When to Worry About the Growth Plates in a Young Athlete

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• Kids Are Not Just Small Adults
Outline

- Pediatric Musculoskeletal System
- Salter-Harris Fractures
- Fractures Unique to Pediatrics
- Overuse Injuries/Apophysitis
Pediatric Musculoskeletal System

- **Bones**
  - Thicker periosteum
    - Increased stability and vascularity
  - More porous, less mineralized
    - More flexible
  - Open growth plates
    - Weak link
  - Generally heal quicker and better than adults
  - Have the potential for remodeling
Pediatric Musculoskeletal System

• Cartilage
  ▫ Softer/Thicker
  ▫ Greater vascularity, potential to heal

• Musculotendinous units
  ▫ Relatively Inflexible
  ▫ Fewer sprains and strains

• Apophysis
  ▫ Secondary growth centers at the site of tendon attachments
  ▫ Source of “growing pains”
Pediatric Musculoskeletal System
Growth

• No evidence that repetitive microtrauma on the epiphysis causes growth delay
  ▫ Need more studies
• Studies of size and longitudinal growth in athletes vs nonathletes have not shown any adverse effect with intense training
• Growth plate fractures can inhibit growth
  ▫ Evidence does not show more prevalence of these in athletes vs nonathletes
Pediatric Fractures

- Chance of a child 0-16yo sustaining a fracture during childhood is 42% for boys, 27% for girls
- Bones are relatively weaker, more prone to breaking than adults
  - Kids break bones, adults pull muscles/sprain ligaments
Pediatric Fractures

• Torus or “Buckle” Fractures
  ▫ Buckling of Cortex
  ▫ Fracture does extend all the way through
  ▫ Generally very stable and heal quickly
Pediatric Fractures

• Greenstick Fractures
  ▫ Fracture of one cortex of the bone with the other still intact
  ▫ Must be reduced if displaced and may move even after reduction
Salter-Harris Fractures

- Type I - Injury through physis alone
- II - Metaphysis and Physis
- III - Physis and Epiphysis
- IV - Metaphysis across physis and Epiphysis
- V - Compression of Physis

• Mnemonic
  - Slipped Epiphysis
  - Above Epiphysis
  - Lower than Epiphysis
  - Through Physis
  - Rammed Physis
Salter-Harris Fractures

- **Growing Bone**
  - Damage to physis can cause growth arrest resulting in shortened bone or angular deformities

- **Treatment**
  - Goal is anatomic reduction without inducing growth arrest
  - Generally increasing risk for arrest with increasing class
  - Type I and II generally do very well with half the healing time of pure bony injuries
  - Type III and IV require anatomic reduction due to involvement of articular surface
  - Type V have poorest prognosis but are rarest
Physeal Fractures

- Displaced or concerning physeal fractures need to be followed for several months after to look for growth arrest
- May look for “bone bar”
- Inform patient/parents of potentials
Patellar Sleeve Fracture

- Avulsion of distal cartilaginous portion of patella
- Age 8-12 yo
- Patella alta on exam and xray
- Small fragment separated from distal patella on radiographs
- MRI if dx questionable
- Nondisplaced → cast
- Displaced → Tension band or excision and tendon repair
Tibial Tubercle Fracture

- Tibial tubercle is anterior and distal extension of proximal physis
- Age 13-16 yo – typically just prior to physeal closure
- Classification
  - Type I – through distal ossification center
  - Type II – through jxn. Tubercle and tibial centers
  - Type III - involves articular surface
- Treatment: ORIF if displaced
Tibial Eminence Fracture

- Avulsion of ACL
- Age 8-14 yo
- Hyperextension or direct blow
- May have ACL stretch with fracture → mild residual instability
- Meniscus (medial) may block reduction
- Loss of extension biggest complication
Tibial Eminence Fracture

• Treatment
  ▫ Type I – Minimally displaced
    • Immobilize in cylinder cast 4-6 wks
  ▫ Type 2 – Displaced and hinged posteriorly
    • Attempt closed reduction with full extension
    • Cylinder cast in extension (some prefer 20-30 deg flexion to relax ACL)
    • Internal fixation if closed reduction fails
  ▫ Type 3 – Completely displaced
    • Internal fixation
Medial Clavicle Fracture

