CrackCast Show Notes – Musculoskeletal Disorders – May 2017
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Chapter 175 – Musculoskeletal Disorders

Key concepts (points in bold are those that were podcasted)

- The **growth plate is the weakest part of the bone and is more likely to separate before the adjacent tendon or ligament tears, thereby making sprains uncommon.**

- **Of supracondylar fractures, 95% are of the extension type. Displaced fractures are at risk for neurovascular injury and compartment syndrome; the anterior interosseous branch of the median nerve ("A-OK sign") and the brachial artery are most commonly involved.**

- **Developmental dysplasia of the hip affects 1% of children**; all children who are not yet walking should have **a thorough hip evaluation, including Ortolani and Barlow testing.**

- **Transient synovitis presents between 3 and 9 years of age and usually involves the hip. It can be differentiated from septic arthritis and other causes of hip pain with a thorough physical examination and directed laboratory and radiographic evaluation.**

- The **peak incidence of septic arthritis is between 6 and 24 months of age. Patients presents with pain, fever, and decreased use of the involved limb. The knee is usually involved, followed by the hip. Inflammatory markers tend to be elevated, although they may be normal in young children with Kingella kingae infection (oropharyngeal colonizer). Blood and synovial fluid cultures are positive less than 50% of the time. Staphylococcus aureus is a frequent culprit. Treatment consists of joint drainage and empirical antibiotics (eg, nafcillin and ceftriaxone, with or without vancomycin).**

- **Examination of the hip is warranted in all patients with knee pain.**

- **Legg-Calvé-Perthes disease is an idiopathic avascular necrosis of the hip that has a peak presentation between 5 and 7 years of age. It is bilateral in 20% of cases.**

- **A slipped capital femoral epiphysis (SCFE) is a posteroinferior slippage of the proximal femoral epiphysis on the metaphysis. It is more common in boys than girls, more common with obesity, and bilateral in 80% of cases. It is best seen on a cross-table or frog leg lateral view radiograph; 90% are stable.**

- **Osgood-Schlatter disease is the most common form of apophysitis. The onset is insidious, and treatment is conservative and symptomatic.** A sudden onset of apophyseal pain is more suggestive of an avulsion fracture.

Episode overview

1. What are the indications for orthopedic surgery for clavicle fracture?
2. List 5 Xray features of supracondylar fracture
3. Describe the Gartland Classification for Extension-type supracondylar fractures
4. List specific complications of a supracondylar fracture.
5. Describe the sequence of ossification around the elbow.

6. What is Baumann's Angle? (shownotes)
7. Describe the radiographic findings and management of:
    a. Monteggia fracture-dislocation
    b. Toddler's fracture
    c. Nursemaid's elbow.
8. Describe the Ortolani and Barlow maneuvers. (shownotes)
9. List 3 physical exam findings consistent with DDH.
10. List 10 causes of hip pain in children
11. Provide a differential diagnosis of limp in the toddler, school-aged child and adolescent.
12. How would you differentiate between transient synovitis and septic arthritis in a child with hip pain?
13. What is the most common location for septic arthritis in a child?
14. What is the prognosis for transient synovitis?
15. What is the most common cause of septic arthritis?
16. What are the important pathogens of septic arthritis in the following groups:
    a. Age < 2 months
    b. 2 months – 5 yrs
    c. 5 yrs – 12 yrs
    d. > 12 yrs
    e. Prosthetic joint
    f. Sickle cell disease
    g. Immunocompromised
17. Describe three mechanisms for the development of septic arthritis in children.
18. Regarding synovial fluid analysis, which tests should be ordered. How are the results interpreted?
19. Describe the management of a child with septic arthritis? What the indications for operative debridement?
20. What are the potential complications of septic arthritis?
21. Describe the pathophysiology of Legg-Perthes disease; how does slipped capital femoral epiphysis (SCFE) occur?
22. Describe the common clinical presentation of SCFE + LCPD
23. Describe 2 radiographic findings consistent with SCFE + LCPD
24. How is SCFE classified? How is this classification used to determine management? (shownotes)
25. What is the risk of bilateral SCFE? (shownotes)
26. What are the potential complications of SCFE? (shownotes)
27. What is a juvenile Tilleaux fracture? How does it occur?
28. What is a triplanar fracture?
29. List seven red flags for pediatric back pain.
30. What is spondylolysis? What is spondylolisthesis? How is it managed?
31. List 4 common apophyseal injuries in children.

Wisecracks

1) List 6 specific xray findings / fractures consistent with non-accidental injury (shownotes)
2) What is a corner / bucket handle fracture?
3) What are the investigations in a complete skeletal survey (shownotes)
4) List 4 conditions with similar presentation to child abuse (shownotes)
5) List causes of pathologic fractures in children.
6) What is the utility of blood culture, ESR and CRP in a child with suspected septic arthritis of the hip?

7) What the mechanism of a lateral elbow condyle fracture and how are they managed? (shownotes)
8) What is the mechanism of a medial elbow condyle fracture and how are they managed? (shownotes)
9) What is the most common pediatric fracture?

