Bone Up on Pediatric Fractures & Dislocations!

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• Review the unique features of pediatric bone and the classifications of fractures
• Understand how to assess suspected fractures
• Explore fractures and dislocations commonly seen in the pediatric office
• Implement the latest evidence behind fracture management for pediatricians

The Pediatric Skeleton

• Bone is relatively elastic and rubbery
• Periosteum is quite thick & active
• Ligaments are strong relative to the bone
• Presence of the physis - “weak link”
• Ligament injuries & dislocations are less common – “kids don’t sprain stuff”
• Fractures heal quickly and have the capacity to remodel

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### Anatomy of Pediatric Bone

- Epiphysis
- Physis
- Metaphysis
- Diaphysis
- Apophysis

### Pediatric Fracture Classifications

- Buckle/ Torus – compression, stable
- Plastic Deformation – Bowing esp. fibula or ulna
- Greenstick – plastic deformity w/ partial fx on one side of the bone
- Complete - Spiral, Oblique, Transverse
- Physeal – involves growth plate “Salter-Harris fx”
- Avulsion – involves an apophysis

### Buckle (Torus) Fracture

- Buckled Periosteum
  - Metaphyseal/ diaphyseal junction

- “Buckle and a half”
- Oblique
- Oblique, Comminuted
Greenstick Fracture

- Cortex Broken on Only One Side
  - Incomplete

Complete Fractures

- Transverse
  - Perpendicular to the bone
- Oblique
  - Across the bone at 45-60°
  - Unstable
- Spiral
  - Rotational force

Physeal Fractures: Salter-Harris

- "Weak link" of pediatric bone (cartilage)
- Adults - sprains... children - physeal injuries
- Rapid healing (1/2 time of shaft fractures)
- Anatomic alignment critical for minimal deformity
- Tenderness over physis: suspect a SH I fracture, even with normal radiographs!
- Risk of premature growth arrest leading to limb length discrepancy or angular deformity
- Risk of articular complications (SH types 3-5)
Salter-Harris Classification

- **I** = “Same”: through the physis
- **II** = “Above”: from metaphysis into physis (75% of physeal injuries)
- **III** = “Lower”: from physis into epiphysis (more unstable; ensure good alignment)
- **IV** = “Through”: from metaphysis to epiphysis (surgical pinning usually indicated)
- **V** = “Everything Wrong” (including the spelling): crush or compression of physis

“The History”

- Kids are not good historians
- Mechanism - Any Fall
  - Sports/Trampolines/ Monkey Bars/ Skating
  - May not be much swelling, bruising or deformity
- Non-weight bearing
- Limp
- Not using the arm
- Be suspicious!

The History

- Age of patient
- Location of pain
- “Pop”
- Swelling or bruising
- Function
- Mechanism can give important information
- Injury should match mechanism (NAT)
Distal femur fx in a 6 mo infant... NAT???

Physical Exam

1) **Inspection**: swelling, bruising, deformity, skin intact?

2) **Gentle Palpation**: focus on bony vs. soft tissue structures, crepitus, step-off’s, bony mass, & growth plates ($1,000,000 exam tool: one finger to localize tenderness)

3) **ROM**: flexion, extension, abduction, adduction,

4) **Neurovascular**: motor function, sensation, and strength

5) **Special maneuvers**: ligaments, tendons, laxity

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*Consider 2-3 views = AP, Oblique, Lateral

*Focus XR beam: try to pinpoint pain

*Minimize radiation when possible*
Describing Fractures on XR

- Where?
  - Name of bone
  - Right vs. Left
  - Proximal vs. Midshaft vs. Distal
  - Numbered bones (e.g., base of proximal phalanx, 2nd digit)
- Type
- Angulation?
- Displacement?
- Rotation
- Beware of normal variants!

Describe this fracture...

- Which bone?
- Where?
- L or R?
- Type?
- Angulation?
- Displacement?

Splinting: General Principals

- Inspect for any open wound, swelling, or deformity
- Check distal pulse and neuro status
- In general, immobilize the joint above and below the fracture
- Pad all rigid splints (minimum 2 layers, with 3 around bony prominences)
- When in doubt, splint! A sugar-tong is safe choice

The FOOSH

- Fall On the Out Stretched Hand
- Common mechanism — Forearm fx’s #1
- Distal radius fractures = ¼ of all pediatric fx’s
- SH II most common — closed reduction if > 15°
- Excellent remodeling capability
- Growth disturbance is unusual
**Splint vs. Cast for buckle fractures of the Distal Radius**

- Level I - Splint as good as a cast for prevention of re-fracture or loss of alignment
- No difference in pain
- Easier to bathe, better function
- No need for return for cast removal or re-xray

**Elbow Fractures**

- Multiple physes
- Look for swelling
- Effusion
  - Loss of flexion/extension
  - No loss of supination/pronation
- Typically supracondylar in the very young and radial head in the older child

**Ossification Centers of the Elbow (CRITOE):**

- **C** = Capitellum
- **R** = Radial Head
- **I** = Internal (Medial)
- **T** = Trochlea
- **O** = Olecranon
- **E** = External (Lateral)

