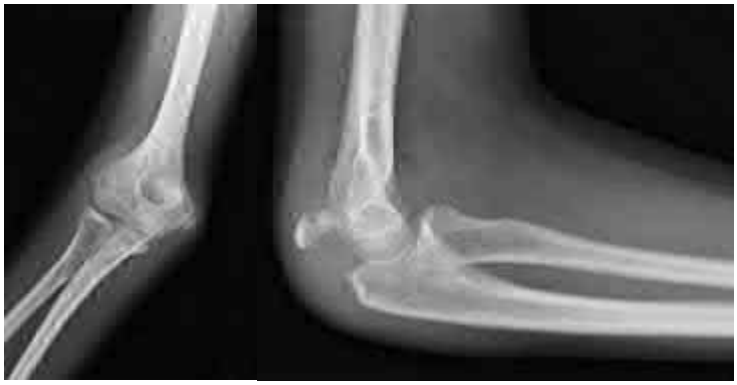
Pediatric Orthopaedic Scored and 1 Recorded Self-Assessment Examination 2020

Question 1 of 100

Figures 1 and 2 are the radiographs of an 11-year-old girl who is having right elbow pain after “trying to beat up a snowman.” She cannot extend her elbow, has point tenderness to palpation over the proximal ulna. Her underlying condition is associated with a mutation in which gene?



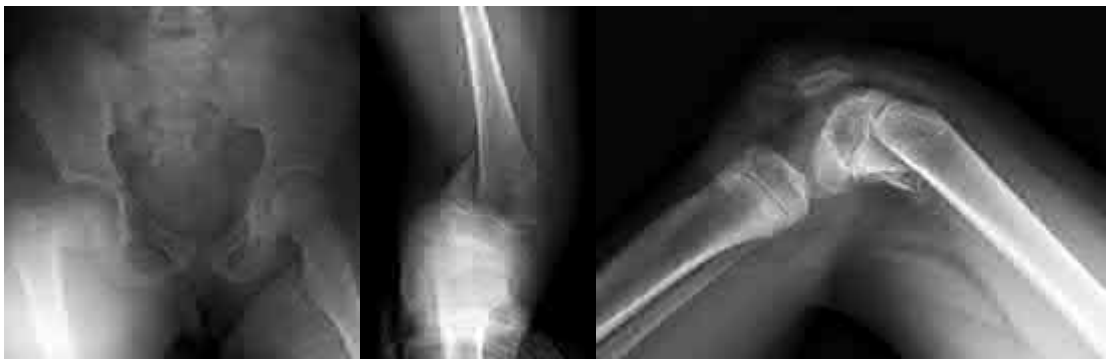
A. Fibroblast growth factor receptor 3 (FGFR3)
B. Diastrophic dysplasia sulfate transporter (DTDST)
C. COL1A1, COL1A2
D. COL2A1

R:C

This patient has a fracture of the olecranon, which is a common injury seen in children with osteogenesis imperfecta (OI), particularly type 1 OI. The genetic abnormality in OI is either autosomal dominant or recessive, with a mutation in collagen type 1, affecting COL1A1 and COL1A2 genes. FGFR3 mutations are associated with achondroplasia. DTDST mutations are seen in diastophic dysplasia. COL2A1 mutations are seen in spondyloepiphyseal dysplasia (SED), Kniest dysplasia, and Stickler syndrome.

Question 2 of 100

Figures 1 through 3 are the radiographs of a 7-year-old girl who sustained complex orthopaedic injuries falling from an all-terrain vehicle. She underwent successful treatment, which healed all of the injuries with no evidence of avascular necrosis or physeal arrest of the right proximal femur, but complete physeal arrest of the distal femur is noted 12 months post-injury. She returns at age 13 years complaining of leg-length discrepancy (LLD). Bone age is age 13. Based on her predicted leg length discrepancy at maturity, which procedure is most appropriate?



A. Contralateral closed femoral shortening
B. Limb lengthening with distraction osteogenesis
C. Open Phemister epiphysiodesis of the contralateral femur
D. Guided growth epiphysiodesis of the contralateral distal femur

R: B

distal femur physis is responsible for 9 mm of longitudinal growth per year. She is expected to reach skeletal maturity at age 14 years. Her projected LLD at maturity is ~6 cm. A limb length discrepancy of >5 cm is typically treated with distraction osteogenesis of the short limb. Closed femoral shortening >5 cm may result in quadriceps insufficiency. An accommodative shoe lift would be useful for an LLD <2-2.5 cm. Phemister is an open technique for physeal ablation by removing a segment of bone and reinserting it in a flipped position. Guided growth epiphysiodesis using staples or eight plates placed at the distal femur is also an option; however, given her remaining growth, neither Phemister, nor guided growth techniques will provide sufficient correction.

Question 3 of 100

A 13-year-old boy is complaining of elbow and wrist pain following a fall off a bike. Radiographs are taken in the emergency department (Figures 1 through 4). The wrist injury is unstable, and the patient is taken to the operating room for closed reduction and pinning of the distal radius fracture, closed treatment of the proximal fractures. Subsequent to surgery, the patient is noted to have increased irritability and progressively requires more IV pain medication throughout the night. He is anxious, argumentative, and refuses to comply with neurovascular assessments of his upper extremity. What is the best next step in treatment for this patient?

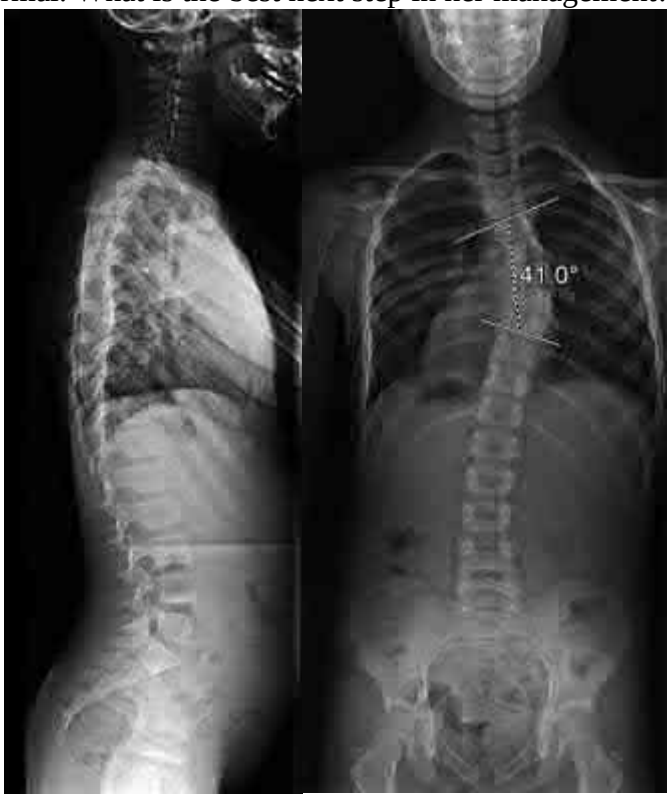
A. Provide diazepam (Valium) for anxiety and muscle spasms
B. Continue with ice, elevation, anti-inflammatory drugs to improve pain and swelling
C. Measure compartment pressures within the volar and dorsal forearm compartments
D. Return to the operating room for emergent volar and dorsal compartment fasciotomies

R: D

This patient is manifesting the signs of acute compartment syndrome (ACS). In the pediatric population, the 5 P's are less reliable signs of ACS. Instead, pediatric patients manifest increasing analgesic requirements, agitation, and anxiety in the evolution of ACS. Given this patient's clinical signs and risk factors for developing ACS (increased age/adolescence, male predominance, multiple fractures within an extremity), the appropriate treatment is to proceed with emergent forearm fasciotomies.
Administering diazepam (Valium) for the anxiety only masks the underlying condition, which may result in a poorer prognosis if the diagnosis is further delayed. Providing ice and elevation may be useful to diminish swelling and pain, but will not successfully treat the compartment syndrome. Importantly, the diagnosis of ACS is primarily a clinical one. Measuring compartment pressures may be more useful to help confirm or rule out the diagnosis in an obtunded child or one with severe mental/communication difficulty.

Question 4 of 100

Figure 1 and 2 are the radiographs of a 5-year-old girl who is being evaluated for back pain and intermittent headaches. Her parents deny any injury, changes in bowel or bladder function, or significant family history. Her neurological exam is normal. What is the best next step in her management?



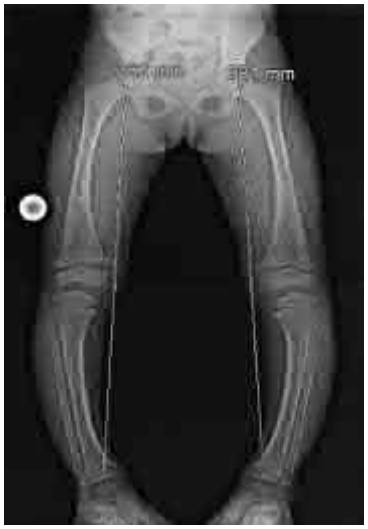
A. Physical therapy
B. Observation
C. MRI of the entire spine
D. Thoracolumbar sacral orthosis (TLSO)

R: C

This is a 5-year-old girl with a new diagnosis of scoliosis, having an isolated right thoracic curve. This is considered juvenile onset idiopathic scoliosis, which presents between the ages of 3-9 years old. The initial radiographs show a curve measuring 41°. Any curve >20° in a patient with early onset scoliosis should undergo MRI of the entire spine to assess for intraspinal pathology, with an average of 20% of patients having underlying diagnoses, i.e. Arnold-Chiari, syringomyelia. Observation or TLSO bracing may be indicated; however, an MRI is still the first line of management in this patient. Physical therapy may be useful for adjunct treatment, but the MRI is still required at this stage of evaluation and diagnosis.

Question 5 of 100

Figure 1 is the radiograph of a 4-year-old girl who is being evaluated for genu varum. She has a family history of bowed legs and short stature. She has a mutation in the *PHEX* gene. Identify the laboratory studies most consistent with this diagnosis.



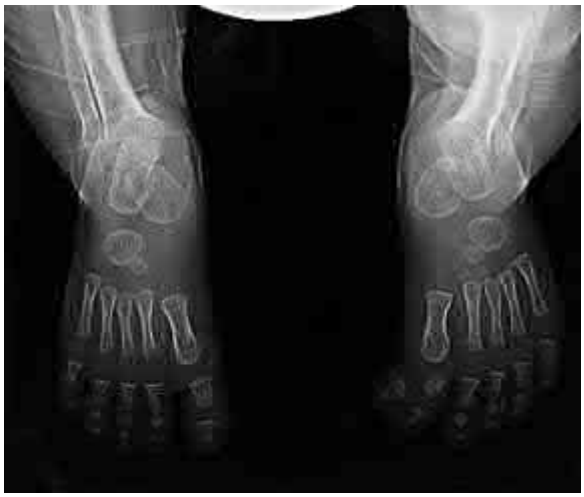
A. Decreased phosphorus, increased serum alkaline phosphatase, normal calcium and vitamin D 25-OH
B. Decreased phosphorus and calcium, increased serum alkaline phosphatase and increased PTH, decreased 1,25 OH vitamin D
C. Increased phosphorus, increased calcium, decreased alkaline phosphatase
D. Increased phosphorus, decreased calcium, increased alkaline phosphatase, and increased PTH

R: A

This patient has the diagnosis of X-linked hypophosphatemic rickets, which is associated with a mutation in the *PHEX* gene. Answer A demonstrates the typical lab findings with this diagnosis. Answer B is associated with vitamin D-dependent rickets type 1. Answer C is associated with hypophosphatasia. Answer D is associated with renal osteodystrophy.

Question 6 of 100

Figure 1 is the radiograph of a 7-month-old boy who is being evaluated for an isolated right forefoot deformity that has not improved over time. His parents are worried about difficulty with shoe wear in the future. In addition to excising the duplicated medial digit, what is the most appropriate combined procedure to perform on this patient?



A. Osteotomy of the first metatarsal
B. Physiolysis
C. Osteotomy of the proximal phalanx
D. Release of the abductor hallucis muscle

R: D

This patient has pre-axial polydactyly with a longitudinal epiphyseal bracket. A longitudinal epiphyseal bracket (LEB) is also known as a delta phalanx. The proximal epiphysis is C- shaped and extends along the medial side of a phalanx or metatarsal, forming a trapezoid shape to the bone. This patient has an LEB of the proximal phalanx, and it is not yet ossified. There are four stages of the condition; the first is pre-ossified. In this situation you would remove the duplicated medial digit, then excise the bracket (physiolysis). Interposition material may be placed, especially as more ossification occurs.
Excision of the duplicated digit alone will result in continued deformity, or hallux varus, of the great toe with growth. Excision of the duplicated digit with osteotomy is performed when ossification is complete and the epiphyseal bracket is closed. Releasing the abductor hallucis may be helpful if it is taut and behaves as a deforming force, but this will not correct the underlying abnormality of the delta phalanx.

Question 7 of 100

A 15-year-old boy is brought to the emergency department after one week of left shoulder pain after lifting weights. He is also complaining of fever, chills, nausea, and fatigue. He appears in distress; his skin is mottled. He decompensates and is transferred to the ICU. Vital signs are temperature of 39.4°C, heart rate 165 bpm, and blood pressure of 80/55. WBC count at admission is 22.4; CRP level is 37.7 mg/dL. Which antibiotic should be started empirically?

A. Vancomycin
B. Clindamycin
C. Ticarcillin-clavulanate
D. Cefazolin

R: A

The initial antibiotic therapy for suspected methicillin-resistant *Staphylococcus aureus* (MRSA) infections in patients with sepsis and/or instability is Vancomycin. Clindamycin is useful for first-line therapy in MRSA infections in which the patient is clinically stable, without ongoing bacteremia or intravascular infection. Neither cefazolin nor ticarcillin-clavulanate is appropriate empiric treatment for suspected MRSA.

Question 8 of 100

Which factor leads to the worst long-term prognosis in slipped capital femoral epiphysis (SCFE), most likely requiring total hip arthroplasty (THA)?

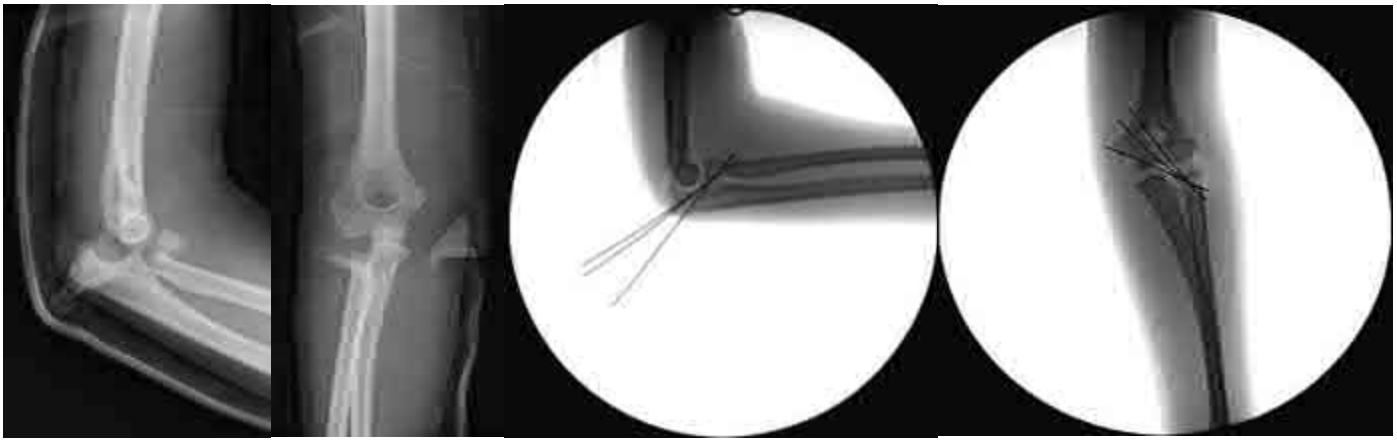
A. Avascular necrosis (AVN)
B. Age at onset of SCFE
C. Slip severity or slip angle
D. Femoral acetabular impingement (FAI) with degenerative changes

R: A

In patients identified and treated for a SCFE, the most devastating complication is AVN. The most likely indication for a total joint replacement in patients with SCFE is the presence of AVN or chondrolysis. The severity of slip, presence of FAI, and/or degenerative changes may increase the possibility of requiring a THA, but typically at an older age than patients with AVN. The age of onset of SCFE has not been found to be directly related to complications or outcomes, such as the development of AVN.

Question 9 of 100

Figures 1 through 4 are the injury radiographs and postsurgical open treatment radiographs of a 13-year-old girl who fell while on a trampoline and sustained an injury to her right-dominant elbow. The skin is closed and she has normal vascular and neurologic examination findings. Which complication most likely could occur as a result of this injury and treatment?



A. Compartment syndrome
B. Loss of elbow motion
C. Avascular necrosis (AVN) of the radial head
D. Nonunion of the fracture site

R: B

This girl sustained a fracture dislocation of the elbow with a severely displaced and rotated radial neck fracture. Required treatment was open reduction and internal fixation (ORIF). Less severely displaced radial neck fractures can be treated with closed reduction, percutaneous pinning, or flexible nail manipulation. In this scenario, interposed capsular tissue and rotation of the radial head were indications for ORIF. ORIF is associated with a higher risk for poor outcomes. Complications following ORIF of radial neck fractures in children include posterior interosseous neuropraxia, valgus angulation, premature closure of the radial head physis, AVN of the radial head, nonunion, and elbow stiffness. Stiffness is most common. Compartment syndrome, infection, and anterior interosseous nerve palsy are less common complications.

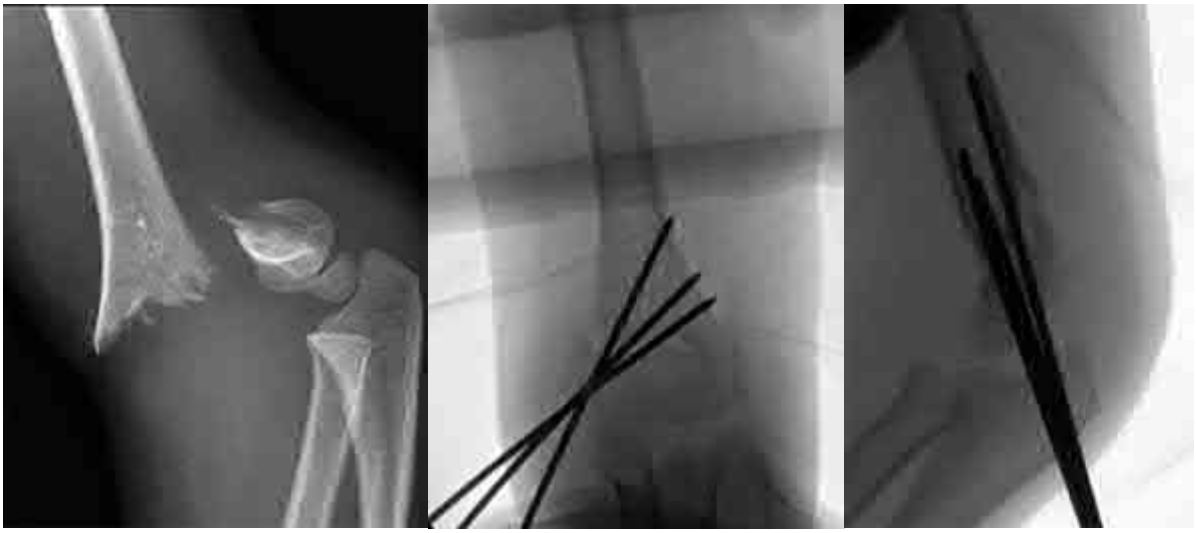
Question 10 of 100
Second-impact syndrome following a concussion

A. poses minimal concern for morbidity or mortality.
B. is less common in adolescents than in adults.
C. is related to a disruption of cerebral autoregulation.
D. refers to a second head injury after the athlete has been medically cleared to return to play.

R: C

According to several consensus statements, no child or adolescent athlete with a concussion should be allowed to return to play on the same day, regardless of severity. Second-impact syndrome refers to a second traumatic head injury that occurs while an athlete is still experiencing symptoms from the first injury. Young athletes are particularly vulnerable to second-impact syndrome. The mechanism by which this syndrome occurs likely is disruption of cerebral autoregulation, which may result in cerebral vascular congestion, diffuse brain swelling, and death.

Question 11 of 100
Figure 1 is the initial radiograph of a 7-year-old boy who fell from monkey bars 4 hours ago. He has intact motor function in his fingers and normal capillary refill, but his radial pulse is not palpable. Figures 2 and 3 are the radiographs following closed reduction and pinning. This boy's hand and fingers remain pink, but his radial pulse remains nonpalpable. What is the best next step?



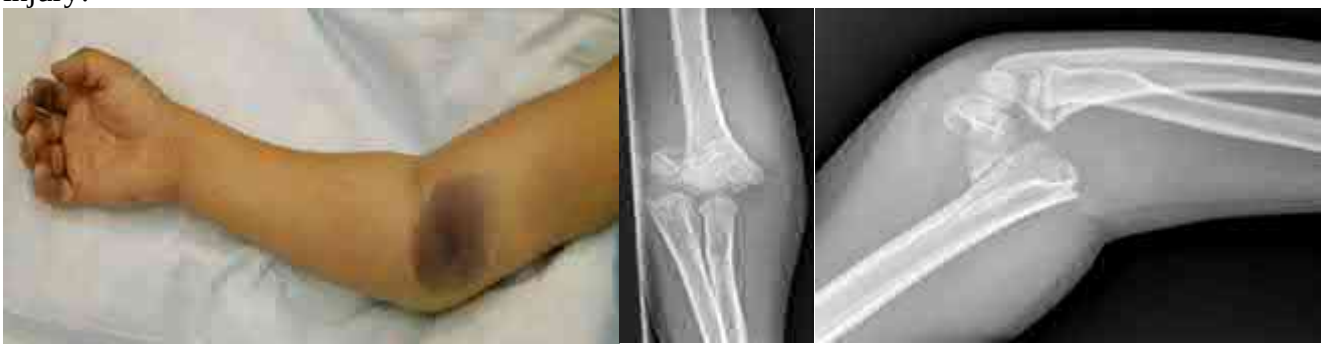
A. An arteriogram to evaluate the brachial artery
B. Open exploration and repair of the brachial artery
C. Pin removal to rereduce the fracture
D. Additional splinting and continued observation in the hospital

R: D

Figure 1 shows a completely displaced supracondylar humerus fracture. The first step in the situation described, which involves a pink pulseless hand, is to perform an urgent closed manipulation and pinning. The vascular examination should be reassessed following the reduction. When adequate reduction has been achieved and the pulse remains nonpalpable but the hand is pink and capillary refill is normal, the fracture may be splinted and the patient observed closely in the hospital. Arteriography is not useful and may delay revascularization or increase vessel spasm. Although some investigators have concluded that exploration of the brachial artery may be indicated, the algorithm that includes observation only is the most supported and the most commonly practiced treatment. The radiographs show adequate reduction and fixation without medial widening at the fracture site, which might indicate a site of brachial artery entrapment. Therefore, pin removal and fracture rereduction is not indicated.

Question 12 of 100

Figures 1 through 3 are the clinical photograph and radiographs of a 5-year-old boy who fell and injured his right elbow. His radial pulse is thready. Which neurologic deficit is most commonly associated with this injury?



A. Anesthesia in the first dorsal web space
B. Inability to extend the fingers
C. Inability to abduct the fingers
D. Inability to flex the thumb interphalangeal (IP) joint

R: D

This injury is a type III supracondylar humerus fracture with posterolateral displacement. The area of ecchymosis is anteromedial, corresponding to the proximal spike of the humeral metaphysis. The brachial artery is likely tented over this spike, leading to diminished perfusion. The median nerve also resides in this area, and any neurological deficit is likely in its most vulnerable fibers, those of the anterior interosseous nerve (AIN). The AIN contains no sensory fibers, and its motor function involves flexion of both the thumb IP joint and the index distal IP joint.
First dorsal web space anesthesia and an inability to extend the fingers would indicate radial nerve neuropraxia, which would be more likely with posteromedially displaced fractures and lead to anterolateral ecchymosis. Finger abduction is controlled by the ulnar nerve, which most often is injured in flexion injuries and iatrogenically by medially placed pins.