Text in italics is from Rosen's 9th edition, chapter 175

Rosen's In Perspective:

- Pediatric fracture descriptions include bone location (diaphysis, metaphysis, physis, or epiphysis), relationship of fracture fragments to one another (angulation and displacement), and relationship of fracture fragments to adjacent tissue (open or closed), and involvement of the articular surface or not.
- Check out this resource on what may be acceptable fracture angulations/displacements based on the age and bone! https://www.rch.org.au/clinicalguide/fractures/

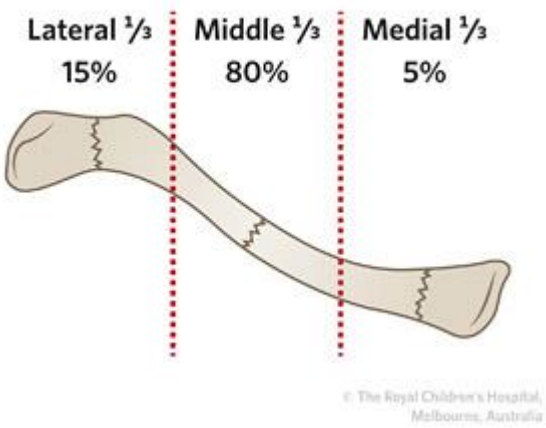
1) What 5 unique types of fractures are seen in children?
- **Plastic deformation**. Bone is bowed, with no obvious cortical disruption.
- **Torus fracture (buckle fracture)**. Buckling of bone without cortical disruption tends to occur from compression failure at the metaphyseal-diaphyseal junction. Distal radius buckle fractures may be immobilized with a Velcro wrist splint. These can be removed by the family or primary care provider in 3 to 4 weeks.
- **Greenstick fracture**. The bone is disrupted, along with one cortex; the periosteum on the fracture's compression side remains intact (ED), minimally angulated (<10 degrees) distal radius greenstick fractures can be immobilized with a splint and patients referred to an orthopedic specialist within 1 week.
- **Toddler's fractures**
- **Bucket handle fractures**

2) List 4 differences between adult and pediatric bone
- *is **the presence of the physis (the growth plate) = physeal injuries**, made up of proliferating cartilage cells between the metaphysis and epiphysis. The physis is the weakest part of the bone and more likely to separate before the adjacent tendon or ligament tears, making sprains less frequent and physeal injuries common.*
- ***thick, physiologically active periosteum:** reduces the amount of fracture displacement; promotes healing*
- *Growing bone is more porous, more pliable, and less dense than adult bone, making **children more susceptible to fractures**. Including buckle and bowing #s*
- ***Greater potential for remodeling** (even despite poor apposition and alignment)*

3) Describe the Salter-Harris classification system
- See Rosen's 9th edition Table 175.1
- Salter I and II do not affect the germinal layer of the growth plate - so growth arrest is rare.
- Type II is the most common

Core questions

1) What are the indications for orthopedic surgery for clavicle fracture?
- *"The physis of the clavicle does not close until the third decade (someone in their 20s) and is at risk for injury until that time. **Midshaft fractures account for approximately 85% of all clavicle fractures.** **Most of these don't need surgery.**"* – Rosen's 9th edition



- Although complications are rare, due to the proximity of the clavicle to the great vessels and brachial plexus, a thorough neurovascular evaluation should be performed. **Posterior sternoclavicular displacement can cause injury to the trachea, esophagus, and subclavian vessels,** whereas lateral clavicular displacement can result in injury to the brachial plexus. Middle third fractures have been associated with neurovascular bundle injuries, pulmonary injury, and pneumothorax.

- **Reasons to call ortho: (red = obvious; black - you may have to know)**
    1. **Open fracture**
    2. **Skin tenting**
    3. **Neurovascular injury**
        a. **Brachial plexus, artery**
        b. **Suspicion for a posterior clavicle displacement injury**
    4. **Fractures with > 100% displacement of the fracture fragment**
    5. **Pathologic fractures**
    6. **Displaced medial third and lateral third fractures**
    7. **Distal clavicular fractures and middle clavicular fractures that are comminuted or displaced more than 2 cm may require surgical management;**
    8. **High-level athletes should also be referred to an orthopedist for surgical evaluation because surgical repair may expedite a return to sports.**
    9. **Severely comminuted or shortened middle third (>2 cm if over 12 years of age)**

- *Younger children generally require shorter periods of immobilization (2–4 weeks) than adolescents and adults (4–8 weeks).*
- *Rehabilitation includes early range of motion and strengthening of the rotator cuff.*

- Think of the 1-2-3 rule for clavicle fractures.
    - Three parts to it
    - Parts 1 and 3 are “odd” - because they are rare and should probably be run by the ortho on call if there is any displacement
    - Part 2 (middle ⅓) is “even” more common and up to 2 cm of displacement is allowed.

2) List 5 Xray features of supracondylar fracture

- Until age 8 the ligaments and joint capsule around the elbow are stronger than the bone, so make sure you see three proper views: AP view of the extended elbow, oblique view, and lateral view of the flexed elbow.
- Features:
    1. Posterior fat pad sign (indicates intra-articular injury; does not mean there must be a fracture - although ~90% of the time there is) on the lateral view
        1.1. Protruding or bulging anterior fat pad
    2. No bisection of the anterior ⅓ of the capitellum with the ANTERIOR HUMERAL LINE on the lateral view
    3. Broken "hour-glass" or deformed "figure of 8" on the lateral view
    4. LACK of the radiocapitellar line bisecting the capitellum on the lateral and AP extension views
    5. BREAK in the cortical lines of the distal humerus
    6. Asymmetric Baumann's angle
- For more, see: Figure 175.13 (in a normal elbow, the anterior humeral line and proximal radial line should bisect the capitellum), http://dontforgetthebubbles.com/elbow-xr-interpretation/, http://www.wikiradiography.net/page/The+Paediatric+Elbow

- **A helpful approach:**
    - E - effusion
    - L - lines should line up!
    - B - bony cortex
    - O - ossification centres
    - W - watch all three views! (or WOW your consultant with Baumann's angle)

3) Describe the Gartland Classification for Extension-type supracondylar fractures

- *Supracondylar fractures are classified according to mechanism of injury as flexion or extension injuries. The extension type of injury constitutes 95% of all supracondylar fractures and typically results from a hyperextension injury incurred from a fall onto the outstretched arm.*
- Gartland classification of extension-type supracondylar fractures (see Rosen's Table 175.2 for original)
    - I – nondisplaced fracture
    - II – displaced fracture with intact posterior cortex
    - III – displaced fracture with no cortical contact
    - IIIA – posteromedial rotation of the distal fragment
    - IIIB – posterolateral rotation of the distal fragment

- When you order anything, Medium (medial) comes before Large (lateral)

- *Gartland type I fractures can be splinted in the ED, with the arm maintained in 90 degrees of flexion and neutral rotation.*
- *Gartland type III fractures require immediate orthopedic consultation and should be treated in the operating room by closed reduction and percutaneous pinning or open reduction and internal fixation. Treatment of type II fractures is controversial. Some surgeons operatively reduce and pin, whereas others perform closed reduction and cast.*

- *In the less common flexion type of supracondylar fracture, the elbow is flexed when it hits the ground. This mechanism results in a supracondylar fracture with anterior displacement of the distal fragment and failure of the cortex posteriorly.*

4) List specific complications of a supracondylar fracture.