- 2 Years
- 4 Years
- 6 Years
- 8 Years
- 10 Years
- 12 Years

**Elbow Fat Pads**

- Anterior – normal if lying flat against the humerus, abnormal if elevated – “sail sign”
- Posterior – always pathologic!
- Indicates hemarthrosis
Occult Fracture

Motor Function

- Radial Nerve - posterior interosseous
- Median Nerve - anterior interosseous
- Ulnar nerve

Hand Case #1

- 16 y/o football player comes to the office c/o “jammed finger”
- TTP over PIP joint

Essentials for Finger and Hand Injuries

- Beware of the “jammed finger!”
- Xray with any suspicion

ALWAYS
- Do a visual inspection !!!
- Check motor function & ROM
- Check sensation
- Blood flow (warmth, color, pulses, & capillary refill)
Avulsions common...

Visual Inspection
- Give every hand & finger injury the Kentucky Quick-Eye Test

Phalangeal Fx
- Assess closely for angulation and need for reduction
- Beware of malrotation!
- Tx if stable/nondisplaced/nonangulated...buddy-tape and splint for sports x 3-4 weeks
- If unstable or intra-articular, refer for orthopedic evaluation

Hand Case #2
- A 14 y/o presents to the office with an obvious injury to the 5th finger
Finger Dislocations

- Almost always dorsal dislocation after hyperextension and axial load
- Beware of “jammed finger” & avulsion fractures!
- Xray!
- “One-pull rule”

Dislocations

- If no Fx, splint in 30 deg flexion
- Buddy-taping for sport x 4-6 wks.
- ROM exercises ASAP

Hand Case #3

- 15 year old lacrosse player involved in fight during rec league and presents c/o hand pain

Boxer’s Fracture

- Usually fracture the 5th metacarpal neck
- May occur with any metacarpal
- Degrees of angulation
- Immobilize for 4-6 weeks
Hand Case #4

- 16 y/o basketball player lands on outstretched hand after getting undercut while getting rebound (FOOSH)
- Now c/o Right Wrist Pain

Scaphoid Fracture

- Pain on radial side of wrist
- Palpate snuffbox region
- Immobilize if any concern!
- Tricky blood supply
- Scaphoid view x-rays
- Consider MRI if persistent symptoms and negative x-rays
- Thumb spica x 6 weeks or longer

Clavicle Fracture

- Most are midshaft
- Beware of proximal clavicle and distal clavicle
- Tx: Sling or figure-of-8 brace for 3-4 weeks
- Encourage early ROM when pain allows
- No return to contact sports for 8 weeks
- The “bump” may persist!
A 13 y/o gymnast presents to the ED with right hip pain and the inability to bear weight. She felt a “pop” in her hip while doing the splits.

Her most likely diagnosis is...

- Femur fracture
- Hamstring strain
- Pelvic avulsion fracture
- Slipped capital femoral epiphysis (SCFE)

Ischium Avulsion

- On exam she had limited ROM with hip flexion, hip IROM, knee extension.
- She was tender to palpation over the ischium.

Pelvic Avulsion Fractures

- Occur with aggressive, athletic motions
- Iliac crest - baseball
- AIIS - soccer/rugby
- ASIS - sprinters/soccer
- Ischium - gymnasts/hurdlers
- Treat with crutches, nonweight-bearing, and pain control
Hip/Thigh Case #6

- 16 yo runner (XC and track) presents with L-hip pain x month
- Worse w/ running
- Does not recall injury

Femoral Neck Stress Fracture – 17 yo runner

Ankle Fractures to Know!

- The SH I of the distal fibula - the “ankle sprain of the immature skeleton”
- Clinical diagnosis! Tenderness over the physis and mild soft tissue swelling
- X-rays usually normal except for soft tissue swelling
- Excellent prognosis & low risk
- Tx: Ankle stirrup/crutches x 5 days then advance as tolerated

Ankle Fractures to Know!

- The Tillaux fracture or SH III of the tibia
- Appears in teenagers when the tibia physis starts to close medially but not laterally
- Eversion force results in an avulsion of the lateral physis
- Intraarticular fracture and requires orthopedic consultation
Ankle Fractures to Know!

- The Triplane fracture or SH IV of the tibia
- Extension of the Tillaux across the physis & out through the metaphysis
- Also intraarticular & requires orthopedic consultation
- CT often helpful

Ankle Injuries with Foot Pain

- Avulsion fractures of the 5th metatarsal
- Caused by pulling of the peroneus brevis
- Always feel the bump!

Preventing fractures

- Any toddler with a mechanism and – refuses to bear weight
- Regardless of exam or xray

Toddler’s fracture
Bad Actors (Deformity, Malunion)

- Displaced Supracondylar Fractures
- Any Lateral Condyle Fracture
- Any Displaced distal femur or Proximal Tibia Fracture
- Midshaft Forearm Fractures
- Salter-Harris III/IV
- Osteochondral Fractures