Question 13 of 100

Figures 1 and 2 are the radiographs after attempted reduction of an injury in a 9-year-old girl. Which anatomic structure is most likely to be interposed?

A. Brachialis muscle
B. Radial nerve
C. Median nerve
D. Ulnar nerve

R: D

The injury shown is a flexion-type supracondylar humerus fracture. The most commonly interposed anatomic structure is the ulnar nerve. The brachialis muscle is often interposed in extension-type fractures, as are the median nerve and radial artery. The radial nerve is at risk for entrapment in a humeral shaft fracture or distal third humeral fracture.

Question 14 of 100

A 17-year-old cross country athlete runs 7 miles per day, 6 days per week. She has new-onset right groin pain. Passive flexion of her hip is normal, but internal rotation of the hip, resisted hip flexion, and knee extension reproduce the pain. Hip radiograph findings are normal. What is the best next step?

A. Recommend decreasing training regimen
B. Obtain a bone scan
C. Obtain an MRI scan
D. Obtain a dual-energy x-ray absorptiometry (DEXA) scan

R: C

A stress fracture of the femoral neck or pelvis should be ruled out in this patient. She should be placed on crutches and not allowed to run. The consequences of missing such a diagnosis can be devastating. Superior

cortical femoral neck stress fractures are tension injuries and can progress to a complete fracture and avascular necrosis. Surgical fixation may be indicated. Plain radiographic findings often do not appear until late in the clinical course. MRI is more accurate, more specific, and is superior to radionuclide bone scanning for the diagnosis of stress fracture in young endurance athletes. MRI detects early changes in osseous stress injury and allows precise definition of the anatomy and extent of injury. This patient may have the female athletic triad: disordered eating, amenorrhea, and osteoporosis. However, the workup for this condition (including a possible DEXA scan) may be delayed until after the stress fracture is diagnosed and treated.

Question 15 of 100

A 5-year-old boy has an asymptomatic 2.5 by 1.5-cm soft-tissue mass in the popliteal fossa of the right knee (Figure 1). His mother noted the mass when giving the child a bath last week. The mass trans illuminates. Radiographs were normal and ultrasonography demonstrated a cystic mass. The best next step in treatment is

A. obtain an MRI scan because the mass in highly associated with a torn discoid lateral meniscus in children.
B. surgical excision of the mass and send the specimen to pathology.
C. chest CT, complete blood count (CBC), erythrocyte sedimentation rate (ESR), C-reactive protein (CRP) level, and refer the patient to an oncologist.
D. observation.

R: D

Cystic mass lesions in the popliteal area, called popliteal cysts, are usually minimally symptomatic and not related to intra-articular morbidity in the pediatric population. The popliteal cyst is a fluid-filled mass that is a distention of a preexisting bursa in the popliteal fossa, most commonly the gastrocnemius-semimembranosus bursa. In children, popliteal cysts are most often an incidental finding discovered during a routine physical examination and can be expected to completely resolve in due course without treatment. The cyst may persist for more than 2 years.

Question 16 of 100

Physeal sparing and physeal respecting anterior cruciate ligament (ACL) reconstruction techniques have been developed for use in skeletally immature athletes to minimize the risk of

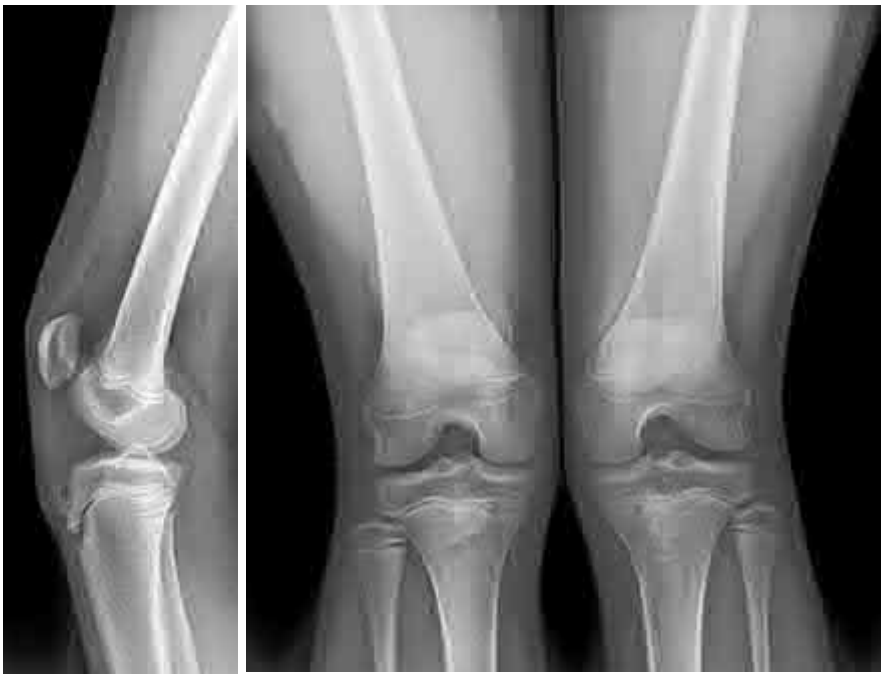
A. tibial procurvatum and meniscal tears.
B. limb length inequality and tibial procurvatum.
C. tibial recurvatum and angular deformity.
D. chondral damage and femoral varus angulation.

R: C

Several physeal sparing and physeal respecting ACL reconstruction techniques have been developed to use in skeletally immature patients to minimize the risk of growth disturbance. Growth disturbance can occur after ACL surgery in skeletally immature athletes and includes tibial recurvatum resulting from tibial tubercle apophyseal arrest, as well as limb length inequality and / or angular deformity, typically femoral valgus resulting from physeal arrest or overgrowth. Procurvatum does not occur. A stable ACL reconstruction will also minimize meniscal injury and chondral injury.

Question 17 of 100

A 12-year-old girl soccer player has a 4-week history of pain, swelling, and tenderness of the right knee. She has not started her menstrual periods. The patient practices 4 nights per week and plays up to 4 games each weekend but is now unable to compete because of the pain. Examination reveals a tender mass at the right tibial tubercle. The cruciate ligaments are stable and the meniscal signs are negative. She demonstrates an antalgic limp. Radiographs are shown in Figures 1 and 2. The best next step is



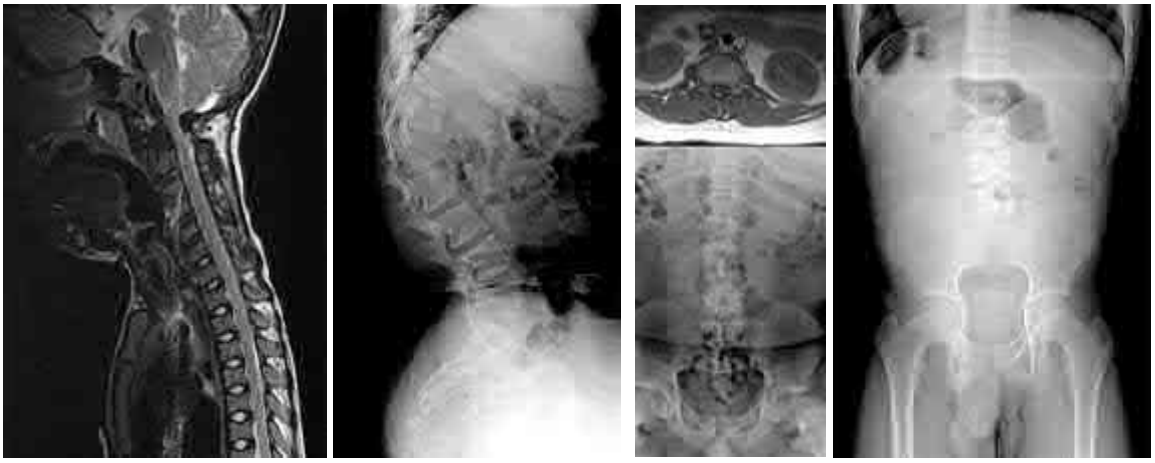
A. obtain an MRI scan of the knee and a CT scan of the chest.
B. complete blood count, erythrocyte sedimentation rate, C-reactive protein level, and blood cultures.
C. immediate surgical excision of the tibial tubercle ossicle.
D. ice, rest from soccer, and NSAIDs.

R: D

The patient has Osgood Schlatter syndrome, a traction apophysitis of the tibial tubercle as a result of overuse repetitive strain on the secondary ossification center. Radiographic changes include irregularity of the apophysis, separation from the tibial tubercle, and fragmentation. Radiographs are recommended in all unilateral cases of Osgood Schlatter to rule out infection or tumor. About 90% of patients respond to rest, ice, activity modification, and NSAIDs. In rare cases, surgical excision of the ossicle may provide good results in skeletally mature patients.

Question 18 of 100

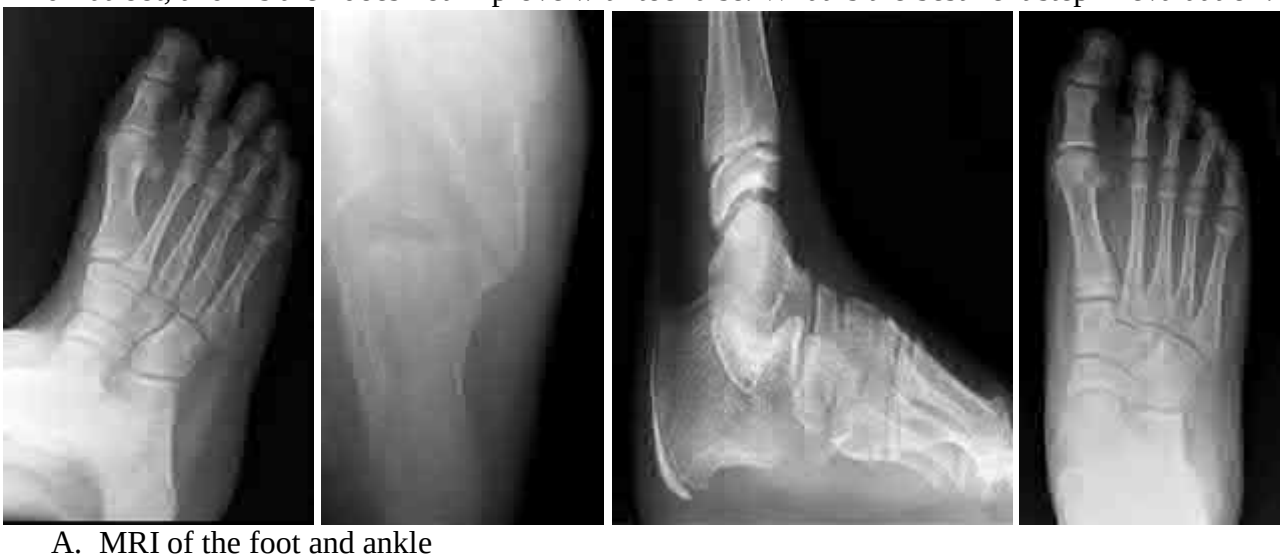
Which of the radiographs reveals an atypical spine manifestation for patients who are known to have rhizomelic dwarfism and fibroblast growth factor receptor 3 mutation?



A. Figure 1
B. Figure 2
C. Figure 3
D. Figure 4

R: D
Achondroplasia is the most common form of rhizomelic dwarfism, characterized by a disproportionate shortening of the proximal limbs relative to the trunk. In achondroplasia, a quantitative decrease in the rate of enchondral bone formation is seen, but rates of membranous bone formation; calcification; and remodeling are normal. This results in a variety of skeletal manifestations that are recognizable at birth.
In the pediatric population, foramen magnum stenosis with cervicomedullary compression is the most notable spinal condition that deserves attention. In preadolescent children with achondroplasia, thoracolumbar gibbus formation and kyphotic deformity can also produce neurologic dysfunction secondary to the compression of conus medullaris or cauda equina. In older children and adults with achondroplasia, multisegment spinal stenosis involving the subaxial cervical or thoracolumbar spine may also be present. Premature fusion of the ossification centers of the vertebral bodies and posterior neural arches results in laminae and pedicles that are short and thick. In addition, the vertebral bodies have reduced height, the neural foramina are smaller, and the interpedicular distance is narrowed. Figure 4 shows the spine and pelvis radiographs of an individual with caudal regression and sacral agenesis, which occurs sporadically and multigenetic and environmental factors likely play a part in determining the risk of developing this condition. Caudal regression and sacral agenesis is not considered to be a part of common skeletal manifestations of achondroplasia.

Question 19 of 100
Figures 1 through 4 are the lateral, oblique, and AP radiographs of an 11-year-old boy who presents to the clinic with complaints of activity-related pain in his right foot, progressive flatfoot deformity, and frequent ankle sprains. On examination, he has slightly increased hindfoot valgus compared with the opposite side with mild flatfoot, and his arch does not improve with toe raise. What is the best next step in evaluation?

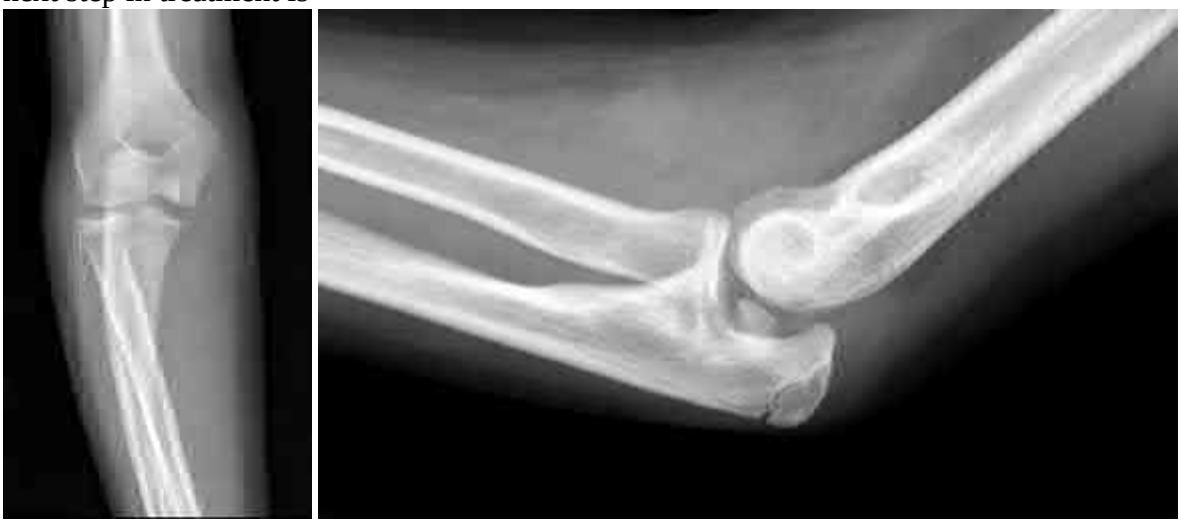


A. MRI of the foot and ankle
B. CT scan of the foot

C. Complete blood count, erythrocyte sedimentation rate, C-reactive protein level
D. Referral to a rheumatologist

R: B
The plain radiographs are suggestive of a tarsal coalition of the middle facet of the subtalar joint. The anterior view shows medial deviation of the talar head, which is partially uncovered by the navicular. The oblique view is normal, and the lateral view shows a positive C sign with poor visualization of the subtalar joint. The axial heel view shows an obliquely oriented middle facet, which is suggestive of a middle facet fibrous or cartilaginous coalition.
CT scan is the better study for surgical planning, although an MRI can be obtained to evaluate for coalition and is helpful for differentiating between fibrous, cartilaginous, and bony coalitions. MRI is not as satisfactory at showing the bony anatomy, percentage of the joint involved, and the amount of hindfoot valgus.
If the imaging studies are negative, then other causes of painful flatfoot need to be investigated. The differential diagnosis of a painful flat foot includes any condition that irritates the subtalar joint. This includes septic arthritis, osteomyelitis, and inflammatory arthritis. These patients will also have a different presentation, with fever indicating infection and morning stiffness indicating inflammatory arthritis.

Question 20 of 100
An 11-year-old gymnast sustains a right dominant elbow dislocation. She undergoes a closed reduction in the emergency department with conscious sedation. Figures 1 and 2 are the postreduction radiographs. The best next step in treatment is

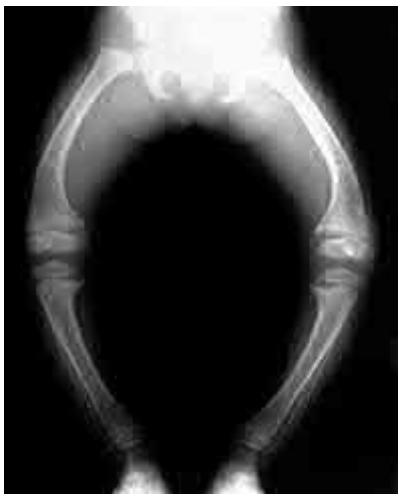


A. cast application with follow-up in 2 to 3 weeks.
B. MRI of the elbow to look for ligamentous injuries.
C. CT scan to assess the intra-articular bone anatomy.
D. open reduction and internal fixation.

R: D
The AP lateral radiographs show an incarcerated medial epicondyle. This is one of the absolute indications for surgical treatment of a displaced medial epicondyle fracture. The radiograph views show a nonconcentric reduction; therefore, immobilization without reduction will result in a painful stiff elbow. Although both MRI and CT scan will confirm the diagnosis, they are not necessary, are expensive, and a CT scan would expose the child to significant radiation.
Although controversy exists regarding surgical fixation of displaced nonincarcerated medial epicondyles, almost all surgeons agree that entrapped fragments should undergo open reduction and internal fixation. A number of fixation techniques are avaiable including divergent Kirschner wires, cannulated screws, suture anchors, and removal of the fragment with suture fixation. Screw fixation allows for shorter immobilization times and earlier motion.

Question 21 of 100
Figure 1 is the AP radiograph of a 22-month-old toddler who is being evaluated for bowed legs. His parents note that the deformity seems to be worsening and that it does not appear to cause any pain. Clinically, the

child has severe genu varum with tibiofemoral angles of 25 degrees. The best next step in management should be



A. parental reassurance.
B. institute brace treatment.
C. schedule for corrective osteotomy.
D. send for blood work, calcium, phosphorus, alkaline phosphatase, and vitamin D, as well as renal function tests.

R: D
Bowed legs is a common presenting complaint in toddlers. Most of these children will have physiologic genu varum and will require no treatment other than parental reassurance. The physiologic deformity generally improves as the children approach 16 to 18 months-old, and the deformity itself rarely exceeds a tibiofemoral angle of 20°. The differential diagnosis includes Blount disease, skeletal dysplasias, and metabolic disorders, such as rickets. This radiograph shows physeal widening and metaphyseal flaring, which is consistent with rickets. Blood work will confirm the diagnosis and differentiate vitamin D-deficient rickets from vitamin D-resistant rickets, and renal osteodystrophy.

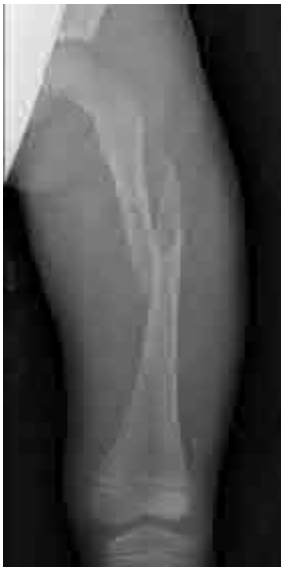
Question 22 of 100
A 2-week-old, otherwise healthy neonate presents at the emergency department with a 1-day history of fever, pain with diaper changes, and poor feeding. The complete blood count, erythrocyte sedimentation rate, and white blood cell count are all elevated. On examination, the baby holds the leg flexed, abducted, and externally rotated and has pain with any attempts at ranging the hip. Plain radiographs are negative, but hip ultrasonography shows a large hip joint effusion. The patient is taken to the operating room and undergoes a hip aspirate and irrigation and debridement of this septic hip. What is the most likely organism causing the infection?

A. Beta-hemolytic streptococcus
B. *Haemophilus influenzae*
C. *Kingella kingae*
D. *Escherichia coli*

R: A
Although *Staphylococcus aureus* is the most common infecting organism in children with septic arthritis, in an otherwise healthy newborn, Streptococcus occurs more commonly. Kingella kingae is becoming a more commonly seen infecting organism, but it is more often seen in the toddler age range. Newborns in the neonatal intensive care unit are at risk for infections with Gram-negative organisms as well. With the introduction of a vaccine against *Haemophilus influenzae*, this organism is now rarely seen as a causative agent in septic arthritis.

Question 23 of 100

Figure 1 is the radiograph of a 6-year-old 40-kg boy who landed awkwardly onto his left leg on a trampoline. He has immediate pain and deformity of the thigh and is unable to ambulate. His canal diameter is 7 cm, and he is treated with two 3.0-mm titanium flexible elastic nails (TENs) and nonweightbearing. His fracture shortens 2 cm postoperatively and falls into 20 degrees of varus angulation. What characteristic is most responsible for the malunion?



A. His weight exceeds recommendations for TENs.
B. He had inadequately sized TENs placed.
C. His fracture pattern is rotationally unstable.
D. His fracture pattern is length-unstable.

R: D

The image reveals a length-unstable fracture pattern (the length of the fracture line is more than double the cortical width at the level of the fracture). These fractures are associated with higher risk of malunion. TENs with at least 80% canal fill were placed, and his weight is below recommended upper limits (<49 kg).

Question 24 of 100

When compared with intravenous (IV) antibiotics via a peripherally inserted central catheter, postdischarge treatment of pediatric acute osteomyelitis with oral antibiotics is associated with a

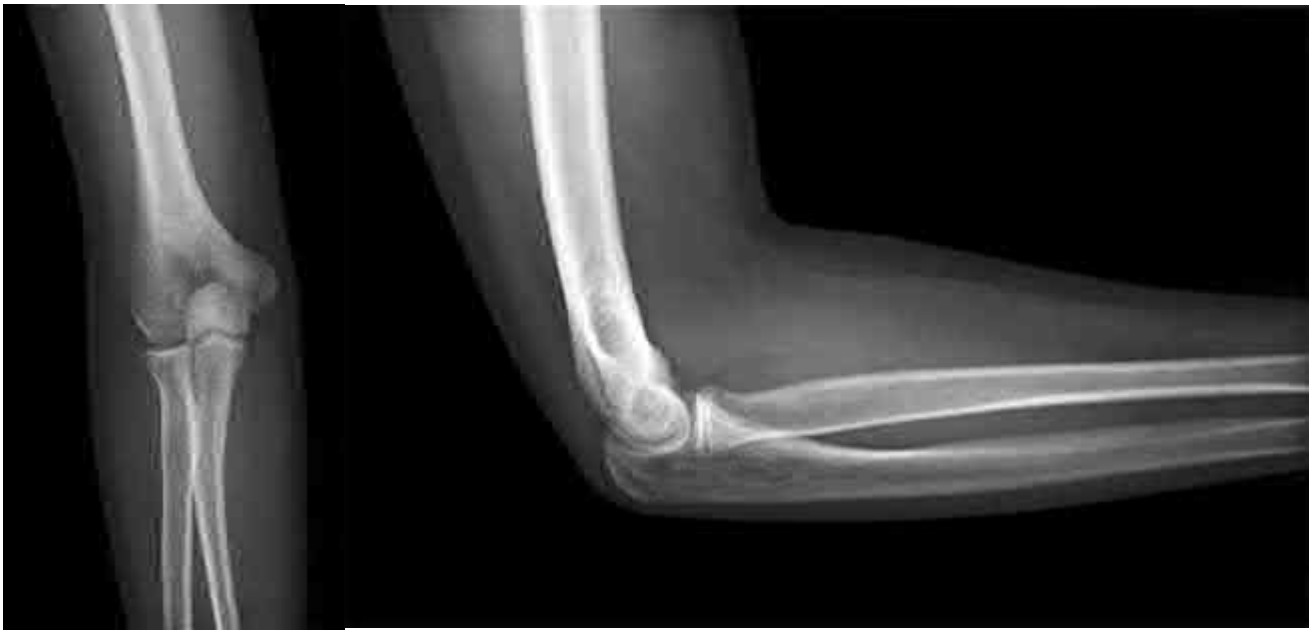
A. lower rate of treatment failure.
B. higher rate of treatment failure.
C. lower rate of rehospitalization or return visit to the emergency department.
D. higher rate of rehospitalization or return visit to the emergency department.