- Acute:
  - Neurovascular injury - 11% of displaced SC#
    - *—the anterior interosseous branch of the median and radial nerves are at risk of damage in extension- type injuries; the ulnar nerve is damaged in flexion-type injuries.* ***Most nerve injuries are neuropraxias that resolve spontaneously****. Although motor function usually returns within 12 weeks, sensory function may not return for 6 to 12 months.*
  - *Brachial artery injuries*
  - Acute compartment syndrome of the forearm or upper arm
- Delayed
  - *Volkmann's ischemic contracture, characterized by fixed elbow flexion, forearm pronation, wrist flexion, metacarpophalangeal joint extension, and interphalangeal flexion.*
  - *Brachial artery thrombosis*
  - *Malunion: Cubitus Varus - Gunstock deformity*

5) Describe the sequence of ossification around the elbow.

- See Fig 175.12 and Table 175.4 for additional details
- Sequence of ossification around the elbow: CRITOE
- Age at appearance = 1,3,5,7,9,11
  - Capitellum = Age 1, close at 14
  - Radial head = Age 3, close at 16
  - Internal (medial internal epicondyle) = Age 5, close at 15
  - Trochlea = Age 7, close at 14
  - Olecranon = Age 9, close at 14
  - External (lateral external epicondyle) = Age 11, close at 16

6) What is Baumann's Angle? (shownotes)

- *"Baumann's angle (aka humeral-capitellar angle) can help identify displacement of a pediatric supracondylar fracture. It is measured on an AP frontal radiograph with the arm in extension. The angle is formed by the humeral ais and a straight line through the epiphyseal plate of the capitelum. A value of 70-80 degrees is considered normal. Due to significant variation between individuals, Baumann's angle is better evaluated by comparison to the contralateral side where a difference of more than 5 degrees is considered abnormal." – Radiopaedia*

- *Baumann's angle is helpful in diagnosing a subtle supracondylar fracture (Fig. 175.14). This angle is formed by a line drawn to follow the growth plate of the capitellum transected with a line that runs perpendicular to the axis of the humerus. The angle should be approximately 75 to 80 degrees. Baumann's angle should be the same in both elbows; differences between elbows can be used to detect subtle supracondylar fractures. In children younger than 3 years, difficult to distinguish bone landmarks limit the utility of Baumann's angle.*

7) Describe the radiographic findings and management of:

a. Monteggia fracture-dislocation
   i. a fracture of the proximal third of the ulna plus dislocation of the radial head.
   ii. MURG
   iii. The radiographic evidence can be subtle, with only a minor greenstick fracture or bowing of the ulna. Isolated ulna fractures are rare in children; therefore, with all such fractures, a dislocation of the radial head should be excluded
   iv. "Ulna bow sign" - make sure that the radial head transects the capitellum on all views!
   v. Require ortho - ORIF or CRIF

b. Toddler's fracture
   i. oblique nondisplaced fractures of the distal tibia caused by low-energy torsional forces applied to the porous bone of infants and young children. The peak incidence is between 1 to 3 years of age but it can occur in children as old as 6 years.
   ii. AP and lateral radiographs may reveal a spiral or oblique fracture extending downward and medially through the distal third of the tibia
   iii. An internal oblique radiograph is helpful if evidence of fracture is absent on the AP or lateral view. If no fracture is apparent, the child should be splinted for comfort and radiography repeated in 10 days, at which time periosteal new bone or sclerosis of the fracture edges will make the fracture visible.
   iv. Treatment of a toddler's fracture consists of a long leg cast with the knee flexed for approximately 3 weeks.

c. Nursemaid's elbow.
   i. Radial head subluxation, also known as annular ligament displacement: *the radial head slips out of the annular ligament, trapping the ligament in the radiocapitellar joint*
   ii. MOI: Axial traction (pulling/swinging) on an extended, pronated arm.
   iii. may occur when the child falls onto the outstretched arm, sustains minor direct trauma to the elbow, or simply twists the arm.
   iv. 5 months to 5 years.
   v. The affected arm is typically held against the body, with the elbow slightly flexed and the arm pronated. Physical examination is significant for lack of swelling, erythema, ecchymosis, or deformity.
   vi. Clinical diagnosis
   vii. Success rates are approximately 85% with supination and 95% with hyperpronation. Pronation may be less painful to the patient and is the reduction method of choice.
   viii. Child should start using their arm within 30 mins; it make take longer if the injury is > 4 hrs old.

- *Children with extension-type supracondylar fractures hold the affected arm in extension with an S-shaped configuration of the elbow and exhibit a prominence at the olecranon.*

8) Describe the Ortolani and Barlow maneuvers. (shownotes)

- Ortolani (reduction) maneuver
  1. Stabilise the pelvis with one hand
  2. With the other hand, slighly abduct the infant's hip

3. With the index and long fingers over the greater trochanger, pull up the thigh to gently reduce the hip

- Barlow (provactive) test
  1. Stabilise the pelvis one hand
  2. Place the thumb on the inner aspect of the thigh near the lesser trochanter
  3. Adduct the hip
  4. Exert downward pressure on the thigh with the thumb and push it into the table
- See also this graphic form medcomic – https://medcomic.com/medcomic/barlow-vs-ortolani/
- See Rosen's Box 175.1 for original table

9) List 3 physical exam findings consistent with DDH.

