

EMERGENCY MEDICINE CASES

KNEE INJURIES:

In general, children's ligaments are stronger than their bones, **thus fractures are more likely than sprains**. Have a low threshold for imaging if suspicious.

The same **ACL-injury mechanism** (sudden deceleration of distal leg with forward and rotatory movement) will cause a **tibial spine fracture** in a younger child, and an **ACL tear** in a teenager or adult. (See page 4 for a photo of a tibial spine fracture.)

Lachman test for ACL tear involves pulling the proximal tibia anteriorly while holding the knee in flexion. It has good sensitivity (>80% and specificity of 95%) (1). **The pivot shift test** (valgus force and internal rotation to extended leg, which is then flexed to feel subluxation) is also sensitive for ACL tear. **Always do a straight leg raise to rule out extensor mechanism rupture.**

[Click for a Youtube video demonstrating these tests.](#)

Check the X-ray for a **Segond fracture**, a vertically oriented avulsion fracture off the lateral proximal tibia. This is highly associated with ACL and meniscal tears. (See page 4 for a picture.)

Management of ACL tears:

- pain management in acute phase (NSAIDs, tylenol, morphine)
- short term immobilization (splint as needed, +/- crutches), but atrophy of quadriceps occurs quickly, so start range of motion in 2-3 days. Some experts recommend weight bearing as tolerated immediately.
- Surgical repair is delayed until range of motion has recovered. Refer to outpatient orthopedics.

Additional X-ray views:

- patellar injury requires a "skyline view" (views patella with knee in flexion) to detect fractures
- tibial spine and tibial plateau fractures are best seen on a "tunnel view"



EPISODE 35:
PEDIATRIC ORTHOPEDICS
WITH DR. SANJAY MEHTA &
DR. JONATHAN PIRIE

Patellar subluxations: the child may feel a "pop", from the kneecap subluxing, and feel unstable on the leg. First time patella dislocations and non-displaced fractures **do need knee immobilization**, with weight bearing as tolerated. Displaced fractures or fractures with an impaired extensor mechanism **need urgent orthopedic consultation.**

Remember kids with knee pain can be having pain from a source in the hip, so always examine the hip as well.

Do the Ottawa Knee Rules Apply to Kids?

OKR state that a standard knee series is indicated if:

- age >55 years (this won't apply to kids...) or
- isolated tenderness of patella or
- tenderness at head of fibula or
- inability to flex knee to 90° or
- inability to bear weight immediately after injury AND in the ED for 4 steps (limping is accepted)

Multicenter studies show these rules are **100% sensitive in children for clinically significant fractures** and capable of reducing radiographs by 31%. (2).

Non-accidental trauma

Some fractures **always** raise suspicion of non-accidental trauma (i.e. posterior rib fractures). However non-accidental trauma can result in any type of fracture pattern. *Always remember to be systematic when taking histories, and document carefully!*

Clues for non-accidental trauma (3):

- 1) Delay in presentation,
- 2) Vague or inconsistent explanation of mechanism,
- 3) Mechanism described that is inconsistent with injury,
- 4) Injury inconsistent with developmental stage of child.

APPROACH TO THE CHILD WITH A LIMP:

- 1) Rule out septic arthritis
- 2) Look for fractures, which can be very subtle, and ask about trauma
- 3) Look for clues of systemic illnesses such as a rash, fever, bruising

Assess the *persistence* of the limp from the history and observations of the child. **Give analgesia**, which can help improve the physical exam.

Use distraction and observation of the child at play to complete a full physical examination (4).

SEPTIC ARTHRITIS vs. TRANSIENT SYNOVITIS?

Transient synovitis of the hip is a self-limited inflammation of the synovial lining. It is often preceded by a viral infection, and should resolve in 3–10 days. However, concurrent illness can make diagnosis challenging.

Pay attention to vital signs, general appearance (well or unwell appearing) and symptom progression.

The **Kocher criteria** for predicting septic arthritis gives increasing probability for each of the following criteria met (5):

- 1) non-weight-bearing on affect side
- 2) ESR > 40 mm/hr
- 3) fever
- 4) WBC > 12,000

The Kocher rule is helpful to *rule-in higher pre-test probability patients*.