R: C

In the management of pediatric acute osteomyelitis, early transition to oral antibiotic therapy has been demonstrated to have a similar risk of treatment failure as prolonged IV therapy via a peripherally inserted central catheter (PICC). Transition to oral antibiotic therapy can avoid the substantial risks of a PICC complication, which can result in a higher rate of rehospitalization or return visit to the emergency department.

Question 25 of 100

Figures 1 and 2 are the radiographs of a 12-year-old boy who has been experiencing increased pain in his right, dominant elbow while pitching. He notes that his velocity is decreasing, and he can no longer throw as many pitches without discomfort. Examination reveals tenderness on palpation of his medial distal humerus, but no evidence is seen of instability to valgus stress at either 0° or 30° of elbow flexion. What is the most appropriate recommendation at this time?



A. Cessation of throwing for at least 4 to 6 weeks
B. Surgical fixation of the medial epicondyle
C. MRI evaluation of the elbow
D. Surgical reconstruction of the ulnar collateral ligament

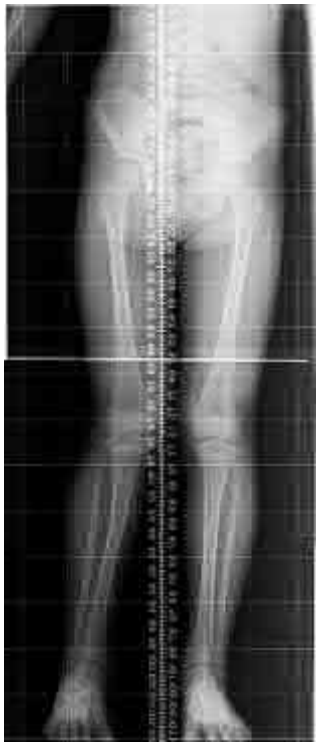
R: A
Radiographs and examination are consistent with medial epicondylar apophysitis, or "Little Leaguer elbow," which is thought to be secondary to repetitive traction stresses across the open physis while throwing. MRI generally does not change the treatment in these patients. Surgical fixation is indicated in patients with displaced avulsion fractures of the medial epicondyle, particularly in throwing athletes. In light of the lack of clinical instability, ulnar collateral ligament reconstruction is not indicated in this patient.

Question 26 of 100
A 3-year-old girl is seen for an evaluation of short stature. Physical examination reveals angular deformities of the upper and lower extremities, as well as blue coloration of the sclera and abnormal dentition. Lower extremity imaging shows diffuse osteopenia and mild angular deformities of the tibia and femur bilaterally. These physical and radiographic findings are consistent with a genetic abnormality that most commonly affects the formation of which type of collagen?

A. Type I
B. Type II
C. Type IV
D. Type X

R: A
The physical and radiographic findings are consistent with a diagnosis of osteogenesis imperfecta (OI). Approximately 90% of cases of OI are secondary to defects in the COLIA1 or COLIA2 genes, which affect the production of type 1 collagen. The incidence of OI is between 1 in 10,000 and 1 in 20,000. Type II collagen abnormalities have been associated with achondrogenesis type 2. Type IV abnormalities with Alport syndrome, and type X defects with Schmid metaphyseal chondrodysplasia.

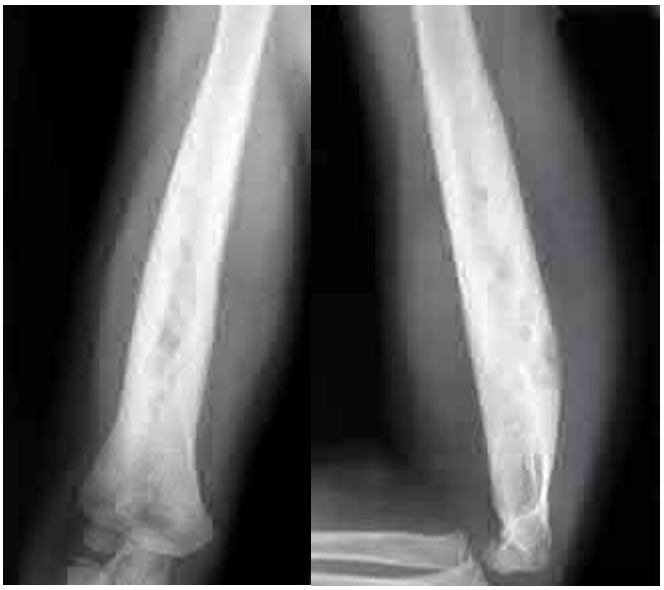
Question 27 of 100
A 5-year-old girl sustained a nondisplaced fracture of the proximal tibial metaphysis, which was treated with a long leg cast and which healed uneventfully. Clinical examination and the image seen in Figure 1 reveals a deformity at 1 year postinjury. The most appropriate management at this time would be



A. continued observation.
B. MRI evaluation of the proximal tibia.
C. medial proximal tibial-guided growth procedure.
D. Proximal tibial osteotomy and acute realignment.

R: A
Development of proximal tibial valgus is an uncommon, but well-documented, complication of proximal tibial metaphyseal fractures in children. There are multiple theories as to the origin, but the exact etiolgy is unknown. Management with a guide-growth procedure is rarely required, because most patients ultimately achieve spontaneous correction.

Question 28 of 100
Figures 1 and 2 are the AP and lateral radiographs of a 5-year-old African-American boy who has a 1-month history of pain and swelling in his upper arm. His mother reports a medical history that includes sickle cell disease. Laboratory studies demonstrate elevated erythrocyte sedimentation rate and C-reactive protein level, and a white blood cell count of 17,000. What organism is most likely associated with this process in the patient?

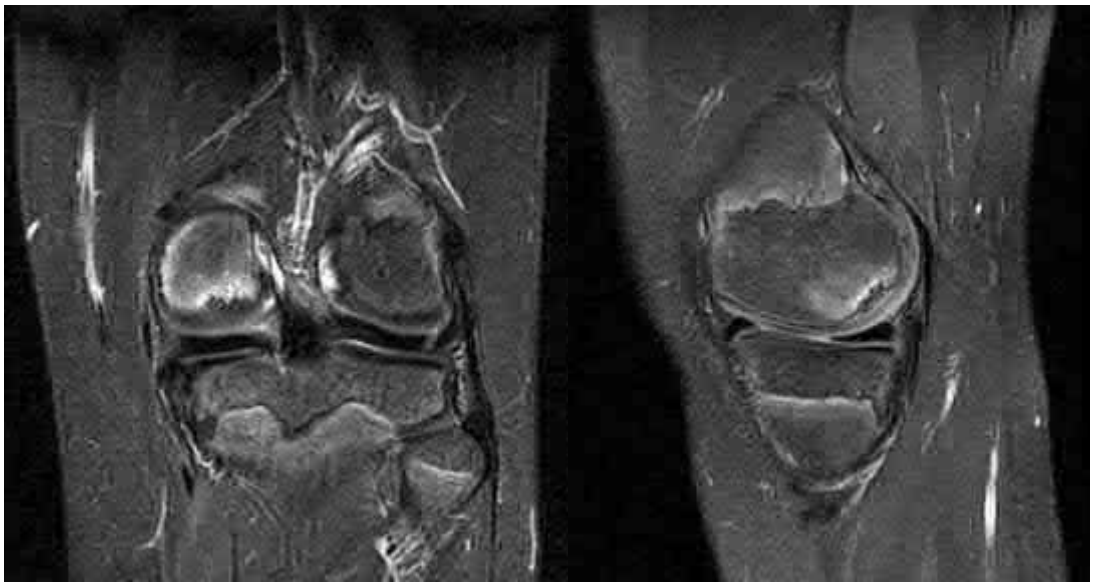


A. Salmonella

B. Group B streptococcus
C. *Staphylococcus aureus*
D. *Kingella kingae*

R: C
Although patients with sickle cell disease are at far higher risk of developing salmonella osteomyelitis than the general population, *Staphylococcus aureus* remains the most common organism causing osteomyelits in children of this age group.

Question 29 of 100
Figures 1 and 2 are MR images of a 13-year-old boy with activity-related left knee pain and swelling without mechanical symptoms. He does not have a history of a clear injury but has been having symptoms for 8 months. He has taken a month here and there off from his sports, without real relief. The best next step in management is to



A. provide a knee brace so that he can continue to play with less pain.
B. restrict weightbearing, initiate immobilization, and recheck imaging in 6 weeks.
C. refer him to physical therapy for patellofemoral pain and quadriceps strengthening.
D. offer arthroscopic surgery for correction of the problem.

R: B

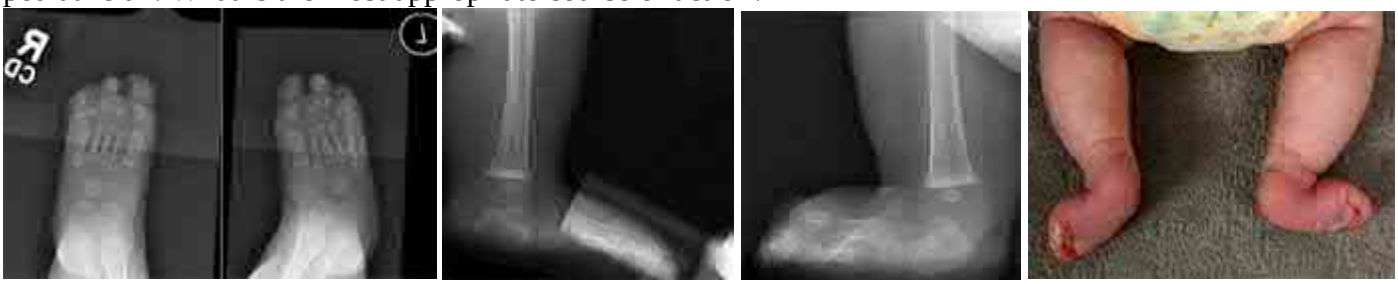
Skeletally immature patients with stable osteochondritis dissecans lesions of the knee have a very high healing rate with conservative treatment, which consists of strict non–weightbearing with or without immobilization. Healing rates are significantly lower for patients treated with unloader bracing who are allowed to continue normal activity. Physical therapy may be required later, but is not an appropriate initial treatment. Because the healing rate with conservative treatment is so high for lesions around the knee, this should be tried for several months before recommending surgical treatment.

Question 30 of 100
Figures 1 and 2 are the radiographs of a 25-month-old boy who sustained an isolated right leg injury leaping from the couch. The patient underwent closed manipulation with immediate spica-cast application. One week following the injury, radiographs in the cast reveal just <2 cm of shortening at the fracture. What is the most appropriate next step in treatment?

A. Continue cast immobilization
B. Remanipulation of the fracture with revision spica-cast application
C. Open reduction with internal fixation
D. Closed reduction with flexible intramedullary nailing

R: A
Limb-length inequality is one of the most common complications following treatment of femoral shaft fractures in children. In children <10 years-old, some degree of accelerated growth, or overgrowth, may occur in the involved extremity. This typically occurs in the 3 to 24 months following injury.
The average amount of overgrowth is 1.5 to 2 cm, such that leaving a fracture shortened by this amount is acceptable in children undergoing spica-cast immobilization for treatment (typically in children between 6 months and 4 to 5 years-old).

Question 31 of 100
Figures 1 through 4 are the radiographs and clinical photograph of a 6-month-old girl whose parents are seeking a second opinion of her feet. Since birth, her parents noted bilateral foot deformities, with some improvement in flexibility and alignment achieved with a stretching program recommended by her pediatrician. What is the most appropriate course of action?



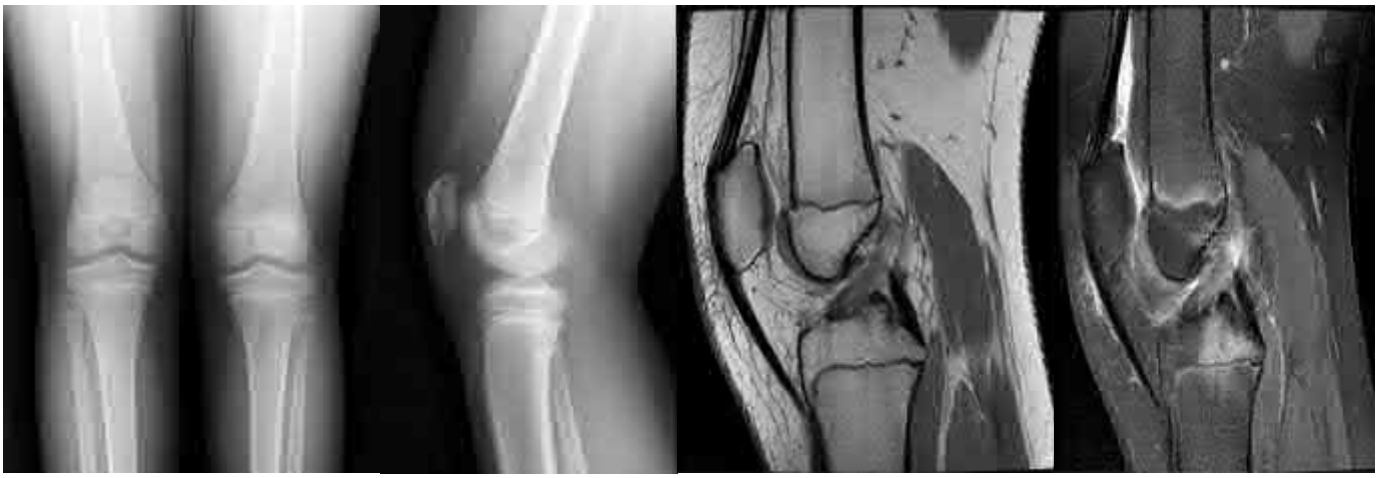
A. Continue with stretching program. These deformities are expected to resolve; no formal treatment needed
B. Reverse Ponseti serial casting with stabilization of the talonavicular joint and Achilles tenotomy
C. Ponseti casting for 5 to 7 weeks followed by Achilles tenotomy and bracing
D. Single-stage extensive surgical soft-tissue release

R: B
The diagnosis is congenital vertical talus (CVT). In this patient, the first step in management would include identifying the underlying etiology. Approximately half of these patients have an associated neurologic or genetic disorder. Subsequent to determining any underlying etiology, the next step in treatment is reverse Ponseti casting, or the Dobbs technique. This involves serial manipulation of the foot in the direction/position opposite that done with Ponseti casting for talipes equinovarus, or clubfeet. Serial manipulation is followed by a minimally invasive reduction and stabilization of the talonavicular joint, with Achilles tenotomy.
A stretching program would be applicable for a calcaneovalgus foot deformity, which is expected to resolve without treatment. Ponseti casting is the standard of treatment for clubfoot deformities. A single- or two-stage

extensive surgical release can be utilized for the treatment of CVT but is typically reserved for older patients, or those who have failed the minimally invasive casting technique.

Question 32 of 100

Figures 1 through 4 are the AP and lateral radiographs and MR images of a 12-year-old postmenarchal girl who injured her right knee playing basketball 2 weeks ago. She developed significant swelling and pain and was unable to bear weight. How should the family be counseled regarding expectations and outcomes following this injury?



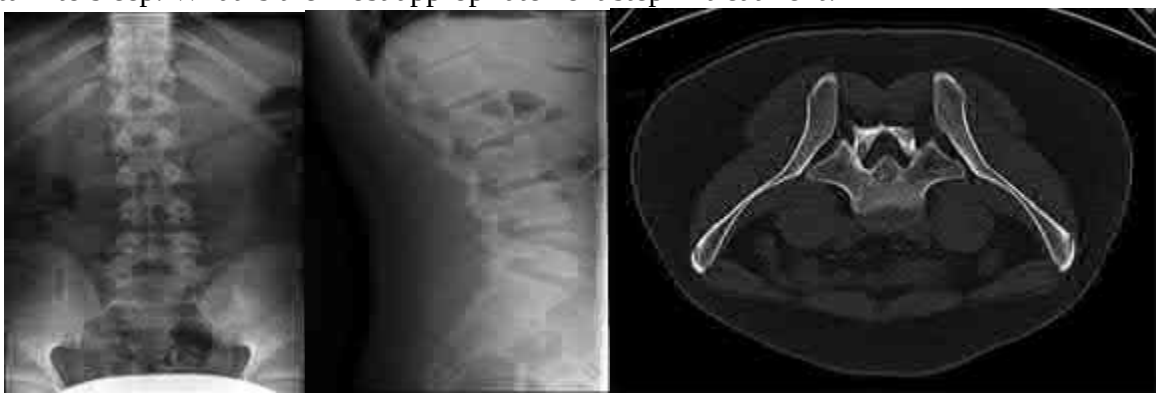
A. Surgical reconstruction should be delayed until skeletal maturity
B. Her risk of repeat injury to the knee is the same as that of skeletally mature individuals undergoing similar reconstructions
C. She has a significant risk of sustaining a similar injury to the contralateral knee
D. She will not be able to return to sports that require cutting and pivoting

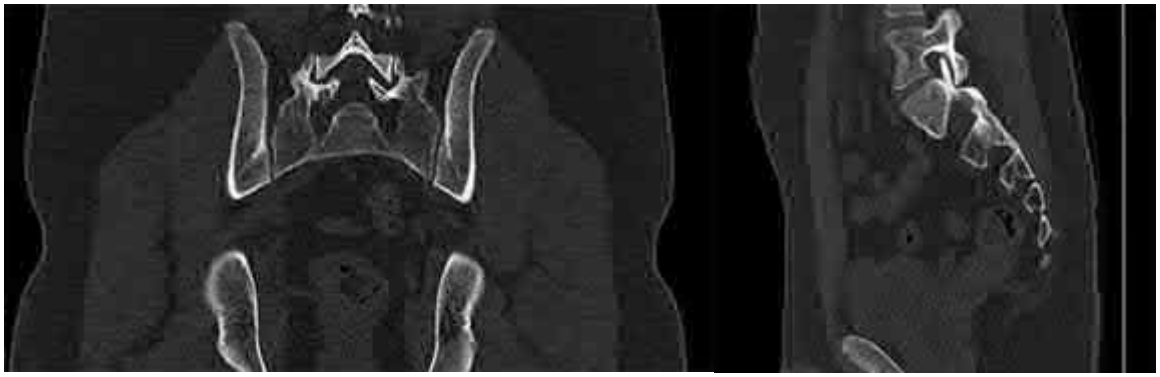
R: C

Historically, anterior cruciate ligament (ACL) injuries in skeletally immature patients were treated nonsurgically with bracing, physical therapy, and activity modification because of concerns about risk to the physis during ACL reconstruction. Current evidence suggests that patients treated surgically have less knee instability, higher rates of return to activity, higher functional scores, and lower rates of subsequent meniscal tear. One of the most common complications encountered after ACL reconstruction in this patient population is secondary injury of the same or the contralateral knee, which has been found to be >5 times greater than that of healthy controls. Nearly 30% of athletes in one cohort sustained a second ACL injury within 24 months of return to sport, with approximately one-third of these injuries occurring in the ipsilateral knee and two-thirds occurring in the contralateral knee. Thus, although most young athletes are able to return to sports after reconstruction of their ACL, they have a significantly higher risk of secondary ACL injury (ipsilateral or contralateral) compared with the adult population.

Question 33 of 100

Figures 1 through 5 are the AP and lateral radiographs and MR images of a 16-year-old boy who has a 1-year history of low back pain. The pain bothers him only at night, and it awakens him from sleep. NSAIDs allow him to return to sleep. What is the most appropriate next step in treatment?





A. Radiofrequency ablation
B. Chemotherapy
C. Radiation therapy
D. Excision

R: D
The history and imaging are consistent with an osteoid osteoma of the posterior sacrum. Percutaneous ablation techniques have become the standard first-line treatment for most extremity lesions. Concern exists about the use of radiofrequency ablation (RFA) in spinal lesions because of the potential for thermal injury of adjacent neurovascular structures, particularly in the absence of intact cortex surrounding the lesion. RFA should be avoided when neurovascular structures would be within 1 cm of the electrode. As such, excision would be preferable. There is no role for chemotherapy or radiation therapy in the management of osteoid osteomas.

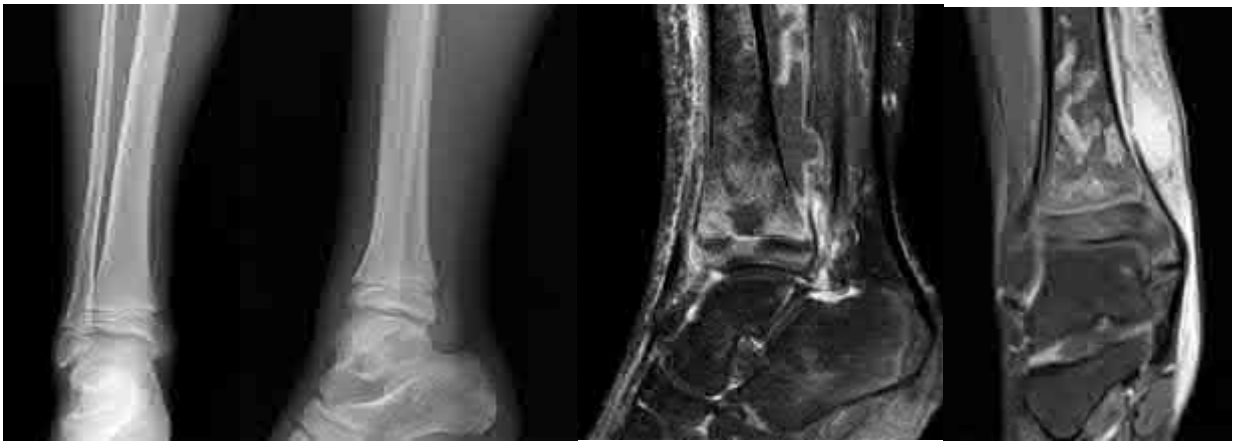
Question 34 of 100
Figures 1 and 2 are the clinical photographs of a 2-month-old infant with a foot deformity. The parents have been doing stretching exercises at home with some improvement in foot position. What is the most appropriate course of treatment?

A. Institute serial casting and schedule for surgical intervention
B. Provide parental reassurance and follow-up as needed
C. Commence brace treatment until deformity is corrected
D. Obtain AP and lateral tibia views, and plan follow-up until maturity

R: D
The figures reveal a calcaneovalgus foot deformity with an associated posterior medial bow of the tibia. The foot deformity occurs quite commonly and is most likely related to intrauterine positioning. Calcaneovalgus foot deformity frequently will spontaneously correct. However, occasionally the deformity may be more severe and require either stretching exercises or even serial casting. With this particular deformity, it is most important to differentiate it from a congenital vertical talus. The congenital vertical talus has hindfoot equinus

associated with it, while a calcaneovalgus foot deformity has a hindfoot that dorsiflexes normally. Because the deformity has improved, it does not require treatment with serial casting or a brace.
Although the foot deformity may do well, posterior medial bowing of the tibia is associated with leg length discrepancy (LLD), which may vary in severity. Typically, surgical intervention for leg length equalization is required. For this reason, the child should be seen on a routine basis to assess correction of the deformity, as well as document the LLD. Initial radiographs should be obtained at this visit to make the diagnosis and document the deformity. Over time, the deformity may improve so that it is not as clinically apparent; however, the LLD will persist.

Question 35 of 100
Figures 1 through 4 are the radiographs and MRI of a 7-year-old girl who came to the emergency department with a one-week history of ankle pain. For the past 24 hours, she has refused to bear weight. There is no history of injury or antecedent systemic infection. She has had an episodic low-grade fever. She has a mildly elevated WBC count, and CRP and ESR levels. Blood cultures are pending. The best next step in treatment should be to



A. refer to a musculoskeletal oncologist.
B. perform operative debridement and begin antibiotics.
C. perform a needle biopsy for source culture.
D. start broad-spectrum antibiotics and assess response to treatment.

R: B
The clinical imaging and lab results are suggestive of osteomyelitis, although tumor could also present in this manner. The plain radiographs are unremarkable, but the MRI shows a distal tibial lesion, which is enhancing, as well as a large subperiosteal fluid collection. This is most consistent with osteomyelitis and an associated soft-tissue abscess. To obtain a source culture and gain control of the infection, incision and drainage are required. The subperiosteal abscess and intramedullary purulence must be drained. Once the source culture has been obtained, antibiotics can be started.
Referring the patient to a musculoskeletal oncologist is not appropriate, as the MRI is most consistent with infection, not tumor. Antibiotics alone will not treat the abscess. Although biopsy of the tibia will most likely result in obtaining a source culture, the subperiosteal abscess remains undecompressed.