- Physis appears at ~17 yo, closes at 20-25 yo
- Presents like SC dislocation, treatment similar
- Posterior may compress mediastinal structures...dangerous!
  - Reduce with bolster b/w scapula, hyperextension of clavicle, and traction
  - May pull anterior with towel clip
  - Usually stable after reduction
  - 3-4 wks in figure 8 splint
  - No fixation
- Anterior dislocation
  - Often unstable after reduction
  - Remodels so do not require re-reduction
Pelvic Avulsion Fractures

- Mostly during adolescence (age 14 to 25)
- Sudden violent muscular contraction or an excessive amount of sustained muscle action across an open apophysis
  - Rapid acceleration or deceleration
  - Sprinters, jumpers, soccer, and football players
- Presentation: acute onset of pain, occasional popping sensation, localized tenderness
  - Can reproduce pain by passive stretch
- Many have history of previous apophysitis
Pelvic Avulsion Fractures

- Iliac Crest
  - Abdominals
- ASIS
  - Sartorius, Tensor Fascia Lata
- AIIS
  - Rectus Femoris
- Ischium
  - Hamstrings/ Adductor Longus
- Lesser Trochanter
  - Iliopsoas
Pelvic Avulsion Fractures

Ischium  AIIS  ASIS  Iliac Crest
Pelvic Avulsion Fractures

• Treatment: Rest, crutches for 2 weeks, progressive rehabilitation to return to sports activity; position extremity to relax involved muscle group
• Progressive rehab program
• Complete healing in 6 weeks-several months
• Ischial Tuberosity - Open reduction and internal fixation of large fragments displaced more than 2 cm
Tilleaux and Triplane Fractures

• Distal tibial physis closes first centrally, then posteromedially, and last anterolaterally
• Results in Triplane and Tillaux fractures
• Actual articular displacement generally more significant than radiographs imply
• CT scan helps elucidate true articular deformity
• Articular incongruity rather than growth arrest is primary concern
• Require ORIF w/anatomic reduction
Pediatric Elbow Fractures

- Pediatric elbow fractures can be occult but serious
  - May cause cubitus varus or even vascular compromise
- Look for anterior and posterior fat pad elevation on Xray
- Obtain CT if diagnosis in question
Pediatric Elbow Fractures

- **Ossification Centers**
  - Capitellum
  - Radial Head
  - Internal (Medial) Epicondyle
  - Trochlea
  - Olecranon
  - External (Lateral) Epicondyle
SCFE (Slipped Capitol Femoral Epiphysis)

- Slippage through the hypertrophic zone of physis
  - Femoral head remains reduced
  - Neck displaces anterosuperior & external rotation
- Etiology
  - Idiopathic – most common
  - Endocrinopathy
  - Renal Failure
  - Prior Radiation therapy
SCFE (Slipped Capitol Femoral Epiphysis)

• Epidemiology
  ▫ Obese
  ▫ Positive FH
  ▫ African American
  ▫ Boys 60%, Girls 40%
  ▫ Mean age at onset
    • Boys 13.5yo
    • Girls 12yo
  ▫ 18-63% Bilateral
SCFE

- **Presentation**
  - Hip, thigh, or knee pain
  - Limited internal rotation
  - Out-toeing gait
  - Initial pain may be vague

- **Treatment**
  - Surgical reduction with percutaneous pinning
  - Contralateral fixation may be recommended
  - Return to play when physio closes and patient asymptomatic
    - Pin removal in athletes is controversial
Overuse Injuries

- Apophysitis
  - Osgood Schlatter
  - Sinding-Larsen-Johansson
  - Sever’s Disease
  - Iselin’s Disease
  - Little Leaguer’s Shoulder
  - Little Leaguer’s Elbow
Osgood Schlatter

- Separately described by Osgood and Schlatter in 1903
- Age of onset in boys 10 – 15 & girls 8 – 13
- Traction apophysitis of the tibial tubercle caused by repetitive microtrauma from a contracting extensor mechanism
- Incidence as high as 20% in athletic youngsters
- Occurs bilateral in 20 to 30% of cases
- Most common in basketball, volleyball, soccer, and gymnastics
Osgood Sclatter

• Clinical Presentation:
  ▫ Antalgic gait
  ▫ Swelling, prominence, and tenderness localized to the tibial apophysis
  ▫ No knee effusion
  ▫ Pain is reproduced by extension against forced resistance
  ▫ Pain with jumping, squatting, kneeling
Osgood Schlatter