Fever is probably the best criteria.

What about CRP? Lack of fever and a CRP < 2.0 has a good predictive value for *ruling out septic arthritis* (6) when pretest probability is low.

Ultrasound? Presence of an effusion can support a diagnosis, but cannot rule out septic arthritis.

Treatment: in patients you suspect septic arthritis, usually you can wait to start empiric IV antibiotics until after the joint can be aspirated. However, if there will be a significant delay, start antibiotics first.

LEG-CALVE-PERTHES:

LCP is **avascular necrosis of femoral head**, typically in a child aged 4–10. It can present insidiously, or may follow a hip injury. The initial x-ray can be normal, or show a very subtle change in appearance of the femoral head. Speak to radiology to carefully review the images, and follow with a bone scan or MRI if very suspicious.

OCCULT FRACTURES:

A commonly missed occult fracture is the **Toddler's fracture** (spiral fracture in children 9 months to 3 years, usually of distal tibia - see page 4 for an example). It can present with subtle findings. Pain with ankle dorsiflexion or calf rotation should raise suspicion. Oblique views can help reveal the fracture (7).

Toddler's fractures need an **above knee immobilizing splint with slight flexion**, with orthopedic follow-up. However, if nothing is seen on the X-ray and symptoms are very mild, consider follow up without a cast, after discussion about pros/cons with parents. Ultrasound may help, when clinical suspicion is high but X-rays appear normal.

Avulsion fractures and **bowing aka greenstick fractures**, are also frequently missed on plain X-ray.

SLIPPED CAPITAL FEMORAL EPIPHYSES:

SCFE is easy to miss! This can present subtly, with pain that radiates into the thigh or knee. Typical patients are older children, overweight, but also skeletally immature.

On exam, pain is usually greatest with *internal rotation* of the hip, and they can present with the hip held in external rotation.

Get x-rays of both hips, including frog's-leg view in addition to standard views. Look for **Kline's line**, the line from the external part of femoral neck, which should intersect part of the femoral head. (See page 4 for an X-ray with Kline's line.) As it slips, the femoral head becomes medial to that line. Compare both sides, but remember SCFE can be *bilateral*.

If suspicious, call orthopedics—these cases need surgical management and SCFE will worsen if patients continue to weight bear.

TIPS FOR FRACTURE PAIN MANAGEMENT:

- Use age-appropriate pain scores.
- Start with ibuprofen/tylenol.
- Add oral narcotics, or IV if planning a reduction. Consider intranasal fentanyl, or intranasal ketamine.
- Morphine (0.2 mg/kg up to 5mg per dose, with instructions about side effects) may be used in addition to ibuprofen/tylenol for severe pain after discharge.

Codeine is not recommended, due to variations in its metabolism, and adverse side effects.

ANKLE FRACTURES:

Salter Harris (SH) fractures around the growth plate (mnemonic SALTR):

I – S = Slip. Fracture of the cartilage of the physis (growth plate)

II – A = Above. Fracture above physis.

III – L = Lower. Fracture below the physis in the epiphysis.

IV – T = Through. Fracture is through the metaphysis, physis, and epiphysis.

V – R = Rammed. The physis has been crushed/heavily damaged.

Ottawa Ankle Rules is highly sensitivity for ankle fractures (7), except SH-I. MRI evidence suggests SH-I fractures are similar to a sprain, and do well when treated as such (8). Non-displaced SH-II lateral malleolar fractures heal as well in an ankle stirrup brace as in a cast or boot, but patients prefer an ankle brace, and mobilize earlier (9).

TILLAUX FRACTURES:

Tillaux fracture (see pic on page 4) is an intra-articular SH-3 with avulsion of the anterolateral tibial epiphysis. Often from a low energy mechanism, in children with partial growth plate fusion (age 11–15). Look carefully for a **triplanar fracture** in these children (an unstable combo of SH-1, SH-2 and SH-3), which requires operative management (see pic).

WRIST FRACTURES:

Buckle fractures of the distal radius heal well in a splint, with greater patient preference over a cast (10). (See pic on page 4).

Studies indicate home splint removal, once symptoms resolve, may be safe and preferred to a clinic visit (11).