Question 36 of 100
A 2-year-old girl has a 1-day history of refusal to bear weight. She has had a low-grade fever. On examination, her knee is warm, red, and swollen and her range of motion (ROM) is limited. Hip and ankle ROM are pain-free. ESR and CRP levels are mildly elevated, and her WBC count is 12,000. Knee aspirate has a WBC of 20,000 with no organisms seen. The most appropriate next step in confirming the diagnosis is to

A. obtain an MRI of the lower extremity.
B. await culture results.
C. send synovial fluid for polymerase chain reaction for *Kingella kingae*.
D. acquire blood cultures.

R: C

Kingella kingae is becoming recognized as a frequent causative organism in musculoskeletal infections in the 6-month to 4-year age range. Patients present with milder symptoms compared with infection with other organisms so there can be a delay in diagnosis. *Kingella kingae* is notoriously difficult to culture; therefore, patients are often diagnosed with "culture negative" septic arthritis. Recently, PCR has been successfully used to increase diagnostic accuracy. Results can often be obtained in a matter of hours.
MRI will diagnose the inflammatory process and perhaps even show an associated bone or soft-tissue infection; however, MRI will not improve the diagnostic accuracy. One can also wait for the culture results, but as mentioned, *Kingella kingae* is very difficult to culture and only a small percentage will be positive. *Kingella kingae* is also difficult to culture from blood.

Question 37 of 100

A 10-year-old right-hand dominant boy has a radial neck fracture that is angulated 70°. He undergoes two attempts at closed reduction with sedation in the emergency department and post-reduction films now show 50° of angulation. The best next step in treatment is

A. application of a long arm cast in 70-90° of flexion with follow-up in 3 weeks.
B. immediate open reduction and internal fixation in the operating room.
C. percutaneous reduction with or without internal fixation in the operating room.
D. repeat closed reduction in the emergency department with application of a long arm posterior splint.

R: C
Fractures of the radial neck in children account for approximately 10% of all elbow fractures. Angulation of >30° and displacement of >1/3 of the width of the radial head are associated with some loss of forearm rotation. When angulation or displacement are unacceptable, reduction is required. This child has failed two attempts at closed reduction; therefore, further attempts in the emergency department are likely to be unsuccessful. Percutaneous reduction in the operating room is the next step in treatment. There are three well-described techniques: percutaneous Kirschner-wire reduction in which the K-wire is used as a joy stick to pry the radial head into position; the Wallace technique in which a Joker or other small elevator is inserted posteriorly between the radius and ulna at the level of the radial tuberosity and used to push the distal fragment to the radial head with external pressure over the radial head; and the Metaizeau technique in which a flexible IM nail or K-wire is inserted distally into the medullary canal and used to capture the radial head and rotate it back into place. These techniques work well and can be done with or without internal fixation, depending on the stability of the fracture.
Immobilization in the current position will result in loss of forearm rotation and should not be used with angulation >30°. Although open reduction may be necessary if the percutaneous techniques are not successful, open treatment has a much higher rate of complications and loss of motion and should be used as a last resort.

Question 38 of 100

A 3-year-old comes to the emergency department after a fall and is found to have a diaphyseal spiral femoral shaft fracture. There is 1.5 cm of shortening and no other injuries. What is the best treatment option for this child?

- Application of a single leg walking spica cast in the emergency department
- Application of a double hip spica in the operating room (OR)
- Reduction and submuscular bridge plating
- Closed reduction with flexible intramedullary nailing (IM)

R: A
Femur fractures are a common injury in the pediatric population, and there are many treatment options available. Treatment choice depends on patient age, fracture type, shortening, stability, and surgeon comfort level. In this patient, there is a low-energy spiral fracture of the femoral diaphysis. A single leg walking spica has been shown to have similar to possibly better results than a traditional double hip spica cast. Some studies even show a decreased time to healing with a lower complication rate. If there is no other reason for inpatient admission (concern for non-accidental trauma, other injuries, parental discomfort), the reduction and cast application can be done under sedation with or without femoral nerve block, with discharge once the patient

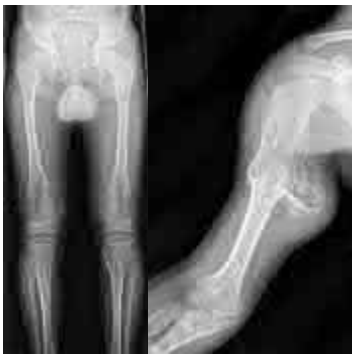
awakens. This is cost effective and has been shown to have similar results to reduction and casting in the OR with no increase in complication rate.
Although a double hip spica cast can be applied in the OR, the extra immobilization may not be needed. It has also been shown that there is Increased cost of a double hip spica for the parents, as a longer time off work may be required. Children treated with a single leg walking spica seem to better fit into car seats and are more comfortable in chairs.
Submuscular bridge plating or any other operative treatment such as flexible IM is not necessary at this age with this fracture pattern due to increased cost, risk of infection, and longer hospitalization.

Question 39 of 100
A 4-week-old girl is referred for an evaluation of her hips. She was the product of a full-term uncomplicated pregnancy. She was delivered by Cesarean section because of breech presentation. She has an older sister treated for developmental dysplasia of the hip (DDH). On examination her hips are stable on Barlow and Ortolani testing. Her primary care practitioner obtained a bilateral dynamic hip ultrasonography. On the ultrasound exam, both hips are stable with stress. The alpha angles are 53°, and there is 48% femoral head coverage. What is the best next step in management?

A. Application of a Pavlik harness
B. No treatment with no scheduled follow-up
C. Closed reduction under general anesthesia with application of a spica cast
D. Repeat ultrasonography in 4-6 weeks

R: D
This child has a normal exam and significant risk factors for DDH (breech presentation and + family history). The ultrasound shows mildly decreased alpha angles or Graf type IIa hips. At age 4 weeks, this would be considered physiologic immaturity. Most of these hips will improve without treatment. Repeating the ultrasound in 4-6 weeks will either show improvement, in which case no treatment will be required, or worsening on the repeat study, for which treatment can be instituted.
Although application of a Pavlik harness could be instituted, given the natural history of possible improvement, this would be overtreatment. The same is true for closed reduction with spica cast application. Because there are significant risk factors, sending the child out without treatment or follow-up, could result in a missed opportunity to treat, if indeed there is worsening.

Question 40 of 100
The radiographs (Figures 1 and 2) demonstrate the phenotype for mutation of



A. EXT1 and EXT2 genes.
B. COL1A1 and COL1A2 genes.
C. NF1 gene.
D. FGFR-3 gene.

R: A
The radiographs are of a child with multiple hereditary exostosis. This is a condition characterized by multiple osteochondromata. It is inherited as an autosomal dominant trait but can also arise from a new mutation. The abnormal genes are EXT1 and EXT2. COL1A1 and COL1A2 genes are associated with osteogenesis

imperfecta and the NF1 gene is found in neurofibromatosis. Abnormalities in the FGFR-3 gene are seen in achondroplasia.

Question 41 of 100

A 12-year-old boy is diagnosed with osteomyelitis and subperiosteal abscess of the distal tibia demonstrated on the MRI. CRP is 13 mg/l. He is taken to the operating room (OR) for incision and drainage. Intraoperative cultures as well as blood cultures grow methicillin-resistant *Staphylococcus aureus* (MRSA). On postoperative day 2, he develops swelling in the leg, as well as an increased oxygen requirement. What should be the next step in evaluation?

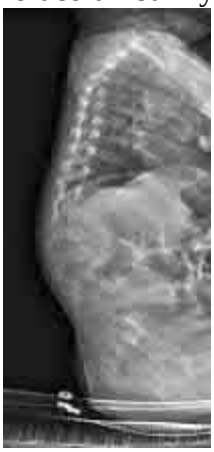
A. Repeat MRI of the leg
B. CT scan of chest
C. Radiograph of chest
D. Return to the OR for repeat incision and drainage

R: B

This child has a MRSA osteomyelitis. Many recent studies have shown that these infections are more difficult to treat and are associated with severe complications and longer hospitalizations. They may also require an increased number of surgical procedures to get control of the infection source. Deep venous thrombosis (DVT) and pulmonary embolism, as well as septic emboli to the lungs occur more commonly with MRSA infections. Increased swelling of the leg may be related to the onset of a DVT and venous ultrasonography is an easy and quick study to help determine if a DVT is present. Currently, the patient has an increased oxygen requirement. Helical CT scan is the next best test to evaluate for septic pulmonary emboli. Plain radiograph of the chest is helpful to look for areas of pneumonia but not diagnostic for septic emboli. Repeat MRI of the leg will be abnormal because of the recent surgical procedure and most likely will not add anything diagnostically. Given his clinical improvement and decreasing CRP, a repeat return to the OR is not indicated at this time, although it is not uncommon for children with MRSA infections to require more than one surgical procedure.

Question 42 of 100

Figure 1 is the radiograph of a 12-month-old girl with a history of type 3 fibroblast growth factor receptor mutation, rhizomelic shortening of the limbs, and dwarfism who is noted to have a thoracolumbar kyphosis (TLK) of 25°. Spontaneous resolution of her thoracolumbar kyphosis is closely associated with



A. appropriate developmental motor progress.
B. absence of ventriculoperitoneal shunt.
C. foramen magnum decompression.
D. gender.

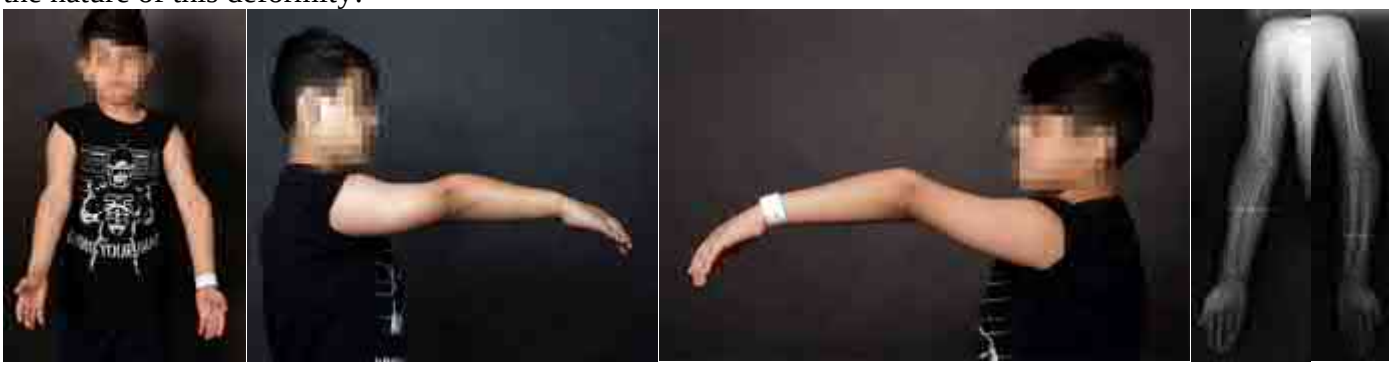
R: A

Achondroplasia is a skeletal dysplasia caused by a genetic mutation in the type-3 fibroblast growth factor receptor gene, which leads to abnormal endochondral ossification. Some, but not all physical features of achondroplasia include rhizomelic shortening of the limbs, midface hypoplasia, frontal bossing, lower extremity malalignment, hyperlordosis and TLK (defined as a Cobb angle of 20° or more centered at T12 and L1).

Thoracolumbar kyphosis is a characteristic feature of achondroplasia and thought to be a result of developmental motor delay and hypotonia and disproportionate head size relative to a small chest size.
Most patients with achondroplasia develop TLK at about sitting age. Studies have shown that most cases of TLK resolve spontaneously within a year after patients start to walk. Studies suggest that approximately 30% of early TLK cases persist, and a third of these cases progress into severe deformities. Apical vertebral translation, percentage of apical vertebral wedging for vertebral height, and developmental motor delay (not sitting by age 14 months and not walking independently by age 30 months) are shown to be risk factors for TLK to persist. Presence of a vertriculoperitoneal shunt, hydrocephalus, foramen magnum decompression, gender, lumbar lordosis were not associated with unresolved TLK. Although the magnitude of the thoracolumbar kyphosis at presentation(>25°) is cited as a risk factor in some studies, this is not verified in other studies.

Question 43 of 100

Figures 1 through 5 are the clinical photographs and radiographs of a 7-year-old boy who has a history of a left elbow supracondylar fracture treated with closed reduction and pinning one year ago. He is referred due to a left arm deformity the family is noticing over the last year. He has no pain. What most accurately describes the nature of this deformity?



A. A cosmetic problem
B. It could lead to tardy posteromedial rotatory instability
C. A varus, extension, and rotational deformity of the distal humerus
D. It has no long-term sequela

R: C

Cubitus varus deformity may occur after pediatric supracondylar and lateral condyle fractures. The deformity is a combination of varus, extension, and internal rotation. Although pediatric cubitus varus following a pediatric distal humerus fracture or congenital deformity has traditionally been considered a cosmetic problem, adult orthopaedic literature cites the posterolateral rotatory instability, ulnar neuropathy, snapping triceps, progressive varus of the ulna, elbow joint malalignment and tendency to distal humerus lateral condyle fracture as possible long-term sequela.

Question 44 of 100

A. missense mutation of the alpha subunit of the G protein (GNSA1).
B. translocation of chromosome 11 and 12.
C. mutation of EXT1 and EXT2 genes.
D. mutations of COLA1 and COLA2 genes.

R: A

Fibrous dysplasia is postulated to occur as a result of a developmental failure in the remodeling of primitive bone to mature lamellar bone and a failure of the bone to realign in response to mechanical stress. In addition, the immature bone does not mineralize normally. The combination of a lack of stress alignment and insufficient mineralization results in substantial loss of mechanical strength, leading to the development of pain, deformity, and pathologic fracture.
The etiology has been linked with a nonheritable missense mutation of the alpha subunit of the G protein (GNSA1 mutation) and is located at chromosome 20q13.2-13.3. The Gsα mutation, which leads to increased

intracellular c AMP content and increased IL-6 secretion may be responsible for the increased numbers of osteoclasts and the bone resorption seen in fibrous dysplasia.
The natural history of fibrous dysplasia depends on the form in which the lesion(s) presents. Monostotic presentation is more frequent, and lesions enlarge in proportion to skeletal growth. The polyostotic form is less common. By early adolescence, patients with widespread polyostotic fibrous dysplasia may have severe deformities. Polyostotic lesions often continue to enlarge after skeletal maturity, with progressive deformity and an increase in pathologic fractures.
The degree of deformation depends on the extent and site of the lesion, the age of the patient, and whether the disease is monostotic or polyostotic. Diffuse polyostotic lesions in large weight-bearing bones are prone to lead to bowing deformities that increase with age and skeletal growth. Unlike deformities in patients with monostotic disease, deformities in patients with polyostotic disease may continue to progress after skeletal maturity. The classic deformity of polyostotic fibrous dysplasia is the so-called shepherd's crook deformity of the proximal part of the femur.
The radiographic features of fibrous dysplasia vary widely. The normal bone is replaced by tissue that is more radiolucent, with a grayish "ground-glass" pattern that is similar to the density of cancellous bone but is homogeneous, with no visible trabecular pattern. The lesions arise within the medullary canal but consistently replace both cancellous and cortical bone so that the usual sharp distinction between the cortex and the medullary canal is obscured. Variations in the cortical thickness are caused by slow resorption of the endosteal surface, commonly referred to as "endosteal scalloping." The periosteal surface is smooth and without reaction.
The key histologic features of fibrous dysplasia are delicate trabeculae of immature bone, with no osteoblastic rimming, enmeshed within a bland fibrous stroma of dysplastic spindle-shaped cells without any cellular features of malignancy. The overall impression is of a variable number of immature, non-stress oriented, disconnected dysplastic trabeculae floating in a sea of immature mesenchymal cells that have little or no collagen about them. The pattern of the bizarrely shaped trabeculae has been likened to "alphabet soup."
Mutations in the COL1A1 and COL1A2 genes are responsible for >90 percent of all cases of osteogenesis imperfecta. Mutations in the EXT1 and EXT2 genes cause hereditary multiple osteochondromas. The most common mutation that causes Ewing sarcoma involves two genes, the EWSR1 gene on chromosome 22 and the FLI1 gene on chromosome 11. A rearrangement (translocation) of genetic material between chromosomes 22 and 11, written as t(11;22), fuses part of the EWSR1 gene with part of the FLI1 gene, creating the EWSR1/FLI1 fusion gene.

Question 45 of 100

During the loading response of the foot through a gait cycle, what muscle activity restrains the rapid plantar flexion of the foot?

A. Eccentric contraction of the pretibial muscles (tibialis anterior and long toe extensors)
B. Concentric contraction of the pretibial muscles (tibialis anterior and long toe extensors)
C. Eccentric contracture of the gastrocnemius-soleus muscle complex
D. Elastic recoil of the Achilles tendon

R: A
The loading response of the foot and ankle during the gait cycle is the time segment that spans from the initial floor contact with the heel to the forefoot contact on the floor. During the loading response of the ankle and foot, in response to the rapid loading of the body weight on the heel lever, the foot is promptly driven to the floor. Intense, eccentric activity of the pretibial muscles (tibialis anterior and long toe extensors) generates an opposing dorsiflexor moment to decelerate this event, making forefoot contact a quiet event. Concentric activity of the pretibial muscles happens during the swing phase of the foot where ankle and foot is dorsiflexed to facilitate floor clearance and limb progression.
Eccentric contracture of the gastrocnemius-soleus muscle provides control of the ankle`s simultaneous progression and stability during the mid stance into the first half of terminal stance phase of the gait cycle. During this phase, soleus activity is the dominant decelerating force compared with gastrocnemius muscle, and their combined activity helps to control the forward progression of the limb by increasing dorsiflexion of the tibia over the articular surface of the talus. During the early pre-swing phase of the gait, activity of gastrocnemius-soleus muscle diminishes, but the ankle continues to plantar flex. Ultrasonography studies

suggest that the abrupt burst of plantar flexor power during this period is elastic recoil of the Achilles tendon following quick release of the previously tense soleus and gastrocnemius. This allows the forces of the plantar flexor muscles to prepare the trailing limb for swing.

Question 46 of 100

A 5-year-old girl with increasing lower extremity bowing and short stature is diagnosed to have X-linked hypophosphatemic rickets. The underlying pathology is due to

A. fibroblast growth factor 23 protein increase.
B. alkaline phosphatase deficiency.
C. 1 ∝-hydroxylase deficiency.
D. carbonic anhydrase deficiency.

R: A

X-linked hypophosphatemic rickets is the most common form of inheritable rickets and is inherited in an X-linked dominant fashion. It is caused by mutations in the phosphate–regulating endopeptidase homolog X-linked gene, which are expressed in osteocytes. Mutation of this gene results in an increase in fibroblast growth factor -23, which then leads to reduction of the proteins involved in renal phosphate reabsorption and 1,25-OH vitamin D production. This leads to phosphaturia and ultimately in decreased mineralization of the long bones and teeth.

Alkaline phosphatase deficiency causes hypophosphatasia and is a recessive condition.1 α-hydroxylase deficiency patients cannot convert 25-hydroxyvitamin D3 to its active form 1,25 dihydroxyvitamin D3, and therefore develop clinical rickets. Carbonic anhydrase deficiency prevents the osteoclasts from acidifying the extracellular space at their ruffled border, which then leads to osteoclast dysfunction and diminished reabsorption of the bone and osteopetrosis.

Question 47 of 100

A 6-year-old African-American boy is brought to the emergency department with acute onset, severe pain through his right leg and left arm. His medical history is significant for sickle cell disease (HgbSS). His clinical exam is consistent with increased warmth and erythema to touch over his extremities, though he can move them, and his inflammatory markers are slightly elevated. He has no fever upon presentation. What is the best next step in the management of this child?

A. Parenteral opioids, aggressive hydration, and oxygen supplementation
B. Radionuclide bone marrow and bone scan
C. Gadolinium-enhanced MRI scan
D. Bone aspirate and broad-spectrum antibiotics

R: A

Sickle cell disease (SCD) is the most common single gene disorder in African Americans, affecting approximately 1 of 375 persons of African ancestry. A vaso-occlusive crisis can manifest as pain in the chest, abdomen; back; or limbs, occurring when red blood cells sickle and cause local ischemia. Vaso-occlusive crisis affecting the bone is the most common acute clinical manifestation in children with SCD. Children with SCD are also prone to increased risk of bacterial sepsis and bone infection. Children with osteomyelitis often present with fever and a painful, swollen, tender limb with limited range of motion, signs and symptoms that are similar to those found in patients with vaso-occlusive crisis. Therefore, diagnosing osteomyelitis in children with SCD can be extremely difficult.

Children with vaso-occlusive crisis tend to have many fewer days with fever, and their inflammatory markers are often only mildly elevated. In the study of Berger and associates, the probability of osteomyelitis increased by 80% for each day a child had fever before presentation, and by 20% for each day a child had pain before presentation. Patients were 8.4 times more likely to have osteomyelitis if they presented with documented swelling of the affected limb. The risk of osteomyelitis was decreased by 30% for each additional painful site if more than one painful site was present.

Plain radiographs obtained during the early phases of either condition often have normal findings or only show soft-tissue swelling. At 2 weeks, both conditions may show periosteal reaction, and radiographs are of limited utility in differentiating the two conditions. Both radionuclide bone marrow and bone scan and Gadolinium-enhanced MRI could be effectively used in differentiating acute osteomyelitis from vaso-occlusive crisis, if needed.
Bone cultures could be helpful but are reported to be positive in only 30% to 86% of cases. Blood cultures could be utilized for definitive diagnosis but they could be even less specific.
Initial management for suspected cases of vaso-occlusive crisis includes intravenous fluids, oxygenation, NSAIDS and parenteral opioids. Patients who do not respond to this regimen may need to undergo advanced imaging and have their cultures taken while they are placed on empiric antibiotics covering salmonella and *Staphylococcus aureus* until a definitive diagnosis is made.

Question 48 of 100
A 4-year-old boy with recent onset of limping and right hip pain is diagnosed with Perthes disease. His radiographs reveal femoral head epiphysis fragmentation and partial collapse consistent with lateral pillar classification B and mild lateral extrusion. His prognosis strongly correlates with his

A. sex.
B. age at the onset of disease.
C. orthopaedic management.
D. ability to bear weight on the extremity.

R: B
Legg-Calve-Perthes disease (LCPD) is a childhood disorder of unknown etiology that can produce permanent deformity of the femoral head. Although LCPD can affect a wide range of children, it is most commonly seen in children aged 5 to 8 years. The male to female ratio is approximately 5:1, and bilateral disease occurs in 10% to 15% of patients. Treatment of patients with LCPD requires an understanding of the natural history of the disease, prognostic factors, and the effectiveness of various treatment methods.
Some of the prognostic indicators of outcome in patients with LCPD includes extent of the femoral head deformity and loss of hip joint congruity at maturity (Stulberg classification), age at onset, lateral pillar height at the fragmentation stage (lateral pillar classification), and premature physeal closure.
Existing studies show a difference in outcome depending on patient age at disease onset. Most patients in whom disease onset occurs younger than age 6 years achieve Stulberg I/II hips at maturity regardless of the type of treatment. These studies show no added benefits in outcome with surgical management in this age group. The treatment results for children aged 6 to 8 years are less clear, though treatment compared with no treatment (brace, range of motion, surgery) may yield better results. For children in whom disease onset occurs older than age 8 years, surgery compared with nonsurgical treatment could be beneficial for the lateral pillar B and B/C border groups but not for patients classified as group C.

Question 49 of 100
An 8-year-old girl with a history of Down syndrome is being evaluated to participate in gym activities. She is otherwise doing well and has appropriate motor developmental milestones. Her neurological exam is normal and cervical spine AP, lateral, flexion and extension radiographs reveal an atlanto-dens interval (ADI) of 7 mm, and normal occipitoatlantal mobility. What is the most appropriate recommendation?

A. Can participate but limit high-risk activities
B. Full, unrestricted activities
C. Limit activities and seek neurology consultation
D. Surgical fusion of the cervical spine

R: A

Down syndrome, with an incidence of 1 in 660 live births, remains the most common human malformation pattern. Individuals with Down syndrome have an increased incidence of congenital heart disease, ophthalmologic disorders, gastrointestinal disorders, thyroid disease, and leukemia.