- Ranges from: subtle acetabular dysplasia to irreducible hip dislocations. Often despite screening, DDH can be missed until later infancy and childhood!
- Asymmetry of
  - Leg length
    - *Galeazzi's sign: Apparent inequality of femur length is manifested as asymmetry in the level of the patient's knees.*
  - Skin folds: in the groin, below the buttock, and along the thighs
    - ***can be present of ⅓ of normal hips though!
  - Hip joint range of motion: flexion, abduction (frog leg position)
  - Leg movements
- Abnormal findings on Barlow and Ortolani maneuvers (less reliable > 4 months of age)
- Post walking:
  - Asymmetric gait
  - Asymmetric in-toeing or out-toeing
  - Flexion contractures
  - Hyperlordosis
  - Trendelenburg gait

10) List 10 causes of hip pain in children

- **Trauma**: hip or pelvis fractures, overuse injuries
- **Infection**: septic arthritis, osteomyelitis, myositis, Lyme disease
- **Inflammation**: transient synovitis, juvenile rheumatoid arthritis, rheumatic fever
- **Neoplasm**: leukaemia, osteogenic/Ewing's sarcoma, metastatic disease
- **Haematologic disorders**: haemophilia, sickle cell disease
- **Miscellaneous**: Legg-Calvé-Parthes disease, slipped capital femoral epiphysis

11) Provide a differential diagnosis of limp in the toddler, school-aged child and adolescent.

	Toddler	**School-aged child**	**Adolescent**
Infectious	Septic arthritis		Gonococcal
Inflammatory	Transient synovitis	JRA	
Traumatic	Toddler's fracture	LCP	SCFE
Metabolic / malignant	Hemophilia, SIckle cell		

12) How would you differentiate between transient synovitis and septic arthritis in a child with hip pain?

	Transient synovitis	**Septic arthritis**
Background	self-limited condition caused by a **nonpyogenic inflammatory response of the synovium.** **Unknown etiology. Peak 3-9 yrs of age. ?post infectious/traumatic/inflammatory**	*Septic arthritis refers to* ***microbial invasion and infection of the joint space. Bacterial pathogens are common in patients with acute septic arthritis,*** ***whereas fungal and mycobacterial pathogens tend to be associated with a more indolent septic arthritis.*** ***Peak incidence at 6-24 months!***
Dx	Insidious onset hip, knee or bilateral joint dysfunction. **Diagnosis of exclusion after full hx, physical, imaging and labs** ● **Well appearing** ○ **May have low fever or malaise** ● hip/groin/knee/thigh/buttocks pain ● **Limited to no pain with passive ROM** ● **Limping or unable to walk** ● leg is held in flexion, with slight abduction and external rotation. ● Decreased range of motion with extreme internal rotation or abduction. ● *In transient synovitis, laboratory values may be normal or may reveal mild elevations in the WBC count, CRP level, and ESR, consistent with a nonspecific inflammatory process.* ***joint effusion on U/S is non-specific for either TS or SA.*	*Infants tend to have fever, failure to feed, lethargy,* ***pseudoparalysis of the extremity, and pain when being handled****.* *Most older children have systemic signs and symptoms of* ***fever, malaise, poor appetite, and irritability, as well as localized symptoms of pain and refusal to move the affected joint. If the lower part of the body is involved, patients may limp or refuse to walk.*** *The physical examination reveals* ***local erythema, warmth, and swelling****. If the hip is affected, it often is held in flexion, abduction, and external rotation.* *Range of motion is decreased because of pain and muscle spasm, and passive joint movement is painful. In infants, joint dislocation may be observed.*

		Children unable to bear weight with CRP values higher than 20 mg/L had a 74% probability of having septic arthritis. *A complete blood count, CRP level, and ESR should be deter-* *mined, and radiography should be performed.* *Patients with severe symptoms—absent range of motion, ill-appearing, or inability to bear weight—fever higher than 38.5°C (101.3°F), and elevated ESR (≥40 mm/hr) or CRP (>2.0 mg/dL or >20 mg/L) should undergo joint aspiration.* Dx with aspirate: gram stain, culture, cell count, differential, -ve crystals. See table in text for cut offs.
Management	Supportive	IV abx; surgical consultation; non-weight bearing; analgesia

- ***(Kocher criteria) can be* used to "help" decide between TS and SA.**
  - *fever,*
  - *inability to bear weight,*
  - *ESR of 40 mm/ (CRP > 20 mg/L) hr or higher,*
  - *serum WBC count higher than 12,000 cells/μL.*

- *Patients with three of the four predictors had a 93% chance of having septic arthritis, and those with all four had a 99% likelihood.*
- *A subsequent study to validate these findings showed that patients with* ***none of these predictors had a 2% probability of septic arthritis, with one predictor, a 9.5% probability, with two predictors, a 35% probability, with three predictors, a 73% probability, and with all four predictors, a 93% probability of septic arthritis. When this algorithm was tested at another institution, however, the presence of all four Kocher criteria predicted septic arthritis only 59% of the time.***
- *A CRP level can also help risk-stratify children for septic arthritis. In a study of children with hip effusions, children with the ability to bear weight combined with CRP values lower than 20 mg/L had less than a 1% risk of septic arthritis. Children unable to bear weight with CRP values higher than 20 mg/L had a 74% probability of having septic arthritis.*
- *Thus, in children who are able to ambulate, have minimal pain after treatment with nonsteroidal antiinflammatory drugs (NSAIDs), and have normal inflammatory markers, outpatient management with close primary care follow-up is reasonable.*

13) What is the most common location for septic arthritis in a child?

