. At 32 months, all were asymptomatic despite a prolonged preoperative course (>30 months) of limiting pain. It is important to recognize stress fractures about the elbow in a young pitching population and treat them accordingly, beginning with rest and cessation of throwing activities. If prolonged, surgical fixation provides reliable results.

References: Charlton WP, Chandler RW. Persistence of the olecranon physis in baseball players: results following operative management. *J Shoulder Elbow Surg* 2003; **12**:59–62.

Torg JS, Moyer RA. Non-union of a stress fracture through the olecranon epiphyseal plate observed in an adolescent baseball pitcher. *J Bone Joint Surg Am* 1977; **59**:264–265.

Rettig AC, Wurth TR, Mieling P. Nonunion of olecranon stress fractures in adolescent baseball pitchers: a case series of 5 athletes. *Am J Sports Med* 2006; **34**:653–656.

7: Preferred response: 4

Discussion: Loss of flexion and internal rotation are hallmarks of FAI. Maximal internal rotation testing with the hip flexed 90° is also known as the anterior impingement test, causing deep groin pain and reproduction of symptoms. Occasionally, a posterior impingement test will be positive with extension and external rotation. There are a variety of causes of FAI; however, the pathology limits motion as the femur (cam) and acetabulum (pincer) are in contact with one another. In addition, only one location needs to be present, such as cam-type or pincer-type versus both cam–pincer lesions, to cause symptoms.

References: Philippon MJ, Stubbs AJ, Schenker ML, *et al.* Arthroscopic management of femoroacetabular impingement: osteoplasty technique and literature review. *Am J Sports Med* 2007; **35**:1571–1580.

Siebenrock KA, Schoeniger R, Ganz R. Anterior femoroacetabular impingement due to acetabular retro-version: Treatment with periacetabular osteotomy. *J Bone Joint Surg Am* 2003; **85**:278–286.

Kubiak-Langer M, Tannast M, Murphy SB, *et al.* Range of motion in anterior femoroacetabular impingement. *Clin Orthop Relat Res* 2007; **458**:117–124.

8: Preferred response: 4

Discussion: Lateral meniscal cysts often arise from myxoid degeneration that progresses from the meniscal center and then outside the meniscus. Horizontal cleavage tears are commonly associated with the condition. Cysts of the lateral meniscus are most commonly the consequence of a tear located in the medial third. If the tear communicates with the joint, arthroscopic partial meniscectomy and cyst decompression are indicated. If the tear does not open into the joint, arthroscopy should be followed by an open cystectomy.

References: Hulet C, Souquet D, Alexandre P, *et al.* Arthroscopic treatment of 105 lateral meniscal cysts with 5-year average follow-up. *Arthroscopy* 2004; **20**:831–836.

Ferrer-Roca O, Vilalta C. Lesions of the meniscus: part I. Macroscopic and histologic findings. *Clin Orthop Relat Res* 1980; **146**:289–300.

Ferrer-Roca O, Vilalta C. Lesions of the meniscus: part II. Horizontal cleavages and lateral cysts. *Clin Orthop Relat Res* 1980; **146**:301–307.

9: Preferred response: 1

Discussion: Appropriate management of osteitis pubis includes rest, NSAIDs, directed rehabilitation, and gradual return to sports. Lack of fever or chills excludes osteomyelitis as a source of pain. Tenderness over the symphysis pubis on examination and pain with resisted rectus abdominus on testing is consistent with osteitis pubis as opposed to a sports hernia, in which a patient would be tender in the abdomen, not the pubis. There is no symphyseal instability that would require symphyseal plating.

References: Fricker PA, Taunton JE, Ammann W. Osteitis pubis in athletes. *Sports Med* 1991; **12**:266–279.

Williams PR, Thomas DP, Downes EM. Osteitis pubis and instability of the pubic symphysis: when nonoperative measures fail. *Am J Sports Med* 2000; **28**:350–355.

10: Preferred response: 1

Discussion: The incidence of preimplantation positive cultures of musculoskeletal allografts used for anterior cruciate ligament reconstruction has varied between 4.8 and 13.3%. Interestingly, in none of the studies evaluating this issue did any of the patients implanted with a 'contaminated' graft develop a clinical infection. The results of the current literature suggest that treatment for low-virulence organisms is unnecessary if no evidence of clinical infection exists. Preimplantation cultures do not appear to correlate with clinical infection. Therefore, the routine culture of allograft tissue is not recommended.

References: Diaz-de-Rada P, Barriga A, Barroso JL, *et al*. Positive culture in allograft ACL-reconstruction: What to do? *Knee Surg Sports Traumatol Arthrosc* 2003; **11**:219–222.

Guelich DR, Lowe WR, Wilson B. The routine culture of allograft tissue in anterior cruciate ligament reconstruction. *Am J Sports Med* 2007; **35**:1495–1499.