Musculoskeletal problems commonly occur in Down syndrome and include patellofemoral and hip instability, bunions, severe flatfoot, and instability of cervical spine, which could result in cord compromise and neurological impairment or death.
Increased ADI in the Down syndrome population has not been directly correlated with a concomitant increase in neurologic compromise. The radiographs of the cervical spine in the Down syndrome population must be evaluated by standards specific to that population, and not by traditional standards derived from the radiographs of the cervical spine in the general population. Radiographic evaluation of the cervical spine in the young athlete with Down syndrome is only one component of the preparticipation screening and must be correlated with a pertinent history of physical activity and a detailed physical exam.
When a Down patient presents with an ADI >10 mm and evidence of spinal cord compression, there is little disagreement about the need for surgical intervention. When the ADI is between 4.5 mm and 10 mm in a patient with no decrease in physical activities and no abnormal neurological finding, this may represent hypermobility rather than instability in the Down syndrome population. With an ADI between 4.5 mm and 10 mm, athletes with Down syndrome may participate in most activities but have been advised to avoid high-risk sports such as diving and football.

Question 50 of 100
A 14-year-old girl with a history of aortic root dilation and FBN1 gene mutation and arachnodactyly presents with a thoracolumbar curve of 55°. When compared with patients with adolescent idiopathic scoliosis, the expected outcome with posterior spinal fusion and instrumentation of this patient's scoliosis would be (a) higher

A. fixation failure.
B. pseudoarthrosis rate.
C. blood loss.
D. neurological complications.

R: A

Marfan syndrome is an autosomal dominant disorder caused by a defect in the FBN1 gene encoding fibrillin-1. The main orthopaedic feature of Marfan syndrome is overgrowth of the long bones and related tall stature, chest deformities (pectus carinatum or excavatum), arachnodactyly, protrusio acetabuli, flatfeet, scoliosis and dural ectasia.
Scoliosis in Marfan patients tends to progress rapidly, be less responsive to bracing, and have more revisions and complications as a result of higher rates of cerebrospinal fluid leaks, fixation failure, spine fracture, distal degeneration, proximal add on, and dural ectasia. Fixation failure is likely attributable to osteopenia, dysplastic pedicles, and dysplastic lamina. Dural ectasia, or enlargement of the dural sac, is a highly specific diagnostic feature of Marfan syndrome and is present in more than two-thirds of patients. As the dural sac balloons, it may erode the surrounding bone, which already is weakened by the genetic mutation. These changes pose a challenge to surgical fixation and create a high likelihood of fracture and dural injury. Although some studies report higher blood loss and longer surgical times than in patients with adolescent idiopathic scoliosis, other studies dispute this. Neurological complication and pseudoarthrosis rates have been similar between these two groups of patients.

Question 51 of 100
A 12-year-old boy with a history of Duchenne muscular dystrophy is being evaluated for progressive scoliosis. He now has 35° long thoracolumbar scoliosis, which was 20° only 6 months ago. He has a pelvic obliquity of 20°. He is a full-time wheelchair user. What is the most appropriate next step for this patient's spine deformity care?

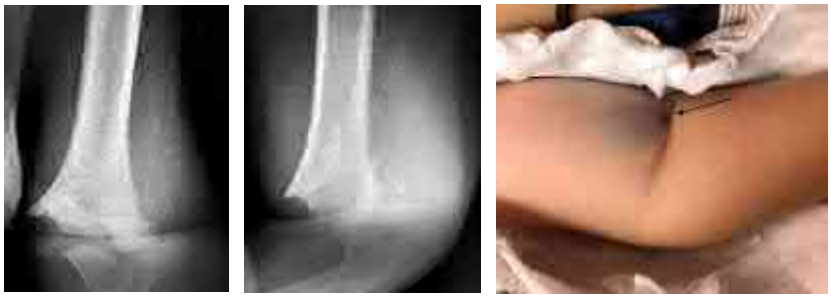
A. Immediate bracing for at least 20 hours a day until skeletal maturity
B. If he is not on glucocorticoids, consider to start
C. Posterior spinal fusion and instrumentation down to pelvis
D. Posterior spinal fusion and instrumentation down to L5

R: C

Duchenne muscular dystrophy is a recessive, X-linked, inherited disorder. Most (90%) untreated boys with this disorder develop progressive scoliosis, secondary to muscle weakness, after becoming full-time wheelchair users. Several studies suggest that the long-term use of glucocorticoids has prolonged effects against detrimental aspects of Duchenne muscular dystrophy.
The widespread use of glucocorticoids for patients with Duchenne muscular dystrophy has dramatically decreased the development of scoliosis and need for subsequent surgical intervention. There is still much to be learned about the impact of glucocorticoids on the spine, including the duration of glucocorticoid treatment needed to reduce the risk of a progressive curve and whether this treatment merely delays the onset. In recent studies in which researchers followed young men into their twenties, it was shown that glucocorticoids protect against the development of scoliosis well past skeletal maturity.
Posterior spinal instrumentation and fusion are recommended in those whose spinal curve is >20°, are prepubertal, and are not on glucocorticoids because progression of the curve is expected. Although patients taking glucocorticoids may still develop a scoliosis, it is reasonable to wait until progression is documented.
When surgery is done to correct scoliosis, it is recommended that those with a pelvic obliquity of >15° also have stabilization and fusion into the pelvis. This helps patients with seating and positioning. Fusion to the L-5 is sufficient for patients who do not have a severe pelvic obliquity. With surgical intervention of the spine, the aim is to reduce the patient's pain, improve his ability to sit comfortably, and prevent further progression.

Question 52 of 100

Figures 1 and 2 are the radiographs of an 8-year-old boy who was brought to the emergency department after falling from monkey bars. The clinical finding in Firgure 3 is caused by impingement of the proximal bone fragment on which structure?



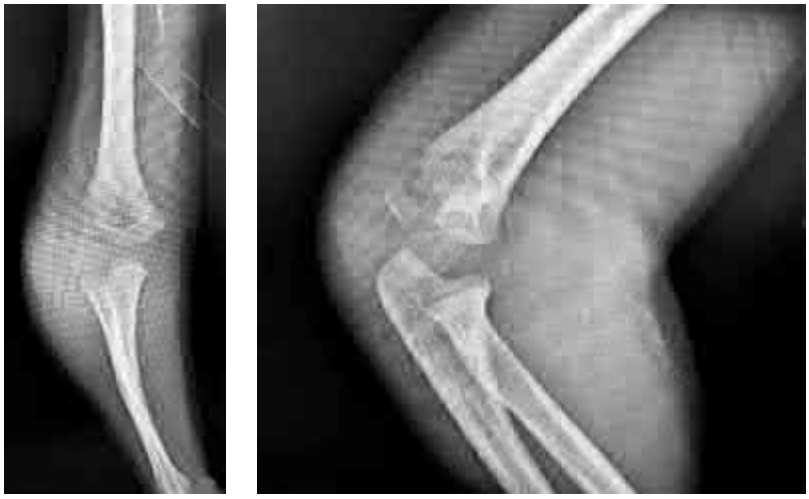
A. Brachialis fascia
B. Biceps tendon
C. Median nerve
D. Lacertus fibrosus

R: A

The clinical findings of anterior skin puckering with ecchymosis is caused by impingement of the brachialis fascia by the proximal bone fragment. Impingement of the bone on the other structures listed does not result in the skin puckering seen in the clinical photo.

Question 53 of 100

A 5-year-old boy develops immediate left elbow pain and swelling following a fall from his hover board. His fracture is demonstrated in Figures 1 and 2. He is taken to the operating room and treated with open reduction and unburied pin fixation. The main advantage of unburied pin fixation compared with buried pin fixation method is

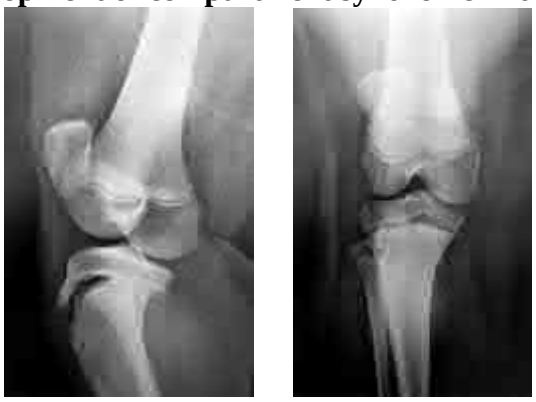


A. unburied pins require more return trips to the operating room.
B. union rate is higher with unburied pins.
C. infection rate is lower with unburied pins.
D. unburied pins are associated with lower patient costs.

R: D
Buried pins require additional return to the operating room for removal, do not decrease infection rate, or improve outcome. The additional return to the operating room significantly increases cost associated with treatment.

Question 54 of 100

Figures 1 and 2 are the radiographs of a 13-year-old girl who stumbled off a porch. Damage to which artery is implicated in the development of compartment syndrome in this patient?

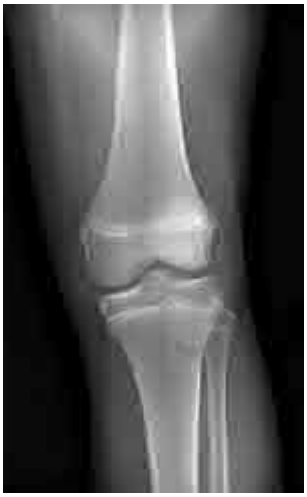
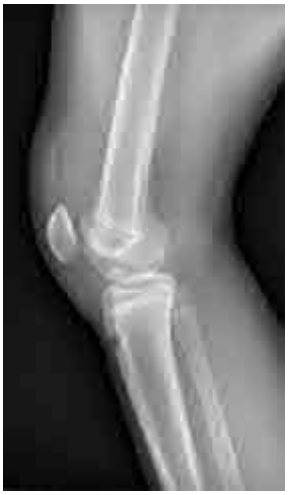


A. Recurrent branch of anterior tibial artery
B. Perforating branch of profunda femoral artery
C. Inferior lateral geniculate artery
D. Posterior tibial artery

R: A
The anterior tibial recurrent artery branches from the anterior tibial artery as it pierces the intermuscular septum and courses proximally near the lateral aspect of the tibial tubercle. This places it at risk for injury with tibial tubercle fractures and can contribute to an isolated anterior compartment syndrome. The other listed arteries are not typically injured in this fracture pattern.

Question 55 of 100

What would be the expected outcome following appropriate management of the injury revealed in Figures 1 and 2?

A. The patient is unlikely to return to sports or strenuous activity after this injury.
B. The patient is at high risk of recurrence of this injury over time.
C. The patient is expected to develop osteoarthritis earlier than uninjured peers.
D. The patient is expected to have a functionally stable knee and resume normal activity.

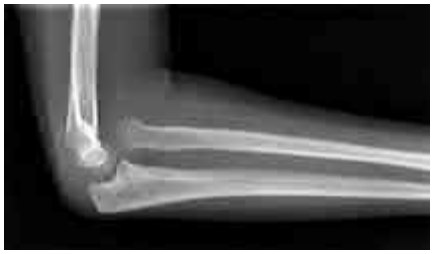
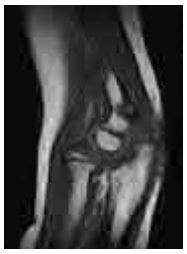
R: D

The images reveal a displaced tibial eminence fracture in a skeletally immature patient. These represent anterior cruciate ligament (ACL)-equivalent injuries in children. Though the ACL elongates as part of the injury process, when the bony fragment is replaced and heals, the knee is usually functionally stable, and patients return to preinjury levels of activity without difficulty.

No long-term injury is expected, so there is no reason to expect inability to return to sports or strenuous activity. This injury heals with normal bone and does not predispose to reinjury. There is no evidence that a stable knee, which is expected after this injury, will lead to premature osteoarthritis.

Question 56 of 100

Figures 1 and 2 are the radiographs of a 5-year-old boy who was treated for a nondisplaced ulna fracture. Eight months later, he complains of a painful prominence over the elbow, causing pain with direct trauma during activity, occurring for several months. What is the best next step in the management of this patient?

A. Excision of the radial head
B. Osteotomy of the ulnar deformity
C. Annular ligament reconstruction
D. Osteotomy of the ulna and radius

R: B

The images are of a chronic, missed Monteggia lesion. MRI demonstrates that the head is still concave, so reconstruction is still feasible. In late deformity, the ulna has to be overcorrected to pull the radial head back into appropriate alignment, making up for the elongation of the previously torn interosseous ligament, and stabilizing it. Osteotomy of the radius is not indicated, as there is no deformity present.

Excision of the radial head is inappropriate for a traumatic condition such as a Monteggia, which will continue to develop radial-ulnar mismatch and progressive wrist and elbow deformities if this is done while significant growth remains. Reconstruction is preferable in this case to salvage.

Annular ligament reconstruction alone will not restore stability in this injury; persistent deformity of the ulna is present.

Question 57 of 100

A 4-year-old girl who has midlumbar myelomeningocele and hydrocephalus is being evaluated for her uneven gait. A hip examination reveals a right hip dislocation. Bilateral hips are pain-free with full range of motion and no fixed deformity. What is the most appropriate course of action?

A. Obtain standing AP pelvis to evaluate the hips; plan open reduction of the right hip when the patient starts having hip pain
B. Obtain supine AP pelvis to evaluate the hips; plan open reduction of the right hip as soon as possible
C. Inform the family that the dislocated hip will not limit the ability to ambulate and will not benefit from reduction
D. Inform the family that the patient's ambulatory potential is poor due to the hip dislocation, which cannot be treated successfully

R: C

A child with midlumbar myelomeningocele, without other lesions, would be expected to have the ability to ambulate, though delayed. She has a high likelihood of hip dislocations because of lack of function of the abductor muscles. The presence or absence of hip dislocation does not affect ambulatory ability; the child is already walking. The best course of action is education of the family and therapist as to the minimal effect that a hip dislocation has in these patients. A shoe lift or brace buildup can address leg length discrepancy; in a hip without contractures, no other treatment is needed.

Radiographs are unnecessary in the management of the hip dislocation in myelomeningocele. Surgery has been shown to convert supple, painless dislocated hips into stiff, painful hips that have a high likelihood of redislocation. Though the dislocation is not recommended for treatment, this does not preclude the ability to safely ambulate and undergo therapy, which is not harmful to the condition.

Question 58 of 100

An 11-month-old boy is being evaluated for scoliosis. Radiographs reveal a right thoracic curve of 20° with a rib-vertebral angle difference of 16°. What is the most appropriate next step in management?

A. A total spine MRI should be obtained, followed by serial casting
B. A thoracolumbosacral orthosis (TLSO) should be fabricated for this patient and used 23 hrs/day
C. The patient does not require any intervention or follow-up for this normal finding and can be discharged from follow-up
D. A repeat examination and PA radiograph should be obtained in 3 months

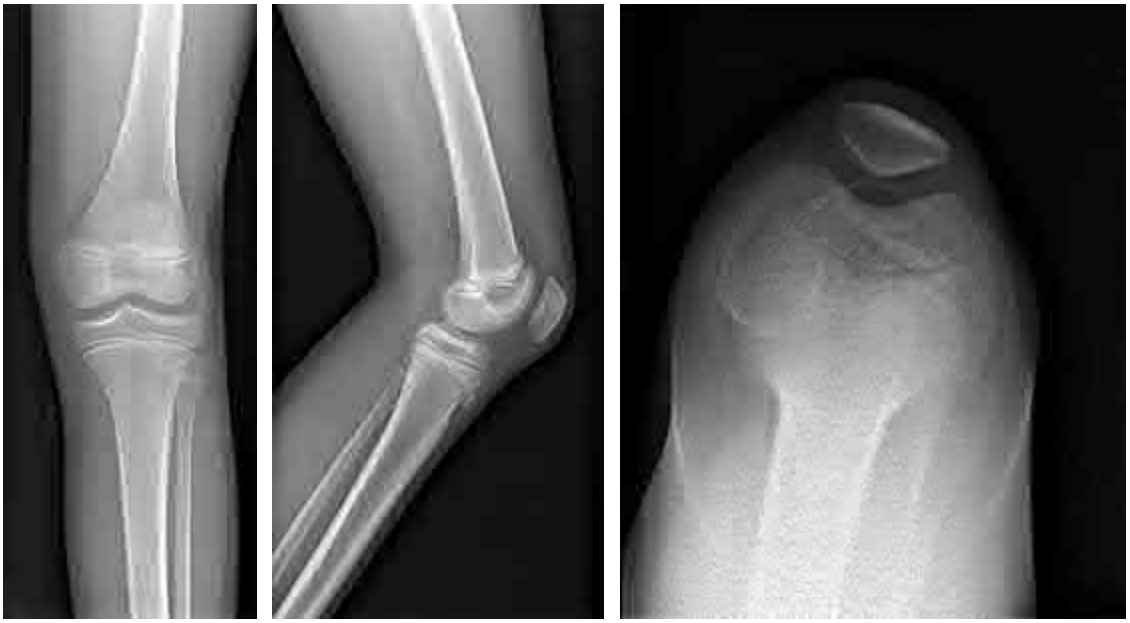
R: D

Infantile scoliosis has both resolving and progressive forms. If the rib-vertebral angle difference of Mehta is not >20 degrees, and the curve is mild at presentation, repeat imaging with a standing film in 3 months is recommended to determine if the curve is of the resolving type.

MRI in younger than age 12 months can fail to detect a tethered cord; as it requires sedation, it can be appropriately delayed until the second image to avoid unnecessary risk. A TLSO is not appropriate initial treatment for infantile scoliosis. While the patient still has a curve, he should be followed to ensure resolution.

Question 59 of 100

Figures 1 through 3 are the radiographs of a 12-year-old female soccer player, who presents with insidious onset of right knee swelling and pain with activity, including walking, over the last month. She has been placed on crutches by the urgent care for comfort. Examination reveals intraarticular effusion, tenderness over the lateral anterior knee, and some discomfort with motion limited by swelling. Ligamentous examination is stable. What is the best next step in evaluation and/or management?



A. Obtain noncontrast CT of the knee
B. Obtain noncontrast MRI of the knee
C. Perform diagnostic arthroscopy
D. Begin physical therapy for rehabilitation

R: B
The images demonstrate osteochondritis dissecans. The history of pain with even mild activity such as walking, presence of effusion, and limited range of motion raise concern for an unstable lesion. MRI is the best modality to detect this and would be the next indicated step in evaluation.
CT is better for delineating bony anatomy, not the stability of the lesion. Arthroscopy is not indicated before MRI. Patients with stable lesions and open physes can heal their lesions without surgery. Physical therapy would not be appropriate without first determining the stability of the lesion.

Question 60 of 100
A 15-year-old football player sustains a concussion on the field. His mother and coach are asking when it will be safe for him to begin a return-to-play program. For the best outcome, he should be advised to wait until he

A. is confident he has fully recovered.
B. completes a week of complete brain rest.
C. undergoes a brain MRI showing no evidence of injury.
D. is completely symptom-free at rest.

R: D
For return to class, students will require cognitive rest and may require academic accommodations such as reduced workload and extended time for tests while recovering from a concussion.
For return to play, concussion symptoms should be resolved before returning to exercise. A return to play progression involves a gradual, step-wise increase in physical demands, sports-specific activities, and the risk for contact. If symptoms occur with activity, the progression should be halted and restarted at the preceding symptom-free step. A greater number, severity, and duration of symptoms after a concussion are predictors of a prolonged recovery.

Question 61 of 100
The four anatomic sites with highest risk of concomitant pediatric septic arthritis and osteomyelitis are

A. proximal humerus, distal femur, proximal femur, and distal forearm.
B. proximal humerus, proximal ulna, proximal femur, and proximal tibia.

C. proximal humerus, proximal radius, proximal femur, and distal fibula.
D. proximal radius, distal forearm, proximal femur, and distal tibia.

R: C

The four high-risk sites for concomitant septic arthritis and osteomyelitis in children are the four intraarticular metaphyses: proximal humerus, proximal radius, proximal femur, and distal fibula. Knowledge of these specific anatomic sites can help with index of suspicion for both pathologies in the setting of acute infection. The key to recognizing these anatomic locations enables avoidance of isolated drainage of septic joints, while neglecting drainage of the causative osteomyelitis. Failing to drain the osteomyelitis has a higher likelihood of recurrent septic arthritis.

Question 62 of 100

Community-acquired (CA)-methicillin-resistant *Staphylococcus aureus* (MRSA) is one of the most common organisms causing severe musculoskeletal infections in children. In contrast to its methicillin-sensitive counterpart, CA-MRSA is associated with

A. a more severe, fulminant illness and need for multiple operative procedures.
B. C-reactive protein levels <4 mg/dL.
C. a first-line of antibiotic treatment with linezolid.
D. less of a risk of deep venous thrombosis and pulmonary thromboembolic events.

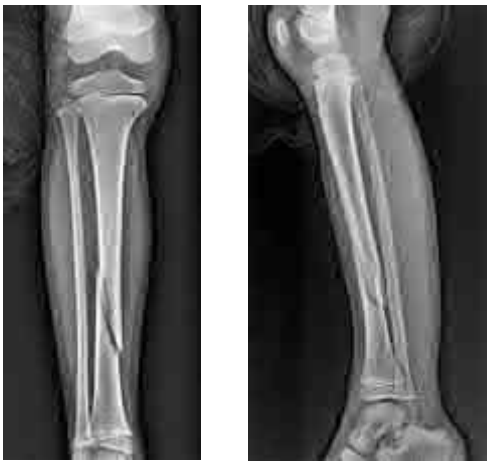
R: A

CA-MRSA is one of the most common organisms causing severe musculoskeletal infections in children. In contrast to its methicillin-sensitive counterpart, CA-MRSA is associated with a much more severe disease burden, including the need for more operative procedures before it is cleared.

CA-MRSA is more likely to be diagnosed when the C-reactive protein level is >5 mg/dL. Currently, clindamycin and vancomycin are the first-line antibiotics used for treatment of CA-MRSA; linezolid is reserved for severe resistant cases or allergies, as it is not indicated otherwise for use in children. CA-MRSA is much more likely to cause associated deep venous thrombosis and pulmonary thromboembolism than hospital-acquired-MRSA, due to a much higher propensity for the former to carry the Panton-Valentin leukocidin gene.

Question 63 of 100

Figures 1 and 2 are the radiographs of a 6-year-old boy who came to the emergency department with a twisting injury to the right leg sustained while skiing. He is nonweightbearing, has no pain with passive motion of his ankle and toes, and remains neurovascularly intact. What is the most appropriate next step in the management of his injury?



A. Flexible intramedullary nailing
B. Long leg casting
C. External fixation
D. Plate and screw fixation

R: B
The images demonstrate a mildly displaced tibial shaft fracture that meets criteria for nonoperative management. At his age, these parameters are typically fracture shortening <1cm, coronal angulation <10°, sagittal angulation <15°, and rotation <10°. Options for operative management should be reserved for injuries that fail nonoperative treatment, open fractures, and potentially fractures with initial shortening >2 cm. Having an intact fibula is a relative indication for surgery; however, recent studies show no difference in operative and nonoperative treatment for this pattern.

Question 64 of 100

A 12-year-old boy at 5'5", 180 pounds comes to the outpatient clinic with 2 months of left anterior knee pain without discrete injury. He has a slight antalgic gait on the left, has full knee range of motion, stable ligaments, and mild tenderness at his tibial tubercle. He has restricted hip internal rotation and worsening knee pain with hip motion. Knee radiographs are negative. What is the best next step in treatment?

A. Non-steroidal anti-inflammatory drugs and physical therapy for tibial tubercle apophysitis
B. MRI of the left knee for evaluation of stress fracture
C. Protected weight bearing with crutches and repeat evaluation in one week
D. AP and frog-lateral pelvis radiographs

R: D
Knee pain in an overweight adolescent patient is a classic presentation for stable slipped capital femoral epiphysis (SCFE). Recognizing the exacerbation of knee pain with hip motion makes radiographic evaluation of the hip the appropriate next step in evaluation. Delaying the diagnosis with treatment focused on the knee such as the other answer options suggest, risks progression of the SCFE and potential long-term consequences.