Greenstick fractures (one cortex broken, the other intact) that are *minimally angulated** also do well with

minimal splinting (12). Minimally-angulated transverse fractures can also be treated similarly.

**acceptable degrees vary, but only dorsal and volar angulation is acceptable!*

FALL ON OUTSTRETCHED HAND (FOOSH):

Examine entire limb, up to the clavicle, and examine the joint above and below the painful site for a second fracture.

Supracondylar fractures are the most common elbow fractures. Mechanism is usually a fall, and elbow extension is typically limited. On imaging, look for fat pads, and assess adequacy of the X-ray (see the hourglass and anterior humoral line (see page 4).

Assess the radiocapitellar line (for radial head dislocations). Review each ossification center, which appear approx. every 2 years from age 2–3 (see page 4 for mnemonic), to rule out an avulsion fracture masquerading as an ossification center.

Neurologic Exam for Supracondylar Fractures:

These fractures have a high risk of neurologic and vascular injuries.

Ask child to do hand signals to test **motor function** of each nerve. Radial nerve - make a “thumbs up”

Median nerve - make a fist, and pinch a piece of paper with a pincer grip

Ulna nerve - make scissors with the index and middle finger, or a peace sign

For the **sensory examination**, test the first dorsal webspace (radial), dorsum of 2nd or 3rd fingertip (median) and fifth fingertip (ulna).

Consider Compartment Syndrome in kids displaying severe pain with suprachondylar fractures.

Immobilizing supracondylar fractures: Cast in a non-circumferential sugar-tong and gutter splint, to ensure stabilization of the distal humerus, with space to swell (to minimize compartment syndrome risk).

Pulled elbow: If mechanism or history is unclear, then consider an X-ray. For a clear “pulled” elbow, the hyperpronation method is very (~95% effective)(13) and may be more comfortable. (See page 4).

References:

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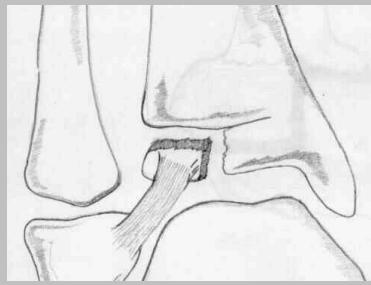


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IMAGES FROM EPISODE:



TIBIAL SPINE FRACTURE



TILLAUX ANKLE FRACTURE



CRITOE MNEUMONIC FOR ELBOW GROWTH PLATES

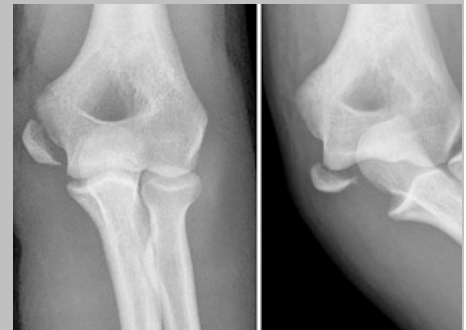
- C - capitellum
- R - radial head
- I - inner (medial) epicondyle
- T - trochlea
- O - olecranon
- E - external (lateral) epicondyle



SEGOND (AVULSION) FRACTURE



TRIPANAR ANKLE FRACTURE



MEDIAL EPICONDYLE FRACTURE



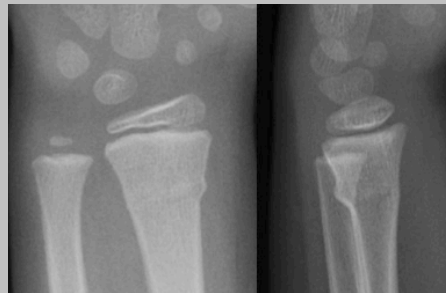
TODDLER'S FRACTURE



ANTERIOR HUMERAL LINE



KLINE'S LINE FOR SLIPPED CAPITAL FEMORAL EPIPHESIS



BUCKLE FRACTURE DISTAL RADIUS (MINIMAL ANGULATION)



HYPERPRONATION FOR PULLED ELBOW REDUCTION

One hand holds elbow at 90 degrees of flexion, and the other hand holds the wrist, then hyperpronates the wrist to complete the reduction.