Centeno JM, Woolf S, Reid JB III, *et al.* Do anterior cruciate ligament allograft culture results correlate with clinical infections? *Arthroscopy* 2007; **23**:1100–1103.

11: Preferred response: 4

Discussion: A resurfacing hip arthroplasty preserves bone stock in the proximal femur at the expense of a higher reoperation rate because of component loosening and femoral neck fracture. Wear rate is the same as both types of hip arthroplasty use a large head metal-on-metal bearing surface.

References: Shimmin A, Beaule PE, Campbell P. Metal-on-metal hip resurfacing arthroplasty. *J Bone Joint Surg Am* 2008; **90**:637–654.

Buergi ML, Walter WL. Hip resurfacing arthroplasty: the Australian experience. *J Arthroplasty* 2007; **22**:61–65.

12: Preferred response: 5

Discussion: DIG is a syndrome that spans a spectrum from relatively asymptomatic to life-threatening. In its fulminant form, patients undergo widespread microvascular thrombosis, leading to overconsumption of coagulation factors and platelets and subsequent hemorrhage. End-organ failure frequently results. The condition is therefore a 'thrombohemorrhagic' disorder. The exact pathophysiology remains poorly understood, but it can be seen in conjunction with a variety of medical conditions, including massive transfusions, sepsis, burns, crush injuries, liver disease, autoimmune disorders, hemolysis, obstetrical emergencies, and malignancy. Laboratory abnormalities frequently include depressed levels of fibrinogen and platelets, increased levels of fibrinogen degradation products and D-dimer, and an elevation in the prothrombin time and activated partial thromboplastin time. In fulminant DIG, treatment is controversial and frequently unsuccessful, leading to death of the affected patients. Heparin, although commonly used, has not been shown to have beneficial effects in controlled trials. Low-grade DIG frequently improves with correction of the underlying medical disorder.

Reference: Townsend CM, Beauchamp RD, Evers BM, *et al*., editors. Sabiston textbook of surgery: the biologic basis of modern surgical practice. 18th ed. Philadelphia, PA: Saunders Elsevier, 2008. pp. 122–123.

13: Preferred response: 5

Discussion: Postoperative administration of ethylhydroxydiphosphonate results in a delay in mineralization of the osteoid, but ultimately HO formation is not decreased. In addition, the delay in mineralization does not improve the range of motion of involved hips. Indomethacin has proven to be an effective long-term therapy. To be most effective, radiation therapy must be performed in the immediate postoperative period.

References: Lorio R, Healy WL. Heterotopic ossification after hip and knee arthroplasty: risk factors, prevention, and treatment. *J Am Acad Orthop Surg* 2002; **10**:409–416.

Pellegrini VD Jr, Gregoritch SJ. Preoperative irradiation for prevention of heterotopic ossification following total hip arthroplasty. *J Bone Joint Surg Am* 1996; **78**:870–881.

Pellegrini VD Jr, Konski AA, Gastel JA, *et al.* Prevention of heterotopic ossification with irradiation after total hip arthroplasty: radiation therapy with a single dose of eight hundred centigray administered to a limited field. *J Bone Joint Surg Am* 1992; **74**:186–200.

14: Preferred response: 4

Discussion: The surgeon in this case is faced with a common scenario at the time of revision total knee arthroplasty and the tendency is to elevate the joint line. Elevation of the joint line is associated with deleterious effects including anterior knee pain, restricted knee flexion, and instability. The error made was resting the femoral component on the bone that is left behind after removal of the previous component; this typically leads to a femoral component that is too small (leading to an enlarged flexion gap) and is located proximal to where it should be (enlarging the extension gap). Although the flexion and extension gaps were equivalent, joint line elevation occurred. To correct this problem, the femoral component size should be increased or offset posteriorly

(to decrease the size of the flexion gap) and distal femoral augments should be used to decrease the size of the extension gap and restore the joint line to the appropriate level.

References: Laskin RS. Joint line position restoration during revision total knee replacement. *Clin Orthop Relat Res* 2002; **404**:169–171.

Yoshii I, Whiteside LA, White SE, *et al.* Influence of prosthetic joint line position on knee kinematics and patellar position. *J Arthroplasty* 1991; **6**:169–177.

Barrack RL, Booth RE Jr, Lonner JH, *et al.*, editors. Orthopaedic knowledge update: hip and knee reconstruction 3. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 123–145.

15: Preferred response: 2

Discussion: The recognized treatment for a proximal periprosthetic fracture is the identification of its extent and then optimization of the correction. Removing the implant seems logical for identification. Several studies indicate that proximal cerclage wiring is adequate to create a 'barrel hoop' stability for the proximal femur. Postoperative management may also include protected weight bearing and periodic radiographs.

References: Barrack RL, Booth RE Jr, Lonner JH, *et al.*, editors. Orthopaedic knowledge update: hip and knee reconstruction 3. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 475–503.