Question 65 of 100

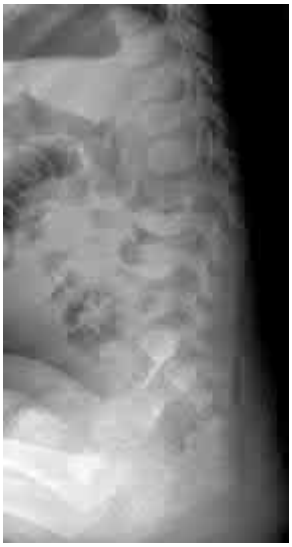
A 162-cm, 11-year-old boy who plays baseball year-round has had 6 weeks of progressive left medial elbow pain, which is worse after throwing. He was last seen 4 months prior for calcaneal apophysitis. At that time, his height was 150 cm, and he recovered without missing activities. His examination is notable for full elbow motion, no pain with valgus stress, mild tenderness at proximal medial epicondyle, and negative Tinel's sign. The most significant risk factor for this injury is his

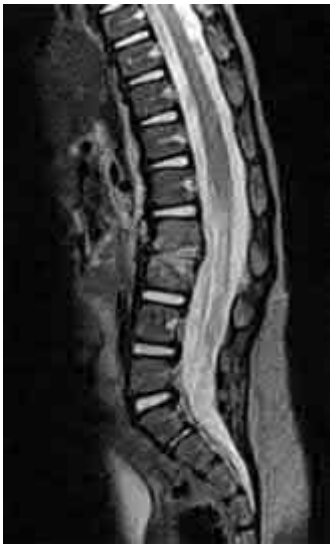
A. recent significant height increase.
B. bat swing velocity.
C. increased shoulder internal rotation.
D. ulnar nerve symptoms.

R: A
Risk factors for elbow pain in young athletes include age (>11 years), height (>150 cm or recent increase), pitcher, days of training, grip strength at least 25 kg, external rotation of the shoulder less than <130°, and increased muscle strength of the shoulder. This patient demonstrated 12-cm growth in a period of 4 months with a height of 162 cm, both being a risk factor for elbow pain in the throwing athlete. None of the other answer choices listed have been demonstrated as risk factors.

Question 66 of 100

A 2-year-old girl is being evaluated for 3 to 4 weeks of limping. She has been afebrile and has stopped walking, prefering to crawl. Unable to stand from a seated position, she has not gained weight over the last 3 months. She has a non-toxic appearance and has no bruises. Her hips have minimal pain with range of motion. She is able to walk with a waddling/lurching gait. A radiograph and MRI of the pelvis were obtained (Figures 1 and 2). The most appropriate next step in management is/are





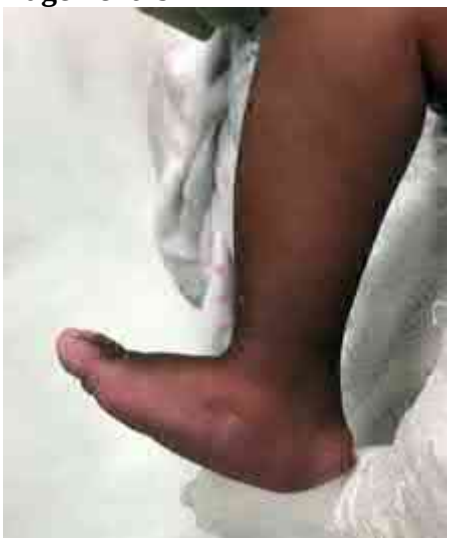
A. hip aspiration.
B. a CT-guided biopsy.
C. antistaphylococcal antibiotics.
D. chromosomal analysis.

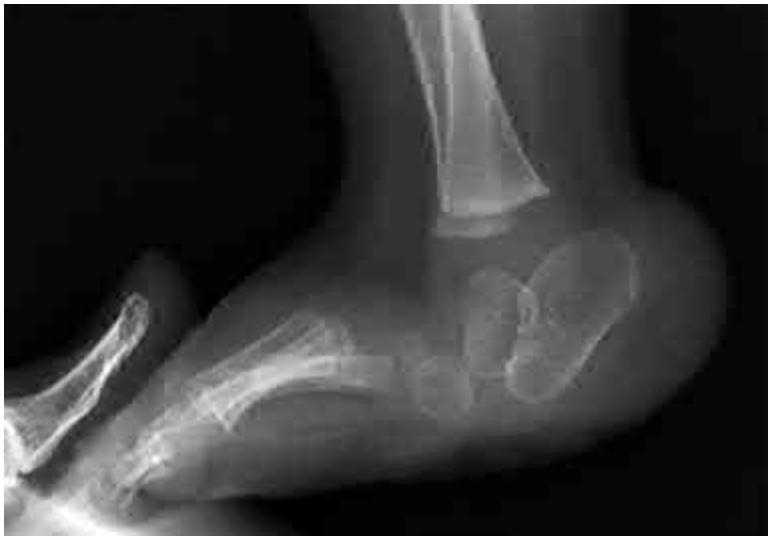
R: C

The plain films show decreased joint space and irregularity of the vertebral endplates at L2-L3. This is confirmed by the MRI. There is no evidence of an abscess. These findings are consistent with discitis/ vertebral osteomyelitis. When cultures are positive, the most common organism is *Staphylococcus aureus*. For this reason, empiric treatment with anti-staphylococcus antibiotics should be the first line of treatment. If there is no improvement, or if there are risk factors for other organisms, (foreign travel, immunocompromised, exposure to unpasteurized milk), CT-guided biopsy may be indicated. Symptoms may also improve with the addition of a brace.

Question 67 of 100

Figures 1 and 2 are the clinical photograph and radiograph of a newborn who is seen for evaluation of his feet. A rigid rocker bottom foot is present with dorsal foot crease. The most appropriate next step in management is





A. serial casting with talonavicular reduction and fixation and Achilles tenotomy.
B. operative release at age 18 months.
C. tendon transfer after age 18 months.
D. observation, physical therapy, and transition into an ankle foot orthosis.

R: A

Congenital vertical talus is a rare condition in which the navicular is dorsally dislocated on the talus. There is also hindfoot equinus and valgus, resulting in the rocker bottom appearance. Fifty percent of cases are associated with other conditions (arthrogryposis, chromosomal abnormalities, skeletal dysplasia, myelomeningocele). Once the diagnosis is confirmed, usually on a plantar flexion lateral radiograph (the first MT does not align with the first metatarsal), treatment with serial casting described by Dobbs and associates is instituted. Once the talus lines up with the first metatarsal, surgical reduction of the talonavicular joint with pinning and Achilles tenotomy are done to correct the deformity.

Question 68 of 100

A 7-year-old girl comes to the emergency department after falling from monkey bars and landing on her outstretched hand. Radiographs show an extension Gartland type III supracondylar fracture of the humerus. Immediately following the fall, she complains of pain and swelling of the right elbow. Examination reveals absent radial and ulnar pulses and associated anterior interosseous nerve (AIN) injury. The hand is pink with brisk capillary refill. Pulses are undetectable by Doppler ultrasonography. What is the best next step in the management of this patient?

A. Immediate closed reduction in the emergency department under sedation
B. Emergent closed reduction and percutaneous pinning
C. Open reduction (OR) and exploration of the brachial artery
D. CT angiography for evaluation of the brachial artery

R: B

Radiographs show an extension Gartland type III supracondylar fracture of the humerus. The child also has associated absent pulses with concern for circulatory compromise and AIN injury. This question tests the management of pulseless pink hand with median nerve or AIN injury. Closed reduction and percutaneous pinning and follow-up for nerve recovery is the most appropriate answer.

Vascular compromise can be present in up to 20% of patients with displaced type III supracondylar humerus fractures. The brachial artery is stretched or kinked over the displaced fracture fragments or may be in spasm. Nerve injuries can occur in 6-11% of supracondylar fractures, with median and AIN being the most common injured nerves.

In a recent multicenter retrospective study by Harris and associates, 71 pulseless supracondylar humerus fractures with median nerve or AIN injury were treated via CRPP or open reduction; 52 patients underwent closed reduction percutaneous pinning (CRPP); 19 patients underwent open reduction and early antecubital fossa exploration. CRPP was sufficient treatment in 50 patients with only 2 requiring reoperation for other reason (one for compartment syndrome and one for loss of reduction in follow-up). Of the 19 patients who underwent OR and early exploration, 6 needed vascular procedures. In patients with at least 3-month follow-up, 59 (61 patients, 97%), patients had complete resolution of nerve palsy. The authors recommended OR and early exploration in patients who have pulseless, pale hand with associated median nerve or AIN injury.

This a displaced Gartland type III supracondylar fracture of the humerus. These injuries are managed by CRPP to prevent malunion and provide good function outcomes. CRPP is required for fracture stabilization first, and exploration of brachial artery should be performed if the hand is poorly perfused after reduction and pin fixation. Finally, CT angiography is not indicated and will only delay the child's care - the important next step is closed reduction and pin fixation.

Question 69 of 100

A 10-year-old boy undergoes standard transphyseal anterior cruciate ligament (ACL) reconstruction with hamstring autograft. What is the most likely angular deformity associated with this technique?

A. Varus
B. Valgus
C. Procurvatum
D. Recurvatum

R: B

The most common deformity after ACL reconstruction in a skeletally immature patient includes valgus deformity from injury to the distal lateral femoral physis. Varus would occur with injury to the medial physis. Limb-length discrepancy would occur with complete physeal arrest.

Question 70 of 100

An 11-year-old boy goes to the emergency department after a twisting injury to his left knee during a soccer game. Radiographs reveal a McKeever type 3 tibial eminence fracture. The most common associated finding with this injury is

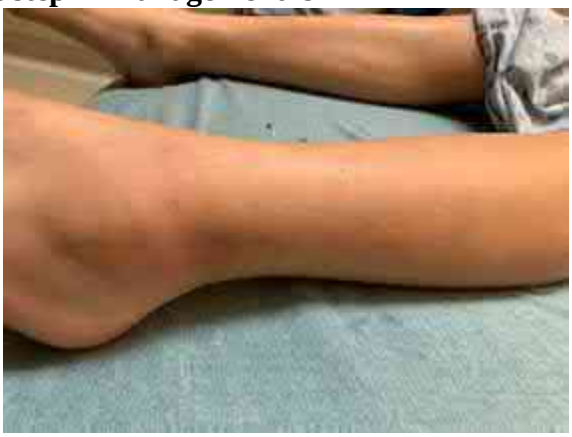
A. meniscal tear.
B. meniscal entrapment.
C. displaced chondral fracture.
D. posterior cruciate ligament injury.

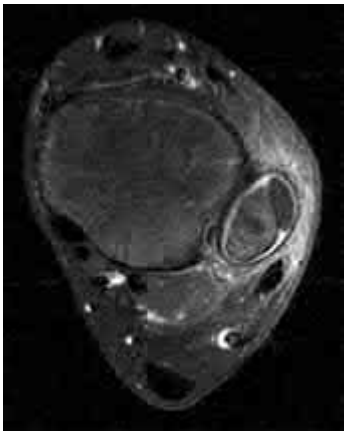
R: B

Concomitant injuries are increasingly recognized with displaced type III tibial eminence fractures. Although meniscal tears, chondral injuries, and posterior cruciate ligament injuries are associated findings, the most common finding is meniscal entrapment.

Question 71 of 100

Figure 1 is the clinical photograph of an 11-year-old otherwise healthy boy who presents to the emergency department following 3 days of progressive left lateral ankle pain, difficulty bearing weight, swelling, and fever. He has a temperature of 102°F and other vitals are normal. He denies other areas of pain. He tolerates gentle ankle motion, and has exquisite point tenderness overlying the region of the distal fibular metaphysis. Radiographs of the ankle are normal. CRP is 32 mg/dL, ESR is 17, WBC count is 10.4. An MRI (Figure 2) and axial T1 fat-saturated post-contrast image are obtained. The most appropriate next step in management is





A. hospital admission to begin empiric antibiotics and await results of blood cultures.
B. consult infectious disease for nonoperative management of osteomyelitis.
C. urgent surgical drainage of his subperiosteal abscess.
D. begin empiric oral antibiotics and outpatient therapy for his cellulitis.

R: C

The clinical photograph and MRI image demonstrate focal swelling and a subperiosteal fluid collection, consistent with osteomyelitis and subperiosteal abscess. Appropriate management includes surgical drainage and antibiotics. Beginning antibiotics are both part of the treatment process, prompt identification of the subperiosteal abscess and decompression is a critical step. Neither waiting on cultures nor outpatient treatment provide sufficient treatment for the abscess. Infectious disease consultation may be utilized for antibiotic guidance; however, surgical management is necessary and takes priority.

Question 72 of 100

What is the most common complication after successful treatment of a distal femoral physeal fracture?

A. Nonunion
B. Compartment syndrome
C. Knee stiffness
D. Premature physeal closure

R: D

Distal femoral physeal fracture have a high rate of premature physeal closure which can lead to limb length discrepancy or angular deformity. These fracture heal rapidly and vascular injury and knee stiffness are rarely reported. Compartment syndrome is more frequently reported with tibial tubercle fractures and not distal femoral physeal fractures.

Question 73 of 100

Figures 1 and 2 are the radiographs of a 10-year-old boy who came to the emergency department after sustaining a basketball injury. He has a large effusion and increased translation on Lachman's examination. What is the most appropriate management of this injury?

A. Long leg casting in extension
B. Surgical treatment with open or arthroscopic reduction and internal fixation
C. Anterior cruciate ligament (ACL) reconstruction with a transphyseal technique
D. ACL reconstruction with a physeal sparing technique

R: B

The imaging shows a displaced tibial spine avulsion. Non-displaced or minimally displaced fractures can be treated with long leg casting in extension, but displaced fractures require either open or arthroscopically assisted reduction and internal fixation with either screws or a suture construct. Although late knee instability is reported, an attempt at fracture fixation is recommended rather than acutely undergoing ACL reconstruction.

Question 74 of 100

A 17-year-old boy sustains a witnessed loss of consciousness during a tackle at a football game. Sideline testing shows no amnesia, with baseline cognition and balance testing. The patient has no history of previous concussions. He is not experiencing any concussive symptoms. What is the most appropriate approach to allowing this athlete to return to play?

A. Immediate return, as he has no symptoms of concussion
B. He should be encouraged to not play contact sports again due to the risk of chronic traumatic encephalopathy (CTE).
C. The patient should be held out of all sports for 2 weeks and then allowed to return.
D. Completion of a supervised graduated return to play program that is dependent on remaining symptom-free.

R: D

The principle of concussion management in adolescent athletes is to recognize and remove. The player should not be allowed to return to play and should enter a graduated return to play program that is dependent on remaining symptom-free and not necessarily according to a strict time line. Although there is a reported link between multiple concussions and CTE, this needs further research and the role of the first-time concussion is unknown.

Question 75 of 100

A 2-year-old boy falls at the playground and sustains an oblique femoral shaft fracture with minimal shortening. There are no other injuries and no skin compromise. Which appropriate treatment is associated with the highest parent satisfaction?

A. Flexible intramedullary nails
B. Single leg spica casting
C. Double leg spica casting
D. Submuscular bridge plating

R: C

Femoral shaft fractures in patients younger than age of 4 to 5 years can be successfully managed in hip spica casts if there are no other extenuating circumstances. Studies have recently shown better parent satisfaction with a single leg spica with comparable healing when compared with double leg spica casting.

Question 76 of 100

A 15-year-old girl has had 4 months of right hip and groin pain. Upon examination, she has 25° of internal rotation with the hip flexed, which causes pain on the right side. Her left side shows 20° of internal rotation but no significant pain. Plain radiographs show that the patient has no dysplasia and an alpha angle of 68° on the right side and 70° on the left side. She has not undergone any formal treatment to date. What is the best course of initial management?

A. Right hip arthroscopic femoroacetabular impingement (FAI) surgery
B. Bilateral FAI surgery
C. Delayed gadolinium-enhanced MRI of cartilage (dGEMRIC), MRI of bilateral hips
D. Trial of physical therapy

R: D

Recent studies have shown success in conservative management for adolescent patients with femoroacetabular impingement syndrome. In a patient who has had symptoms for 4 months with no trial of physical therapy, this is the best step. In addition, even though the radiographic and range-of-motion parameters are more profound in the nonpainful hip, multiple authors have documented the presence of FAI morphology in asymptomatic patients, and the role of prophylactic surgery has not been elucidated. In addition, there are recent concerns about retained gadolinium, and its promise in imaging is starting to decline in elective type procedures.

Question 77 of 100

The parents of a 14-year-old boy bring him for follow-up after undergoing conservative management for Osgood-Schlatter disease with rest and a stretching program. At this time, the patient is no longer symptomatic. He has a 2-cm, fixed, palpable, nontender bony mass over his tibial tubercle. There are no skin changes, and it is confluent with the underlying bone and does not transilluminate. Plain radiographs show a 2-cm ossicle within the patellar tendon adjacent to the tibial tubercle. The most appropriate next step in management is

A. further diagnostic workup with MRI.
B. reassurance with no formal treatment.
C. physical therapy for quadriceps stretching exercises.
D. excisional biopsy.

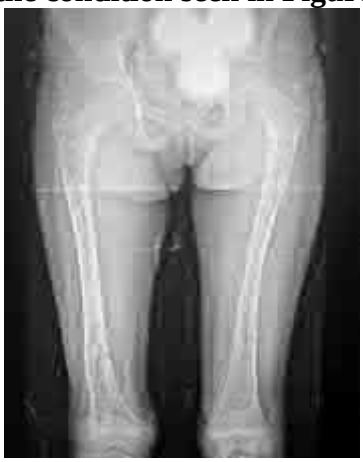
R: B
Osgood-Schlatter disease can be managed with conservative treatment. A percentage of patients will develop a painful ossicle adjacent to the tibial tubercle, but this does not warrant further workup and rarely requires surgical excision.

Question 78 of 100
A 9-year-old boy is admitted from the emergency department after undergoing closed reduction and long leg casting for a displaced tibial shaft fracture. The nursing staff report that he is becoming increasingly anxious and agitated. In addition, he has maxed out the dosing for IV narcotics. The most appropriate next step in management is

A. increasing the dose of narcotic medications as he is currently being undertreated for pain.
B. adding in an anxiolytic medication for the child's anxiety.
C. splitting the cast, underlying cast padding, and the anterior portion of the cast and reassessment.
D. immediate compartment measurements via invasive technique.

R: C
Children who have developing compartment syndrome rarely show the typical physical exam findings that adults do. Instead of paraesthesias; pain on passive stretch; pallor; pulselessness; poikilothermic; and paralysis that adults show, children typically demonstrate agitation, increased analgesic requirement, and anxiety (three As). The first-line treatment in developing compartment syndrome is to remove circumferential bandages/casts. Invasive compartment measurements should rarely be used in cooperative patients but are an adjunct in preverbal, confused, or obtunded patients who do not cooperate with an exam, in those children with regional nerve blocks.

Question 79 of 100
The genetic mutation responsible for the condition seen in Figure 1 involves

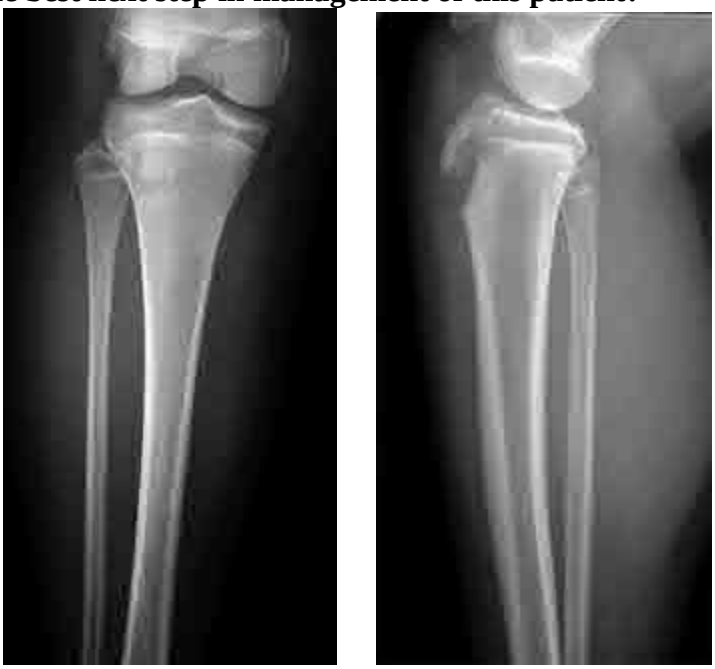


A. GNAS
B. EXT1
C. COL1A1
D. FGFR3

R: A
The radiograph reveals diffuse involvement of both femurs characteristic of polyostotic fibrous dysplasia. Genetic mutations in the gene GNAS in skeletal stem cells are found to be responsible for this condition. Mutations in EXT1 result in multiple hereditary exostosis. COL1A1 mutations are responsible for osteogenesis imperfecta. FGFR3 mutations are found in achondroplasia.

Question 80 of 100
Figures 1 and 2 are the radiographs of a 16-year-old boy who falls following a seizure. He is unable to bear weight on the right lower extremity following the fall. Over the subsequent 24 hours, his leg becomes progressively more painful and swollen. He is taken to the emergency department where on

initial assessment his pain is out of proportion, positive stretch pain, tense leg swelling, and decreased motor function of his foot muscles with decreased sensations throughout the foot. Toes are warm and well-perfused. What is the best next step in management of this patient?



A. Emergent fasciotomy of the leg
B. Open reduction and internal fixation (ORIF) of the fracture
C. CT scan of the knee
D. Closed reduction with long leg cast application

R: B

The radiographs reveal an Ogden type 4 tibial tubercle fracture. The clinical examination of the patient is highly suggestive of compartment syndrome.

Tibial tubercle fractures have been associated with the development of compartment syndrome, with rates as high as 10% reported in literature. It is caused by disruption of the branches of the recurrent anterior tibial artery, which travels on the lateral border of the tubercle. At the time of injury, the artery may be injured and retract under the fascia in the anterior compartment of the leg, leading to excessive bleeding in the anterior compartment. Patients with compartment syndrome should be emergently taken to the OR for fasciotomy and ORIF of the fracture.

Emergent fasciotomy of the leg with posterior splint is not called for, as this fracture needs anatomic reduction and fixation to prevent procurvatum deformity of proximal tibia. CT scan of the knee is not appropriate because this is compartment syndrome, which needs emergent fasciotomy.

This situation needs ORIF for anatomic reduction of the fracture with emergent fasciotomy for compartment syndrome of the leg. Closed reduction and percutaneous screw fixation is not the right option here.

Question 81 of 100

A 4-year-old girl comes to the emergency department with a 3-day history of fever, a limp, and left knee pain and swelling. There is no history of recent trauma. Her temperature is 102.6° F. Her left knee is warm, erythematous, and tender with restricted range of motion. Her WBC count is 14,500, ESR is 72, CRP level is 10.2. What is the most appropriate next step for management of this patient?

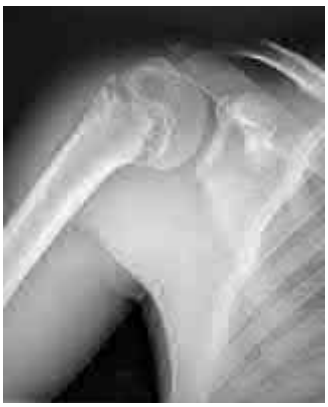
A. Broad-spectrum antibiotics
B. MRI scan of left knee
C. Aspiration of left knee
D. Emergent incision and drainage

R: C

Septic arthritis accounts for approximately 6.5% of all childhood arthritis and is common in children <2 years. Infected joints are swollen, red, hot, and have restricted range of motion. The child limps or refuses to bear weight on the affected lower extremity. There is often an associated infection of the adjacent bone, especially in shoulder; elbow; hip; and ankle joint, as the metaphysis is intracapsular in these joints.
Aspiration is the best next step in management of a child with acute unexplained monoarthritis, as septic arthritis is associated with devastating morbidity if not treated appropriately. A cloudy or serosanguinous tap is highly suggestive of septic arthritis. The synovial fluid often has high polymorphonuclear cell count (50,000 to 300,000/mm^3), or a Gram stain is positive. The culture is positive in 60% to 70% of cases with *Staphylococcus aureus* and *Streptococcus pyogenes* the most commonly isolated organisms beyond neonatal period.
Empiric antibiotics should be started after the diagnostic evaluation. MRI is not the first diagnostic test when the history and examination are highly suggestive of an acute septic joint. However, MRI is helpful to make a diagnosis of associated osteomyelitis.