- **Radiographic Findings**
  - Prominence of the tibial tubercle
  - Fragments of secondary ossification center of tibial tubercle may be displaced slightly anteriorly and superiorly
Osgood Schlatter

**Treatment**
- Reassurance
- Most able to tolerate symptoms and continue play
- Typically spontaneous resolution with closure of the physis; though may have residual tenderness with kneeling
- Knee Pad or cho-pat strap may be helpful
- Ice/NSAIDS
- Quadriceps and hamstring stretching
- Restriction of activities
- If painful after physeal closure, may be ossicle that is symptomatic into adulthood
- May predispose to risk of tubercle avulsion
Sinding-Larsen-Johansson

- Repetitive microtrauma
- Calcification/ossification at the inferior pole of the immature patella
- Most common before the prepubescent growth spurt and in males
- Aggravated by running, jumping, and stairs
- Clinical Presentation:
  - Tenderness at the inferior pole of the patella
  - Limp
  - Quadriceps tightness
  - Protective limited range of motion
Sinding-Larsen-Johansson

- **Radiographic Findings:**
  - Calcification or ossification at the inferior pole of the patella
  - Elongation of the patella

- **Treatment:**
  - Self-limited disease, Reassurance
  - Spontaneous resolution in 12 – 18 months
  - Modification of activities
  - Ice/NSAIDS
  - Lower extremity stretching program (quadriceps, hamstrings, and heel cords)
  - Patella knee sleeve, cho-pat strap
Sever’s Disease

- Described by Sever in 1912
- Calcaneal apophysitis
- Most common in 9-14 age athletes
- Bilateral: 60-80%
- Diagnosis
  - Heel pain with activity
  - Calcaneal apophysis tender
Sever’s Disease

• Radiographic Findings:
  ▫ Sclerosis/Fragmentation
  ▫ May be difficult to distinguish from normal as normal varies greatly
    • Often mistaken for fracture
Sever’s Disease

- **Treatment:**
  - Self limited, Reassurance
  - Heel cord stretching/Strengthening
  - Heel cups or shock-absorbing inserts (watch out for hard-soled cleats)
  - Ice/NSAIDs
  - Responds well to therapy, usually able to return to sports in 6 - 8 weeks or less
  - Differentiate from calcaneal stress fracture (medial lateral compression test)
Iselin’s Disease

- Apophysitis at the base of the 5th Metatarsal
- Presents with pain, swelling, limp
- Differential diagnosis includes Avulsion fracture or Jones fracture
  - Radiographically Iselin’s disease is represented by an oblique fragment on the lateral side of the metatarsal
    - Comparison view may be helpful
Iselin’s Disease

Iselin’s

Avulsion Fx

Jones Fx
Iselin’s Disease

• **Treatment**
  ▫ **Self-Limiting, Reassurance**
  ▫ **Ice, NSAIDs**
  ▫ **Stretching of lower leg muscle groups**
  ▫ **Rest, Activity Modification**
    • *Walking boot often helpful for a few weeks of rest and to limit activity*
Little Leaguer’s Shoulder

- Proximal Humeral Epiphyseolysis
- Throwers, 12-15 yo
- Tender to palpation at the proximal humeral physis, may have generalized shoulder tenderness as well
- Pain/weakness with resisted external rotation
- Xray may show widening of proximal humeral physis
  ▫ This may be normal finding in throwers however
- Treatment is 3 months rest from throwing
Little Leaguer’s Elbow

- Group of injuries to elbow in young throwers
  - Ranges from apophysitis to avulsion fracture to OCD of the capitellum
- Pain with throwing
  - May have acute injury
- Treatment is generally rest
  - Surgery for avulsion displaced >5mm
  - Surgery for OCD lesion with persistent pain/fragments
Gymnast’s Wrist

- Salter I fracture of the distal radius from repetitive trauma
  - May be bilateral
- Usually female 12-14
- Dorsal wrist pain, worse w/activity
  - Pain with extension/flexion
- Treatment
  - Rest from impact 2-4 wks for stage I
  - Cast for 4 wks for stage II (change on Xray)
  - Surgery for stage III (growth arrest)
The END!

Thank You