- ⅓ have a hx of remote trauma.
- **Knee >>> Hip**
- **90% occur via hematogenous spread.**

14) What is the prognosis for transient synovitis?

- Excellent! Self-limited disease.

- *Thus, in children who are able to ambulate, have minimal pain after treatment with nonsteroidal antiinflammatory drugs (NSAIDs), and have normal inflammatory markers (CRP < 20 mg/L), outpatient management with close primary care follow-up is reasonable.* The CRP should normalise within 1 week of supportive care.

- Ideally follow up with good return instructions within 24 hrs. They should rest the affected joint and return to normal activity after the pain has subsided and ROM has normalized.

- 75% of patients are pain free at 2 weeks.

- *persistent joint effusion beyond 6 weeks may be associated with the subsequent development of Legg-Calvé-Perthes disease.*

15) What is the most common cause of septic arthritis?

- Either MSSA or MRSA!
- Usually presents with acute monoarticular arthritis! (usually lower extremity)

16) What are the important pathogens of septic arthritis in the following groups:

a. Age < 2 months (Group B strep – S. aureus, Gram negative rods, N. gonorrhoeae)
b. 2 months – 5 yrs (S. aureus, S. penumonia, S. pyogenes, Kingella kingae, H. influenzae)
c. 5 yrs – 12 yrs (S. aureus, S. pyogenes)
d. > 12 yrs (S. aureus, N. gonorrhoeae)
e. Prosthetic joint
    i. MRSA
    ii. Pseudomonas
    iii. Any other skin bugs
f. Sickle cell disease
    i. Salmonella
g. Immunocompromised
    i. Gram negative bacteria
    ii. Anything else
        1. Extrapulmonary TB
        2. Pseudamonas
        3. Candida
        4. Kingella kingae
            a. *Yagupsky and colleagues have found that the clinical and laboratory features in young children (6–27 months of age) with K. kingae septic*

arthritis and transient synovitis were so similar that the Kocher algorithm was not helpful and, even without fever or leukocytosis, they recommended blood cultures and nucleic acid amplification.

17) Describe three mechanisms for the development of septic arthritis in children.

- Hematogenous
- Contiguous
    - Direct inoculation
    - Spread from adjacent infection
- Iatrogenic

18) Regarding synovial fluid analysis, which tests should be ordered? How are the results interpreted?

- Tests to order
    - Gram stain
    - Aerobic and anaerobic culture
        - PCR with nucleic acid amplification if suspicious for neisseria
    - Cell count and differential
    - Glucose, protein
    - Crystals
- See Table 175.6 for the original table

- *Heyworth and associates have found that 48% of patients with synovial WBC counts of 50,000 cells/mm3 or more had septic arthritis, as did **17% of those with synovial WBC counts less than 50,000 cells/mm3***
- *The synovial glucose concentration may be low (synovial fluid glucose/blood glucose ratio < 0.5) and protein and lactate levels elevated. Because of the intrinsic immunoglobulins in the synovial fluid, **cultures will be positive in less than 50% of cases.***

19) Describe the management of a child with septic arthritis? What the indications for operative debridement?

- *Septic arthritis requires hospital admission, antibiotics, and surgical intervention.*
- *Surgical options range from needle aspiration to open surgical drainage.*

- *Indications for surgical drainage in children with septic arthritis*
    - *involvement of the hip joint,*
    - *presence of large amounts of pus or debris in the joint,*
    - *loculated fluid,*
    - *recurrence of joint fluid after four or five aspirations,*
    - *lack of clinical improvement within 3 days of the initiation of appropriate therapy.*

20) What are the potential complications of septic arthritis?

- Local:
    - Avascular necrosis
    - Osteomyelitis
    - Cartilage destruction

  - Loss of mobility
  - Leg length discrepancy
  - Persistent pain
  - Ligament/muscle/bursal fibrosis/scarring/calcification
- Systemic:
  - Bacteremia
  - Infective endocarditis
  - Sepsis

21) Describe the pathophysiology of Legg-Perthes disease; how does slipped capital femoral epiphysis (SCFE) occur?

- *Idiopathic avascular necrosis of the proximal femoral head, also known as Legg-Calvé-Perthes disease, is named after the men who independently described it in the early 1900s.*
- *The cause remains unclear; theories are myriad and research results conflicting.*

- *SCFE: A slipped capital femoral epiphysis (SCFE) involves posterior and inferior slippage of the proximal femoral epiphysis on the metaphysis.*
- *The cause of SCFE is unknown but is likely to be related to biomechanical and hormonal factors.*
- *Obesity results in increased shear forces across a more vertically and posteriorly oriented growth plate that has been weakened by architectural irregularities and hormonal changes of puberty. The consequence is slippage of the epiphysis inferiorly and posteriorly in the direction of the weight-bearing force.*

- ***Usually idiopathic and associated with obesity.***

22) Describe the common clinical presentation of SCFE + LCPD

SCFE	**LCPD**
(1) race—higher prevalence in African Americans, Hispanics, and Pacific Islanders than whites; *(2) geography—higher rates north of 40-degree latitude and in the northeastern and western United States;* *(3) gender—boys > girls* *(4) underlying medical conditions—more frequent with endocrinopathies (obesity), renal osteodystrophy, and radiation therapy.*	White male, higher latitude
*peak incidence is during the adolescent growth spurt, boys between **12 and 16 years of age (mean, 13.5 years) and girls between 10 and 14 years of age (mean, 11.5 years).***	*occurs between the ages of 3 and 12 years, with the peak incidence between the ages of **5 and 7 years.***