Warren PJ, Thompson P, Fletcher MD. Transfemoral implantation of the Wagner SL stem: the abolition of subsidence and enhancement of osteotomy union rate using Dall–Miles cables. *Arch Orthop Trauma Surg* 2002; **122**:557–560.

16: Preferred response: 4

Discussion: In Duchenne's muscular dystrophy, spinal deformities are common. Spinal deformity usually develops as a child begins sitting and during the preteen years. Unlike adolescent idiopathic scoliosis, scoliosis in Duchenne's muscular dystrophy is treated early; spinal fusion for a 40° deformity is not unusual. Although hematology and neurology consults are not usually necessary before surgery, every child should undergo a comprehensive cardiac evaluation, including an EKG and an echocardiogram, because cardiomyopathy is a part of the pathologic spectrum of Duchenne's muscular dystrophy, requiring preoperative assessment and intervention.

Reference: Fischgrund JS, editor. Orthopedic knowledge update 9. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2008. pp. 790.

17: Preferred response: 1

Discussion: Anterolateral bowing of the tibia is associated with confirmed neurofibromatosis in ~50% of patients. Although the risk for fracture with the development of pseudarthrosis exists, the initial treatment consists of bracing through maturity.

References: Vander Have KL, Hensinger RN, Caird M, *et al.* Congenital pseudarthrosis of the tibia. *J Am Acad Orthop Surg* 2008; **16**:228–236.

Vitale MG, Guha A, Skaggs DL. Orthopaedic manifestations of neurofibromatosis in children: an update. *Clin Orthop Relat Res* 2002; **401**:107–118.

18: Preferred response: 4

Discussion: Humeral shaft fractures in children rarely require open reduction. Shoulder and elbow function does not appear to be affected by up to 40° of angulation in this patient population. Because of the high rate of remodeling in pediatric patients, the standard treatment is immobilization in a sling and swathe, a hanging arm cast, or a compressive dressing. Surgical fixation of humeral shaft fractures is usually only necessary in open injuries, multitrauma, or severely displaced fractures. Most radial nerve injuries associated with humerus fractures are secondary to contusion. Almost all associated radial nerve injuries in pediatric patients can be treated with observation.

References: Abel MF, editor. Orthopaedic knowledge update: pediatrics 3. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 304.

Shrader MW. Proximal humerus and humeral shaft fractures in children. *Hand Clin* 2007; **23**:431–435.

Caviglia H, Garrido CP, Palazzi FF, *et al.* Pediatric fractures of the humerus. *Clin Orthop Relat Res* 2005; **432**:49–56.

19: Preferred response: 5

Discussion: The history, physical examination, and laboratory studies suggest a septic hip. Recent studies indicate that a child with an elevated erythrocyte sedimentation rate, a white blood cell count of greater than 12 000/mm^3, a temperature of greater than 38.5°, and who shows unwillingness to walk is very likely to have septic arthritis of the hip or toxic synovitis. The best way to confirm the diagnosis is by hip aspiration. No medication should be started until a diagnosis is made. Toxic synovitis is common but significantly less likely if three of the above criteria are present. This condition usually responds well to ibuprofen but requires close observation. Septic hip is considered an urgent condition and therefore a repeat evaluation in 2 weeks is inappropriate.

References: Herring JA. Tachdjian's pediatric orthopaedics. 4th ed. Philadelphia, PA: WB Saunders; 2008 pp. 2109–2113.

Abel MF, editor. Orthopaedic knowledge update: pediatrics 3. Rosemont, IL: American Academy of Orthopaedic Surgeons; 2006. pp. 62–65.

Kocher MS, Mandiga R, Murphy JM, *et al.* A clinical practice guideline for treatment of septic arthritis in children: efficacy in improving process of care and effect on outcome of septic arthritis of the hip. *J Bone Joint Surg Am* 2003; **85**:994–999.

Kocher MS, Mandiga R, Zurakowski D, *et al.* Validation of a clinical prediction rule for the differentiation between septic arthritis and transient synovitis of the hip in children. *J Bone Joint Surg Am* 2004; **86**:1629–1635.

20: Preferred response: 1

Discussion: The patient has a grade 2 open fracture and therefore needs wound debridement as a first step, followed by fracture stabilization preferably with an external fixator. A reamed intramedullary nail is not indicated in a 10-year-old child with open growth plates. Submuscular plating is not needed in an open fracture and there is no mention of fracture debridement. Percutaneous Kirschner wires will not provide adequate fracture stabilization, neither will a short leg cast. Flexible nailing should be considered as another form of fixation.

References: Buckley SL, Smith G, Sponseller PD, *et al.* Open fractures of the tibia in children. *J Bone Joint Surg Am* 1990; **72**:1462–1469.

Song KM, Sangeorzan B, Benirschke S, Browne R, *et al.* Open fractures of the tibia in children. *J Pediatr Orthop* 1996; **16**:635–639.