Question 82 of 100

Figure 1 is the radiograph of a 10-year-old boy who has had insidious onset of right shoulder pain for 4 months. He plays baseball 3-4 times per week. He is right-hand dominant. His pain mostly occurs when throwing the ball, but can also occur with non-throwing activities. He is also reporting that his velocity is now decreasing. Physical examination and radiographs of the shoulder are normal. What is the best next best step in management of this patient?



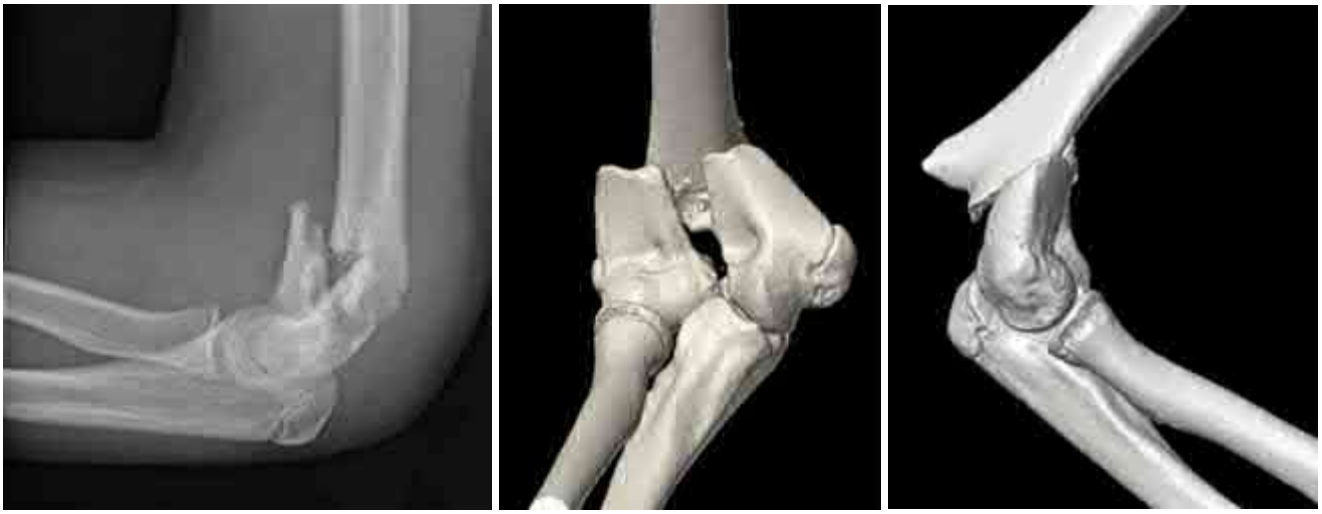
A. Shoulder arthroscopy for superior labral anterior to posterior (SLAP) repair
B. Physical therapy and continued participation in sport
C. MRI scan of the shoulder
D. Complete cessation of throwing activities for 6 weeks

R: D

The patient is suffering from what is called Little League shoulder. It is a traction injury to the proximal humerus physis. Injury to this area is caused by repetitive stress seen in overhead throwing sports. The incidence of this condition is increasing as the frequency and intensity of organized youth sport have increased, and it most commonly presents between age 9 and 12 years before closure of the physis. It is most common in baseball pitchers, football quarterbacks, and tennis players.
Immobilization with brace or cast is necessary for the most severe cases in patients experiencing persistent pain at rest, which is not the presentation of the patient here. Physical therapy is usually started early after a short period of rest for early rehabilitation. MRI is rarely necessary to confirm the diagnosis. Radiographs can show widening of the physis, especially compared with the contralateral side, but is not required for diagnosis.

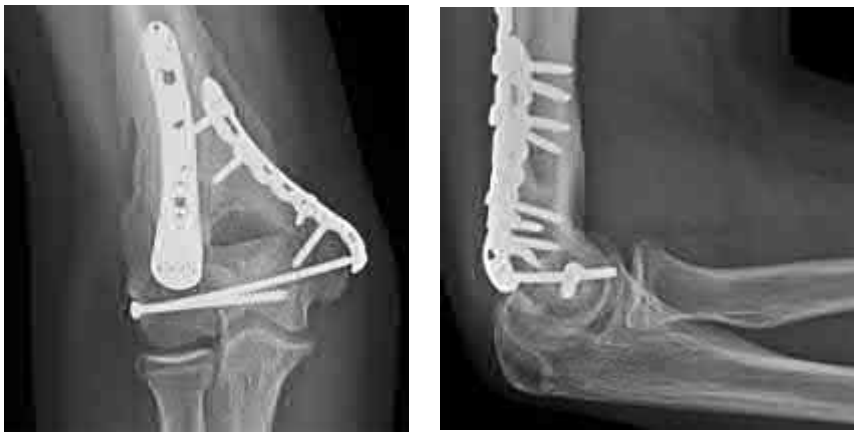
Question 83 of 100

Figures 1 through 3 are the radiographs and 3D reconstruction of a 13-year-old right-hand dominant boy who landed onto a flexed right elbow and now has pain, swelling, and crepitation in the right elbow. The most appropriate treatment would be



A. open reduction with percutaneous pinning with 2.0 mm Kirschner wires.
B. closed reduction and percutaneous pinning with 2.0 mm Kirschner wires.
C. open reduction and internal fixation.
D. traction.

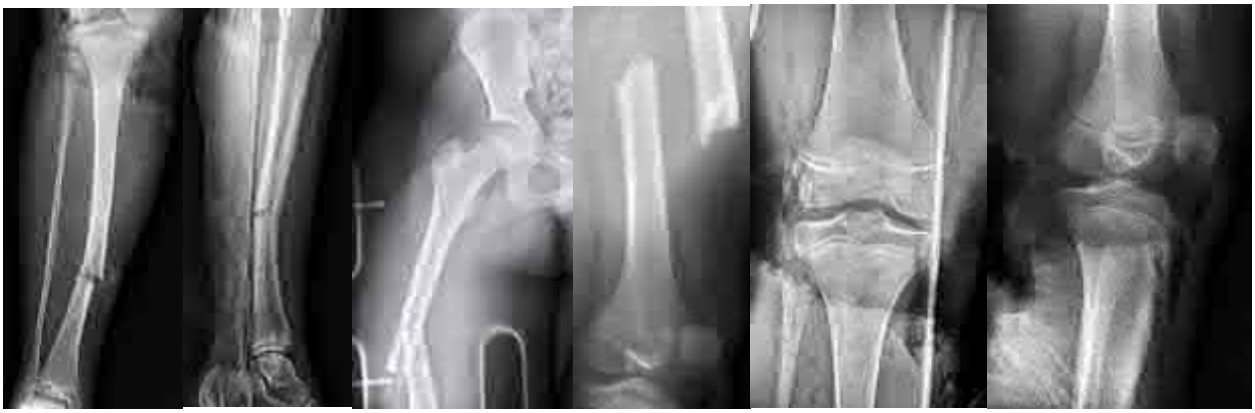
R: C



Imaging demonstrates a displaced, T-type intra-articular distal humerus fracture. Anatomic restoration of the articular surface and stable fixation to enable early motion are imperative in this fracture pattern. Thus, open reduction enables articular reduction, safe identification, and protection of the ulnar nerve, and plate osteosynthesis of both condylar fragments. Olecranon osteotomy is not required, given the lack of comminution and large size of the condylar fracture fragments. The proximal position and lateral plane obliquity of the transverse metaphyseal fracture line render stable percutaneous pinning of the distal fragments to the shaft difficult. Additionally, interfragmentary compression of the articular surface is not attainable with percutaneous Kirschner wire fixation. Traction is of historical interest only and not an appropriate treatment at this time.

Question 84 of 100

Figures 1 through 6 are the radiographs of a 10-year-old boy who is seen in the emergency department following a roll-over ATV accident. He is alert; oriented; and conversive, and has a 5-mm posteromedial tibial wound; a 15-cm suprafascial popliteal fossa degloving injury; and obvious thigh and leg deformity. Physical examination reveals compressible thigh and leg compartments, intact motor and sensory function in the involved distal extremity, and 2+ palpable pedal pulses with capillary refill <2 seconds. No additional injuries are noted in the full trauma workup, and the patient is hemodynamically stable. Following emergent surgical irrigation and debridement of his open wounds, what are the best next steps in surgical intervention?



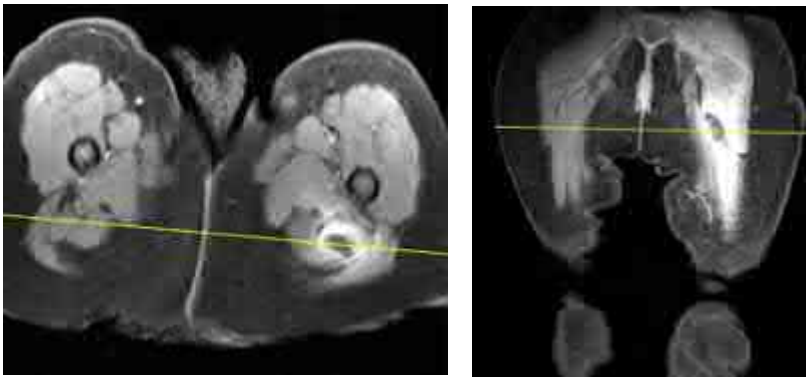
A. Application of popliteal fossa vacuum assisted dressing, trochanteric entry intramedullary (IM) nailing of femoral fracture, and flexible intramedullary nailing of tibial fracture
B. Intraoperative vascular surgical consultation for on-table angiogram and popliteal exploration
C. Application of popliteal fossa vacuum-assisted dressing and spanning femoral-tibial external fixator
D. Application of popliteal fossa vacuum-assisted dressing and reamed IM nailing of both femoral and tibial fractures

R: A

The ipsilateral closed femoral and grade 1 open tibial shaft fractures in this patient are complicated by a large popliteal fossa superficial degloving wound. Critical factors in the decision making for timing and type of surgical intervention include the absence of concomitant head, spinal or abdominopelvic injury, and hemodynamic stability. Given this patient's stability and isolated single extremity injuries, 'damage control orthopaedics' with expeditious external fixation is not indicated and definitive fracture fixation following appropriate excisional irrigation and debridement is indicated. Vascular surgical intervention is not necessary, given the superficial nature of the popliteal degloving wound and the normal vascular exam. Reamed antegrade nailing is contraindicated in the patient with open tibial tubercle apophysis, given the risk of growth arrest and postoperative tibial recurvatum deformity.

Question 85 of 100

Figures 1 and 2 are the MR images of a previously healthy 2-year-old girl who transfers from an outside hospital with a 3-day history of irritability, fevers >39.0°C, and new onset refusal to bear weight on the left lower extremity. Laboratory evaluation demonstrates elevated WBC count of 18.6, ESR of 42, and CRP level of 6.9. Blood cultures from the outside hospital are positive for methicillin-resistant *Staphylococcus aureus* (MRSA) and sensitive to clindamycin, which has been initiated. Physical examination demonstrates persistent tachycardia, mild hypotension, marked left thigh and leg swelling, and an apparent left foot drop. What are the most appropriate next steps in treatment?



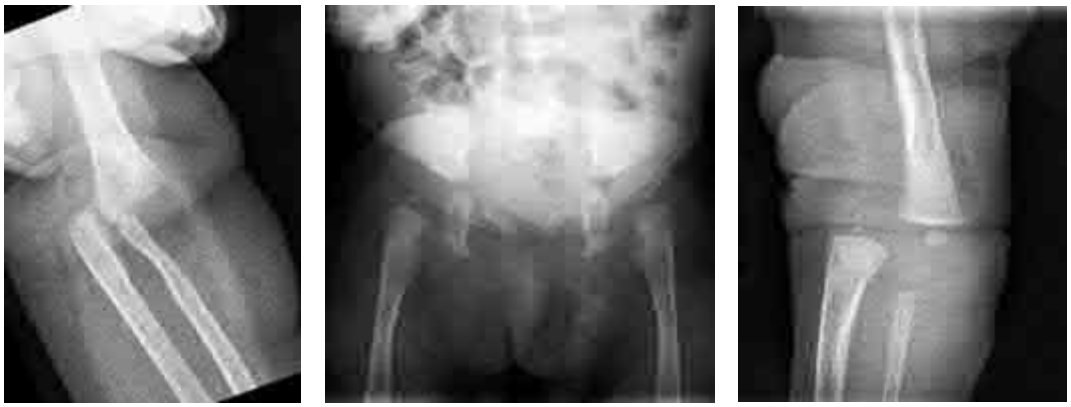
A. Addition of IV vancomycin to broaden coverage for MRSA and echocardiogram to rule out infectious valve vegetations
B. Addition of IV vancomycin to broaden coverage for MRSA and bedside aspiration of posterior thigh abscess

C. Emergent surgical irrigation and debridement of posterior thigh abscess and postoperative duplex ultrasonography
D. In-patient admission with plans for irrigation and debridement in the morning

R: C
The patient's MRI reveals a ring-enhancing posterior thigh soft-tissue abscess. Despite appropriate antibiotic coverage, she is demonstrating systemic signs of septic shock and local signs of sciatic nerve compression secondary to the posterior thigh abscess. Accordingly, emergent surgical irrigation is warranted. MRSA infection is associated with deep venous thrombosis; therefore, duplex ultrasonography is indicated. Broadening antibiotic coverage, evaluation for secondary infectious sources, or delayed semi-elective irrigation and debridement are not appropriate, given the patient's septic hemodynamics. Given abscess depth and location, as well as proximity of sciatic nerve, bedside aspiration is not safe or reliable.

Question 86 of 100

A 4-week-old girl with an unremarkable birth history is being evaluated for facial hypertelorism, depressed nasal bridge, generalized laxity and hypotonia, bilateral elbow flexion contractures with normal appearing flexion creases, bilateral shortened, telescoping thighs, bilateral recurvatum deformity of the knees, and flexible bilateral clubfoot deformity. Figures 1 through 3 are the radiographic survey of the pelvis and upper and lower extremities. What is the genetic etiology of this presentation?



A. Autosomal dominant FLNB mutation
B. Sporadic inheritance with no recognized genetic defect
C. Genetic mutation of the FGFR3 gene
D. Genetic mutation in the COL3A1 gene

R: A
The key to distinguishing the etiology of this patient's multiple congenital joint dislocations (bilateral elbows, hips, and knees) lies in the patient's characteristic facial dysmorphism and described ligamentous laxity – all consistent with Larsen syndrome characterized by autosomal dominant inheritance and related to mutations in the FLNB gene. Larsen syndrome can include potentially lethal cervical kyphosis, which must be evaluated early to avoid myelopathy, respiratory failure, and early death. Infants with arthrogryposis can present with multiple teratologic dislocations as in this case; however, rather than this presentation of generalized laxity, arthrogrypotic patients have restricted joint motion, contracture, and absent flexion creases. Both Larsen syndrome and arthrogryposis are associated with clubfoot deformity and initial orthopaedic treatment typically focuses on Ponseti management. However, it could be potentially disastrous to proceed with extremity treatment prior to evaluating for cervical kyphosis and myelopathy in cases of Larsen syndrome. Ehlers-Danlos syndrome is characterized by generalized laxity and hypermobility, skin hyper extensibility, and potential late manifestations of joint instability, vascular complications, and kyphoscoliosis but is not associated with infantile joint dislocations. Ehlers-Danlos arises form a mutation in the COL3A1 gene. FGFR3 mutation is linked to achondroplasia.

Question 87 of 100

A 16-year-old boy is being evaluated for cervical spine clearance 1 week after he was undercut playing basketball and landed striking the back of his head with a hyperflexion force on his neck. He had immediate complaints of isolated midline neck pain and tenderness. Plain radiographs of the cervical spine and neurological examination was normal at time of injury, and the patient was discharged home in a hard cervical collar. On examination in the office, the patient has resolution of neck pain with complaints of vague headache and difficulty concentrating in school, supple active cervical range of motion, maintained normal neurological examination, and isolated left trapezial tenderness to palpation. Dynamic flexion-extension lateral cervical radiographs are normal. What is the most appropriate next step?

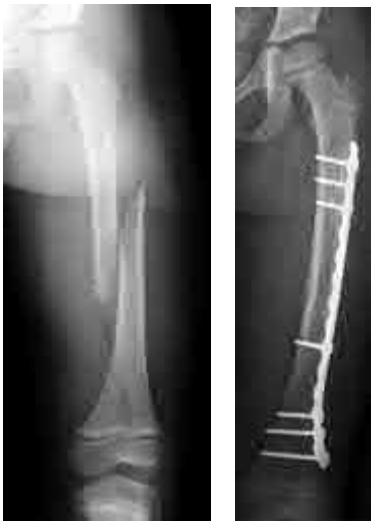
A. Continuation of rigid cervical collar and MRI cervical spine to rule out occult ligamentous injury
B. Clinical and radiographic cervical spine clearance and clearance to return to athletics
C. Physical therapy for persistent trapezial spasm and strain
D. Clinical and radiographic cervical spine clearance and prompt referral to traumatic brain injury clinic

R: D

The patient has a classic hyperflexion neck injury with clinical resolution of neck pain upon follow-up. Furthermore, lack of historical radiculopathy or myelopathy, maintained normal neurological exam static, and dynamic radiographs rule out occult ligamentous or disk injury of the cervical spine. Accordingly, this patient's cervical spine can be clinically and radiographically cleared without indication for further advanced imaging. However, the initial distractor of predominant neck pains should not overshadow the likelihood that this patient had a concussive event and remains symptomatic with headaches and inability to concentrate. Clearance to return to sport poses the risk of second impact and is not advisable. Prompt evaluation by traumatic head injury clinic or concussion clinic is imperative. Physical therapy may be beneficial if patient has persistant trapezial or periscapular symptoms but should not be prioritized over prompt concussion evaluation and treatment.

Question 88 of 100

Figure 1 is the radiograph of a 6-year-old boy who falls off a tire swing and sustains an isolated left femur fracture that is treated with submuscular plating (Figure 2). He went on to uneventful union and full return to activity without disability. Recommendations should include



A. implant removal given the high likelihood of requiring future hip arthroplasty.
B. observation with implant removal only if the patient is symptomatic in the future.
C. implant removal to minimize the risk of valgus deformity.
D. implant retention to avoid potential morbidity of pathologic fracture following removal.

R: C

Submuscular plating of pediatric femur fractures is a reliable technique for length in unstable fractures in the 5- to 10-year-old age group. Several reports have demonstrated a propensity for late valgus development with a contoured lateral plate adjacent to the distal femoral physis and recommend for routine implant removal following fracture union and remodeling prior to development of this sequelae, rather than observation and additional treatment once it occurs. This fracture carries no significant risk of avascular necrosis; thus, future arthroplasty is not relevant to this decision making. Activity restriction is recommended for 4 to 6 weeks following implant removal to minimize the risk of pathologic fracture through a screw hole.

Question 89 of 100

A limping 13-year-old boy is seen in the emergency department several months after returning from summer camp complaining of 5 days of progressive knee swelling and low-grade fever. The patient does not recall a rash or tick bite but notes that several friends had ticks removed while at camp. A physical examination reveals a large right knee effusion, moderately noxious arc of passive motion from 30-95°, and a fever of 38.1°C. Laboratory evaluation evidences a WBC count of 12.3, ESR of 42, and CRP level of 4.4. Knee aspirate obtains 40 cc of cloudy synovial fluid with cell count of 64,000 WBC with 72% PMNs. What is the most appropriate course of treatment?

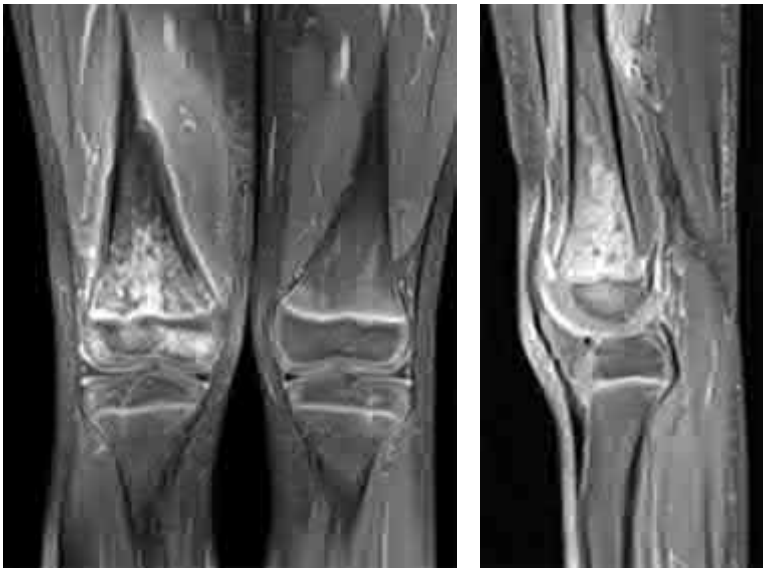
A. Emergent arthroscopic lavage
B. Observation and IV non-steroidal anti-inflammatory drugs (NSAIDs) with repeat aspiration in the morning
C. Emergent MRI with contrast of the right knee
D. Serologic Lyme titer testing and initiation of doxycycline and NSAIDs

R: D

Lyme arthritis is also called ‘pseudoseptic’ due to its similarities in presentation to classic bacterial septic arthritis. As opposed to septic bacterial arthritis, lyme arthritis progesses relatively slowly; children often remain ambulatory, and fevers are less likely to be >38.5°C. Synovial fluid cell counts are often >50,000, leading aspirate to be less useful in differentiating septic and pseudoseptic arthritis. However, neutrophil differential in Lyme arthritis is typically <90%. In this case, symptoms are gradually progressive, fevers are low grade, and the exam findings are not as strikingly noxious as classic bacterial arthritis. Most importantly, the patient has a history of likely tick exposure – most published series reveal a significant percentage of patients without recollection of tick exposure or the classic erythema migrans rash. Clinical diagnosis is confirmed with serologic lyme testing and confirmatory Western blot analysis. Treatment includes a 28-day course of oral amoxicillin or doxycycline NSAIDs and does not require surgical lavage. There is no role for MRI imaging in the treatment algorithm for acute bacterial arthritis or Lyme arthritis of the knee. Observation and NSAIDs may be a relevant treatment option for transient synovitis of the knee, but the synovial fluid cell count in this case does not favor that diagnosis.

Question 90 of 100

Figures 1 and 2 are the MR images of a 5-year-old who has had progressive right knee pain and swelling, fevers to 38.4°C, and refusal to bear weight for the past several days. Laboratory evaluation reveals hematocrit 29.9, WBC count 17.5 with 92% neutrophil on differential count, ESR 48, and CRP level of 8.2. What is the most appropriate course of action?



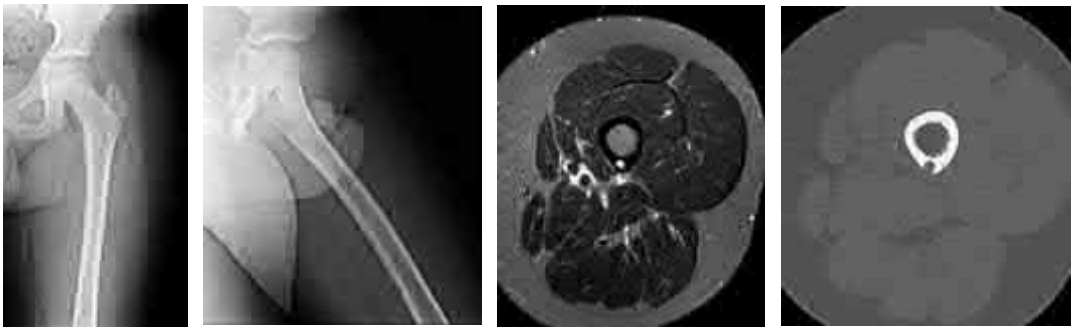
A. Whole body bone scan, CT chest, open biopsy and hematology/oncology consultation
B. Empiric IV antibiotics and serial inflammatory markers to assess response
C. Surgical irrigation and drainage of the right distal femur
D. Arthroscopic lavage of the right knee

R: C

The patient presents with acute hematogenous osteomyelitis. Leukocytosis with left shift, fevers, elevated acute phase reactant and large circumferential ring-enhancing subperiosteal and intraosseous abscess on MRI are diagnostic. Empiric antibiotics with close surveillance of clinical and laboratory response is appropriate if diagnosis is early in disease course when no drainable abscess is identified. However, the abscesses in this case must be surgically irrigated and debrided to decrease local infectious burden and enable effective antibiotic therapy. Arthroscopic lavage is not indicated, as there is no knee effusion on MRI. Febrile presentation, elevated infectious and inflammatory labs, and lack of soft-tissue mass on MRI rule against neoplasm / sarcoma thus staging biopsy, and hematology/oncology consultation are not warranted.