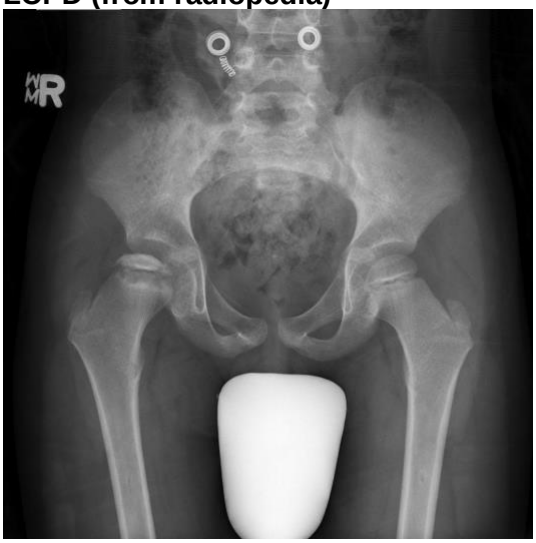
90% of all cases of SCFE are stable, ● ***intermittent limp and pain for weeks to months.*** ● ***Pain in the hip, thigh, groin, or knee.*** ● ***weakness and easy fatigability of the affected limb and limping on exertion.*** ● *Progression = progressive external rotation and shortening of the involved extremity, with subsequent difficulty in daily activities, such as tying shoes.* *On examination:* ● ***loss of internal rotation and experience pain only at the extremes of motion.*** *Advanced disease:* ● *Antalgic gait, internal rotation is lost, abduction* *and flexion of the hip increase, thigh and gluteal muscle atrophy* *is more pronounced, and leg-length discrepancy develops.* *Drehmann's sign can be elicited during passive flexion of the* *affected hip when the patient is supine; as flexion is increased* *from an extended position, the thigh abducts and rotates* *externally.*	● **Insidious and stuttering onset of limp** ● **Gradual pain - anywhere (groin, butt, knee, thigh)** ○ **Worse with activity better with rest** ○ **Worst in the evening** ● **Limited ROM - esp. Abduction and IR**

23) Describe 2 radiographic findings consistent with SCFE + LCPD
MRI is a much more sensitive test for both diseases.

SCFE	LCPD
diagnosis of SCFE is made with AP and lateral radiographs of both hips. With stable slippage, AP and frog leg lateral pelvic radiographs should be obtained. ● ***Lateral view:*** *include a minimal posterior*	Legg-Calvé-Perthes disease is diagnosed and staged by AP and frog leg lateral radiographs. ● Radiolucent, V-shaped, osteoporotic defect in the lateral epiphysis (Gage's sign), ● speckled calcification lateral to the capital epiphysis,

step-off at the anterior physeal plate and widening of the growth plate. ● ***AP view: asymmetric Klein's line (>2 mm)*; blanch sign of Steele*** **Klein's line* *is a line drawn along the superior margin of the femoral neck.* *With a normal hip, the line intersects with or falls within the* *epiphysis, whereas in a hip with a slipped epiphysis, the line does* *not come into contact with the epiphysis.*	● Diffuse metaphyseal reaction (metaphyseal cysts), ● lateral capital femoral epiphysis subluxation, ● and a horizontal physis.

LCPD (from radiopedia)



SCFE (from radiopedia)

- Note the abnormal Klein's line (left hip)
- *modified Klein's line is a comparison of the amount of epiphysis lateral to the Klein line on the symptomatic side compared with the same measurement on the asymptomatic side, with a difference of 2 mm being significant.*
- *The blanch sign of Steele, another SCFE finding seen on the AP radiograph, is a crescent-shaped area of increased density in the proximal portion of the femoral neck created by superimposition of the posteriorly displaced epiphysis on the femoral neck.*

24) How is SCFE classified? How is this classification used to determine management? (shownotes)

- Much simpler classification than LCPD!
- **Classification of SCFE is based on stability.**

- *With or without crutches, in stable SCFE, ambulation is possible, whereas in unstable SCFE, ambulation is not possible.*
- *This classification system is preferred to the traditional classification because it does not rely on patient or parent recall for duration of symptoms and provides information about prognosis.*

25) What is the risk of bilateral SCFE? (shownotes)

- *SCFE is bilateral in up to 80% of cases, although 30% to 40% of these cases are asymptomatic and discovered only on screening radiographs. In unilateral cases, the left hip is affected twice as often as the right.*

26) What are the potential complications of SCFE? (shownotes)

- Two most common:
  - Avascular necrosis
  - Chondrolysis
- Others: *nonunion, premature closure of the epiphyseal plate, and degenerative changes. Degenerative hip arthritis develops over decades and has an earlier onset, with more severe degrees of slippage.*

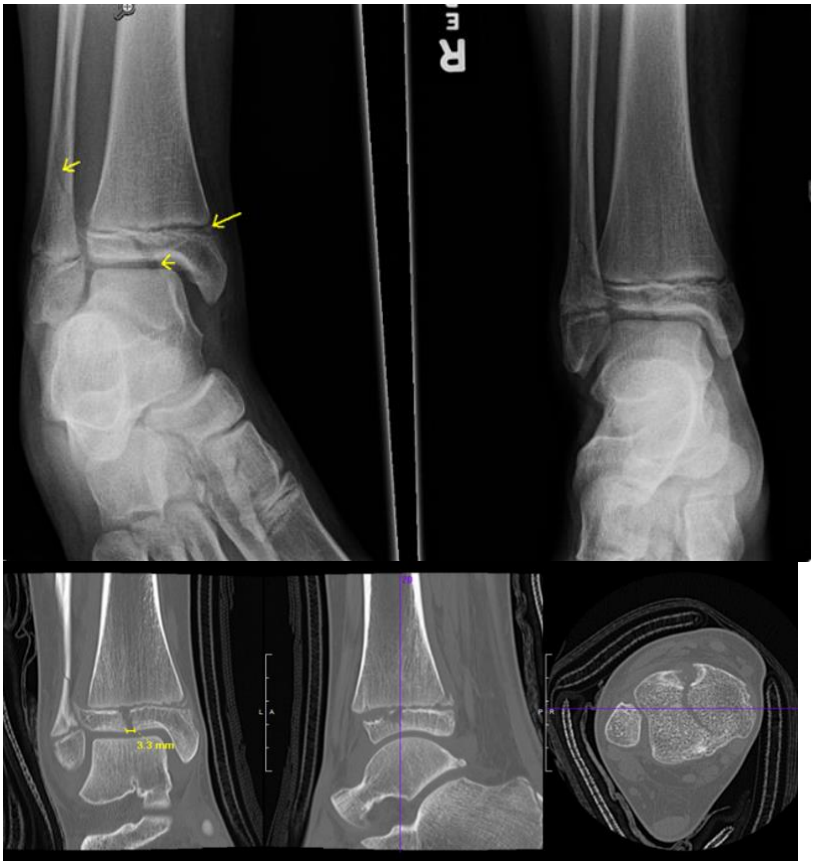
27) What is a juvenile Tillaux fracture? How does it occur?

- See the Orthobullets notes here – https://www.orthobullets.com/pediatrics/4028/tillaux-fractures
- Juvenile Tillaux fractures with >2 mm of displacement warrant urgent orthopedic consultation for closed or open reduction.

28) What is a triplanar fracture?

- See the orthobullets notes here – https://www.orthobullets.com/pediatrics/4029/triplane-fractures

CrackCast Show Notes – Musculoskeletal Disorders – May 2017
www.canadiem.org/crackcast



29) List seven red flags for pediatric back pain.

- You need to think broadly
- From Uptodate:
- MSK
    - Nonspecific - idiopathic low back pain
    - spondylolysis and spondylolisthesis; scoliosis; Scheuermann's (juvenile) kyphosis; and intervertebral disc degeneration, herniation, or calcification
- Infectious
    - discitis, vertebral osteomyelitis (including tuberculous), epidural abscess, and bacterial infection of the sacroiliac joint. Non Spinal infections that can present with back pain include paraspinous muscle abscess (pyomyositis), pyelonephritis, pneumonia, pelvic inflammatory disease, endocarditis, and myalgia caused by viral illness.
- Inflammatory
    - ankylosing spondylitis, psoriatic arthritis, the arthritis of inflammatory bowel disease, and reactive arthritis.
- Neoplastic
    - Osteoid osteoma is the most common tumor that presents with back pain in children. Other tumors that can present in the spine include leukemia, lymphoma, Ewing sarcoma, neuroblastoma, osteoblastoma, osteosarcoma, neurofibroma, and Langerhans cell histiocytosis (eosinophilic granuloma)
- Referred

  - sickle cell pain crisis or vertebral body collapse, syringomyelia, cholecystitis, pancreatitis, chronic recurrent multifocal osteomyelitis, pyelonephritis, and chronic pain syndromes.
- Hx:
  - Age < 4 yrs
  - Wt loss
  - Hx of CA, TB exposure
  - Progressive, severe, nocturnal, disabling pain
  - Morning stiffness, radiation to legs
  - Hx of repetitive trauma or high level sports
  - No relief with rest
- Physical:
  - Fever
  - Fever and weight loss
  - Asymmetric reflexes, tone, power, bladder/bowel symptoms

30) What is spondylolysis? What is spondylolisthesis? How is it managed?

- Spondylolysis is a unilateral or bilateral defect (separation) in the vertebral pars interarticularis (defect), usually in the lower lumbar vertebrae, particularly L5. With bilateral defects, the vertebral body can slip anteriorly, a condition known as spondylolisthesis.

Grossly simplified management plan…!

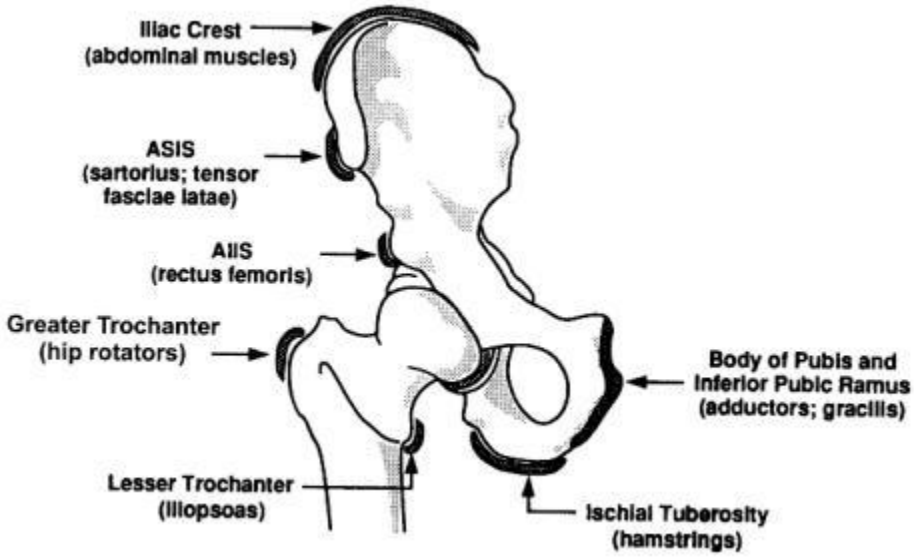
- Spondylolysis: rest from inciting activities for 4-6 weeks
- spondylolisthesis: Grade 1 with no neuro deficits = rest for 60-90 days.

31) List 4 common apophyseal injuries in children.