Question 91 of 100

Figures 1 through 4 are the radiographs and CT scans of a 13-year-old male cross-country runner who has had vague posterior thigh pain for more than a year. Pain is worse at night than while running. History is negative for trauma, fevers, or constitutional signs or symptoms. Pain is relieved with non-steroidal anti-inflammatory drugs (NSAIDs). Labs and inflammatory markers are all normal. What is the most appropriate treatment for this patient?



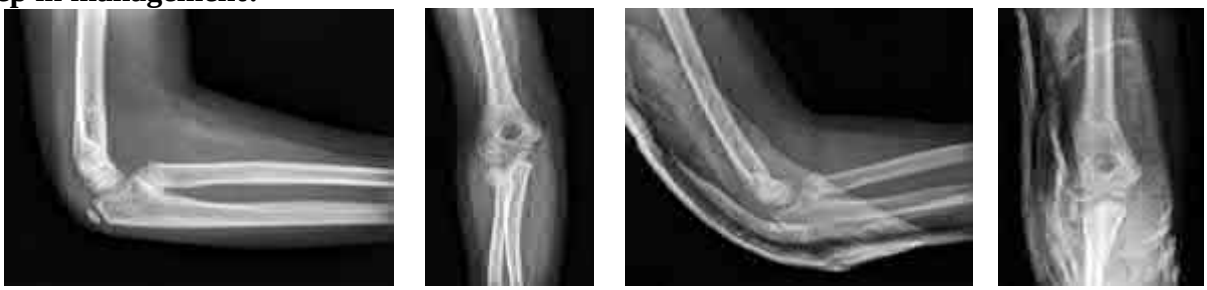
A. CT-guided biopsy to confirm diagnosis and enable prognostic prediction
B. Continued symptomatic management with NSAID therapy with expected resolution of symptoms
C. Activity restriction and touch down weightbearing with potential need for stress fracture stabilization
D. Empiric antibiotics with expectant resolution of lesion after 6 weeks of therapy

R: B

Plain films, CT and MRI evidence an intracortical lucency <1.5 cm in diameter consistent with a benign nidus of an osteoid osteoma. Open biopsy is not required, as the imaging findings are pathognomonic. In this case, symptoms are chronic and well-controlled with NSAIDs, thus more aggressive intervention is not indicated. The natural history of untreated osteoid osteomas is often for spontaneous resolution in 2 to 3 years. Treatment options for osteoid osteomas causing disabling symptoms despite NSAID therapy include open surgical excision or minimally invasive image-guided procedures (i.e., cryotherapy, radiofrequency ablation). The imaging findings are not representative of a 'dreaded black line', as in a stress fracture. Normal labs direct against an infectious etiology for this patient's symptoms.

Question 92 of 100

Figures 1 and 2 are the radiographs of a 10-year-old girl who injured her elbow in an all-terrain vehicle accident. Figures 3 and 4 are radiographs of the elbow following closed manipulation. What is the best next step in management?



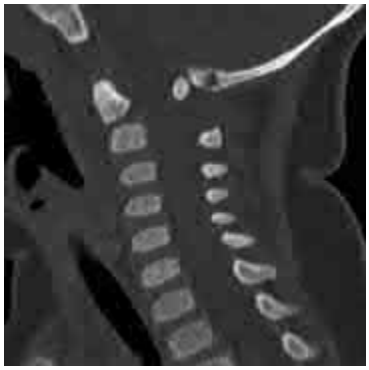
A. Immobilization in a long arm cast
B. Percutaneous reduction and pin fixation, if required
C. Open reduction and pin fixation, if required
D. Open reduction and screw-plate fixation

R: B

The patient has sustained a displaced radial neck fracture. Generally, acceptable alignment of a pediatric radial neck fracture is considered to be <30% translation and <30° of angulation. After closed manipulation, the current alignment is unacceptable, and long arm casting without further treatment is not recommended. The next best step in management of this injury is an attempt at percutaneous reduction of the fracture with a Steinman pin. Open reduction should be performed only if the fracture cannot be reduced to an acceptable position with a closed or percutaneous method, due to the association of open reduction with greater stiffness and poor outcomes.

Question 93 of 100

Figure 1 is the CT scan of a 12-month-old boy who has a neck injury from a motor vehicle accident. He is neurologically intact without any other injuries. Following successful closed reduction of the fracture, what is the best next step in management?



A. Immobilization in a cervical collar
B. Immobilization in a Minerva cast or halo cast
C. Anterior odontoid fixation
D. Posterior C1-C2 instrumented arthrodesis

R: B
The patient has sustained a displaced odontoid fracture through the dentocentral synchondrosis. Reduction of the fracture can usually be achieved by extending the neck under fluoroscopic control. An irreducible fracture may be successfully reduced by transoral digital manipulation. After closed reduction, immobilization in a Minerva cast, halo cast, or halo vest are good options.
A cervical collar will not adequately immobilize the upper cervical spine to maintain reduction of an unstable odontoid fracture. Anterior odontoid fixation or posterior C1-C2 instrumented arthrodesis should be reserved for irreducible fractures or a rare pediatric odontoid fracture nonunion.

Question 94 of 100

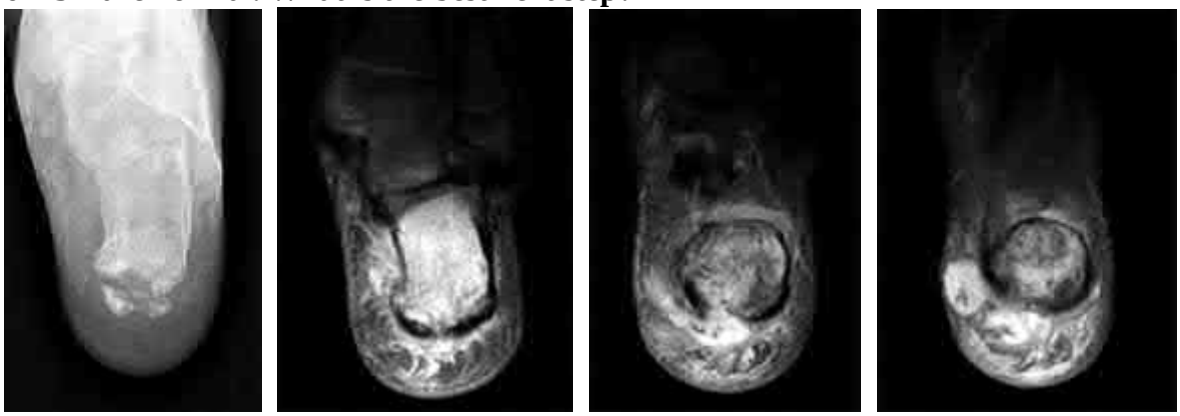
A 14-year-old male cross-country runner is being evaluated for exercise-induced leg pain. The pain is localized along the distal two-thirds of the posteromedial tibia. Radiographs are normal. What is likely to be the greatest risk factor for this condition?

A. Greater hip internal rotation
B. Increased body mass index
C. Excessive foot supination
D. Reduced dorsiflexor muscle endurance

R: B
Medial tibial stress syndrome (MTSS) is an exercise-induced pain localized to the distal two-thirds of the posteromedial tibia. Reported risk factors include female sex, greater body weight or body mass index, increased navicular drop, prior use of orthotics, previous running injury, reduced running experience, and greater hip external rotation. Reduced plantar flexor muscle endurance has been associated with MTSS in adults.

Question 95 of 100

Figures 1 through 5 are the radiograph, MRI scan, and clinical photograph of a 9-year-old boy who has a new wound of the posteromedial heel without recent injury or fevers. He has a 2-month history of heel pain and has been treated for calcaneal apophysitis with a walking boot. Complete blood count, CRP level, and ESR are normal. What is the best next step?



A. Iliac crest aspiration
B. Biopsy and debridement
C. Bone scan
D. Skeletal survey

R: B
This patient has chronic calcaneal osteomyelitis. Pediatric calcaneal osteomyelitis may follow an indolent course with a delay in diagnosis. Given the draining wound, chronic radiographic changes; and MRI evidence of abscess, operative biopsy and debridement is the next step. Iliac crest aspiration may be appropriate if leukemia is suspected based upon the complete blood count. A bone scan or skeletal survey may be a consideration if the biopsy is consistent with malignancy or if the patient has poorly localized symptoms.

Question 96 of 100

An 8-year-old boy with distal femoral osteomyelitis has methicillin-resistant *Staphylococcus aureus* (MRSA) bacteremia, and a vancomycin infusion is started. He develops a mild erythematous, pruritic rash over his face, neck, and upper torso. No other symptoms are noted and vital signs remain normal. The infusion is stopped. The most appropriate next step is to

A. restart the infusion after a dose of rifampin.
B. wait 2 hours and restart the infusion at 50% of the original rate.
C. start linezolid.
D. administer diphenhydramine and ranitidine.

R: D

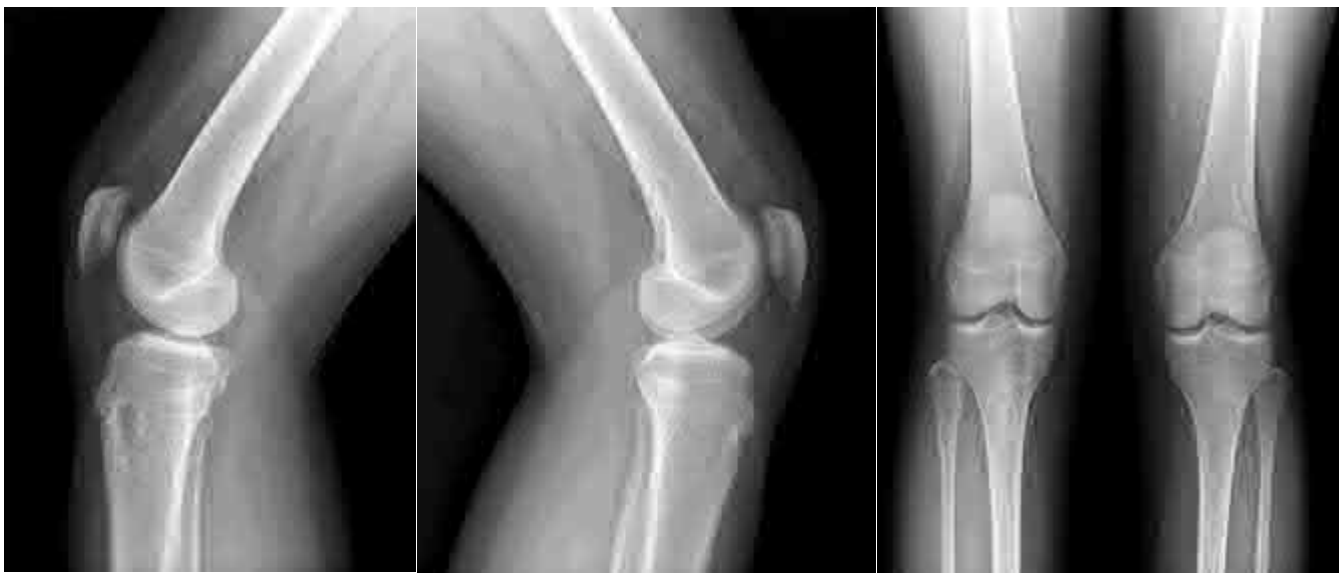
The increased incidence of MRSA has led to increased use of vancomycin. The patient is manifesting "red man syndrome" (RMS), an anaphylactoid reaction, the most frequent adverse reaction to IV vancomycin. The most severe reactions occur in patients age <40 years, particularly in children.

When RMS occurs, the infusion should be immediately discontinued. Mild cases (mild flushing and pruritus) can be treated with antihistamines such as diphenhydramine and ranitidine. After symptoms resolve, vancomycin can be restarted at 50% of the original rate.

Moderate to severe cases (hypotension, tachycardia, chest pain, severe rash, back pain, muscle spasms, weakness, angioedema) should be evaluated for anaphylaxis. Symptoms such as hives, hypotension, stridor, breathing difficulty, or wheezing suggest anaphylaxis, and epinephrine should be given immediately and emergency care provided as needed. If no signs of anaphylaxis are noted, antihistamines should be administered, and normal saline boluses can be used to support hypotension. Once symptoms resolve, vancomycin can be restarted after premedicating with diphenhydramine and ranitidine. If alternatives to vancomycin are an option, they should be used instead.

Question 97 of 100

Figures 1 through 3 are the radiographs of a 14-year-old girl who is being evaluated for a soccer-related injury. Examination of the right knee reveals full motion, no effusion, and a stable ligamentous examination. Skin examination demonstrates numerous light brown macules. The gene product responsible for this patient's disorder is likely to be



A. Gs alpha protein.
B. isocitrate dehydrogenase.
C. neurofibromin.
D. EXT glycosyltransferases.

R: C

The radiographs show multiple cortically based, well-circumscribed, lucent lesions consistent with non-ossifying fibromas (NOF). Jaffe Campanacci syndrome (JCS) is classically described as the presence of

multiple nonossifying fibromas of the long bones, mandibular giant cell lesions, and café-au-lait macules in individuals without neurofibromas. In a recent study of patients with JCS, most had pathogenic germline NF1 mutations, suggesting that JCS patients may actually have neurofibromatosis type 1. The gene product of NF1 is neurofibromin.
McCune-Albright syndrome is defined by the triad of fibrous dysplasia of bone, café-au-lait skin spots, and precocious puberty. The disease results from mutations of the GNAS gene, which encodes the cAMP regulating protein, Gs alpha.
Ollier disease and Maffucci syndrome are both characterized by multiple enchondromas, while Maffucci syndrome is accompanied by soft-tissue hemangiomas. These conditions are caused by mutations in the IDH1 or IDH2 genes, which encode isocitrate dehydrogenase.
Multiple hereditary exostosis (MHE) is characterized by multiple osteochondromas. MHE is primarily caused by mutations in the EXT1 or EXT2 genes, which encode EXT glycosyltransferases.

Question 98 of 100

A 7-year-old boy is treated for a femoral shaft fracture with flexible intramedullary (IM) nailing. At 2 years postoperative, 1.5-cm overgrowth of the injured side is noted. Which factors increase the risk of overgrowth?

A. Length stable fracture pattern and nail canal diameter ratio <0.8
B. Length stable fracture pattern and nail canal diameter ratio ≥0.8
C. Length unstable fracture pattern and nail canal diameter ratio <0.8
D. Length unstable fracture pattern and nail canal diameter ratio ≥0.8

R: C

The incidence of leg-length discrepancy following IM nailing of femoral shaft fractures ranges from 8% to 20% related either to overgrowth or shortening through the fracture site. Overgrowth may be related to greater fracture instability and hyperemia, which stimulates the physis. Length unstable fracture patterns and decreased "canal fill" by the flexible nails (nail canal diameter ratio <0.8) have both been associated with femoral overgrowth.

Question 99 of 100

A 5-year-old boy is being evaluated after 4 days of refusal to walk, fever to 101.6°F, and left hip pain. The patient prefers to maintain the hip in extension. Laboratory evaluation demonstrates a CRP level of 160 mg/L and platelets of 200x103 cells/uL. A left hip effusion is noted on ultrasonography. In addition to aspiration and synovial fluid analysis of the hip joint, what is the best next step in management?

A. Deep vein thrombosis scan
B. MRI pelvis
C. Bone scan
D. Operative debridement

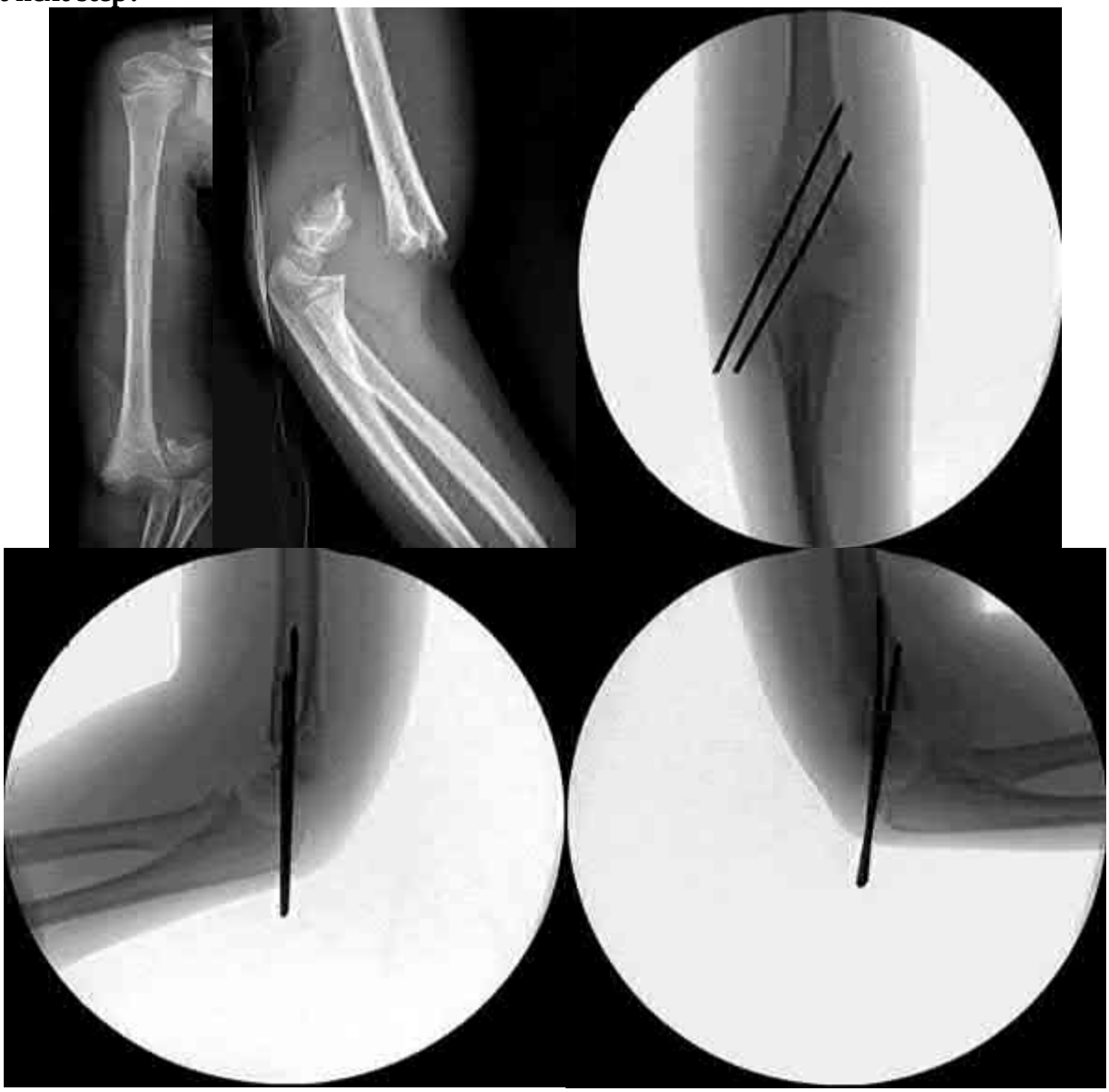
R: B

The clinical picture is concerning for musculoskeletal infection with hip pain, fever, and elevated CRP. Septic arthritis is a possibility given the hip effusion; however, the effusion may be reactive to an adjacent focus of infection. With septic arthritis of the hip, the limb is typically held in flexion, abduction, and external rotation. An MRI of the pelvis is the imaging modality that would best evaluate for adjacent osteomyelitis or pyomyositis. Failure to identify a distinct adjacent infection may result in inadequate initial treatment, worsening illness, extended length of stay, and return to the OR.
A published and validated algorithm describes criteria for preoperative MRI scan in the setting of septic arthritis based on five variables: Age >4 years, CRP >13.8 mg/L, duration of symptoms >3 days, platelets <314x103 cells/uL, and ANC >8.6x103 cells/uL. If there are fewer than three positive variables, the MRI may not be necessary and the patient could be taken directly to the OR for debridement of septic arthritis. If there

are greater than three positive variables, then a preoperative MRI of the pelvis should be obtained. However, if an MRI cannot be obtained in a timely fashion, drainage of hip septic arthritis should not be delayed.

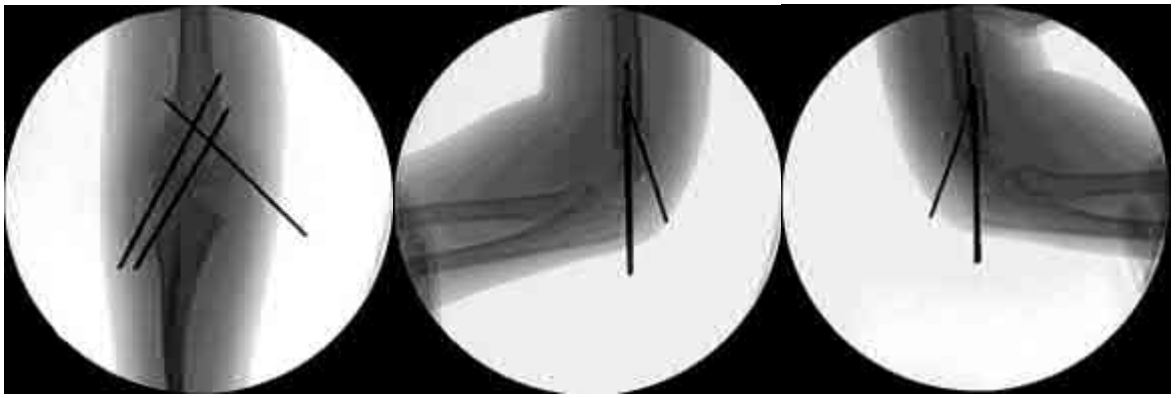
Question 100 of 100

Figures 1 and 2 are the radiographs of a 6-year-old girl who has a displaced supracondylar humerus fracture. Lateral entry pin fixation with two 2.0 mm pins was performed (Figures 3 and 4) Intraoperative internal rotation stress testing demonstrates instability of the medial column with a lateral rotation percentage of 61% (Figure 3). To improve rotational stability of the fracture, what is the best next step?



A. Immobilize with a long arm cast
B. Remove pins, repeat reduction maneuvers, and replace the pins
C. Supplement fixation with a 3rd lateral entry pin or a medial entry pin
D. Revise fixation with larger diameter pins

R: C



Supracondylar humerus fractures may be rotationally unstable after pin fixation. Gordon and associates described the radiographic change in rotational alignment of a supracondylar humerus fracture after pin fixation as the lateral rotation percentage. This is determined on a lateral radiographic image and is defined as the width of the medial column displacement divided by the width of the humerus distal to the fracture site, multiplied by 100.

The lateral fluoroscopic image (Figure 5) reveals that the medial column has displaced anteriorly with the internal rotation stress test. Supplemental fixation with a 3rd lateral entry pin or a medial entry pin can provide rotational stability of the fracture. Zenios and associates prospectively used an intraoperative internal rotation stress test (IRST) to evaluate the rotational stability of type 3 supracondylar humerus fractures and the need for additional fixation. They found that 28% of type 3 fractures were rotationally stable with two lateral pins. Adding a 3rd lateral pin allowed another 48% of fractures to become stable. The remaining 24% required three lateral pins and a medial pin to achieve rotational stability. Bauer and associates noted that use of an IRST to determine the need for supplemental fixation improved the final radiographic alignment. For this fracture, a medial pin was added (Figures 6 and 7) which provided rotationally stability with a repeat IRST (Figure 8).

Larger diameter pins have been noted to impart greater rotationally stability. Pradhan and associates demonstrated that 1.6-mm wires provided greater torsional stability than 1.25-mm wires in a sawbone supracondylar humerus fracture model. However, in this case example, 2.0-mm wires were utilized, and generally wires >2.0 mm are not utilized for supracondylar humerus fixation in a child of this age. If there is an inadequate initial reduction, backing out the pins and repeating reduction maneuvers is an option to improve the alignment; however, this fracture was well-reduced. A long arm cast will not improve the rotationally stability of this fracture.