- ***The apophysis is a cartilaginous structure that serves as a site for insertion of tendons on the growing bone.*** *It has its own growth plate, with a slower rate of growth than the nearby epiphyseal plate. Apophysitis is unique to patients with skeletal immaturity and involves inflammation of this actively growing bone prominence, which is under great tensile stress.*

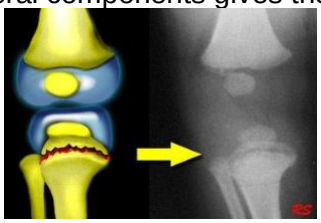
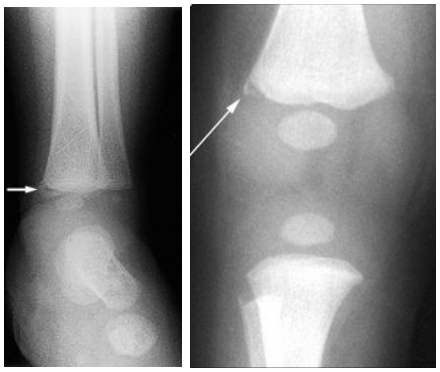
- Little leaguer's elbow (medial epicondylitis)
  - *including apophysitis, medial epicondylitis, and osteochondritis dissecans of the radial head and capitellum.*
- Osgood schlatter's disease - tibial tubercle
- Sinding-Larsen-Johansson syndrome - inferior patella
  - https://www.orthobullets.com/sports/3030/sinding-larsen-johansson-syndrome
- Sever's disease
  - apophysitis of the calcaneus due to traction by the gastrocnemius-soleus complex.
- Hip/Pelvis apophysitis
  - ASIS - tensor fasciae latae; sartorius
  - AIIS - Rectus femoris
  - Iliac crests - abdominal muscles
  - Ischial tuberosities – hamstrings

- Thanks to Orthobullets for this image:



Wisecracks

1. **List 6 specific xray findings / fractures consistent with non-accidental injury (shownotes)**
    - See Orthobullets: https://www.orthobullets.com/pediatrics/4001/pediatric-abuse

2. **What is a corner / bucket handle fracture?**
    - From orthobullets:
        - Fractures often seen in non-ambulatory child that are highly suspicious for NAT.
        - Bucket handle fracture: horizontal avulsion fracture with appearance of central and peripheral components gives the appearance of a bucket handle.
            - 
        - Corner fracture: discrete avulsion of the metaphysis
            - 

3. **What are the investigations in a complete skeletal survey (shownotes)**
   - The standard skeletal survey [from Uptodate]
     - Appendicular skeleton
       - Humeri (AP)
       - Forearms (AP)
       - Hands (PA)
       - Femurs (AP)
       - Lower legs (AP)
       - Feet (AP)
     - Axial skeleton
       - Thorax (AP, lateral, right and left oblique views to include ribs, thoracic spine and upper lumbar spine)
       - Ribs (oblique views)
       - Abdomen (AP, to include pelvis)
       - Lumbosacral spine (lateral)
       - Skull (frontal and lateral)
       - Cervical spine (lateral, if not completely visualised on lateral skull)
     - Technique (high resolution, high contrast)
     - ...including specific view of areas with bruising and tenderness!

4. **List 4 conditions with similar presentation to as child abuse (shownotes)**
   - osteogenesis imperfecta
   - osteopenia of prematurity
   - scurvy
   - copper deficiency
   - Menkes disease
   - disuse osteopenia (nonambulatory or minimally ambulatory children)
   - chronic disease (kidney and liver)

5. **List causes of pathologic fractures in children.**
   - *bone tumors, rickets, McCune-Albright syndrome, juvenile osteoporosis, chronic renal insufficiency, osteogenesis imperfecta (OI), and osteopetrosis are all at greater risk for fractures.*
   - *The proximal femur and humerus are the most frequent sites for pathologic fractures and unicameral (simple) bone cysts, aneurysmal bone cysts, and nonossifying fibromas are the most common tumors. -uptodate*

6. **What is the utility of blood culture, ESR and CRP in a child with suspected septic arthritis of the hip?**

- ESR and CRP are better “rule out tests”. They play an important role in the workup - but minimal elevations don’t rule out the diagnosis. They can also play a role in monitoring response to therapy.

- *A CRP <1 mg/dL (10 mg/L) was associated with a negative predictive value of 87 percent for positive synovial fluid culture. CRP is more useful than ESR for monitoring response to treatment; the CRP peaks within 36 to 50 hours of onset of infection and usually falls to normal within a week of successful treatment, whereas ESR may remain elevated for up to 30 days.*

- *We recommend that aerobic blood cultures be obtained in all patients in whom bacterial arthritis is a consideration. Blood cultures are positive in approximately 40 percent of cases and sometimes yield the pathogen when joint fluid cultures are negative. Anaerobic cultures should be obtained if anaerobic infection is a concern (eg, direct inoculation or in jugular vein suppurative thrombophlebitis [also known as Lemierre's syndrome] caused by Fusobacterium infection. - uptodate.*

7. **What the mechanism of a lateral elbow condyle fracture and how are they managed? (shownotes)**

- Classified using Milch system (Type 1 – # line lateral to trochlear groove vs Type 2 – # line into trochlear groove)
- From orthobullets:
    - Usually ~6 yr olds. HIGH risk fracture; elbow injury in kids with the worst prognosis - don't miss it!
    - mechanism of injury
        - pull-off theory: avulsion fracture of the lateral condyle that results from the pull of the common extensor musculature
        - push-off theory: fall onto an outstretched hand causes impaction of the radial head into the lateral condyle causing fracture
- If no displacement - long arm cast x 4-6 weeks
- If displaced may need operative fixation.

8. **What is the mechanism of a medial elbow condyle fracture and how are they managed? (shownotes)**
    - Mechanism
        - fall on outstretched arm: most common
        - elbow dislocation: associated with elbow dislocations in up to 50%, most spontaneously reduce but fragment may be incarcerated in joint
        - traumatic avulsion: usually occurs in overhead throwing athletes
    - Management
        - Shorter periods of immobilization if not significantly displaced.
    - Don't forget to think about medial epicondylitis - if > 5mm of displacement surgery may be indicated!

9. **What is the most common pediatric fracture?**
    - Probably the distal forearm - buckle/torus fracture.

Check out https://www.rch.org.au/clinicalguide/fractures/
Next time you're on shift and don't know what's acceptable!