Musculoskeletal Concerns of the Pediatric Athlete

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Objectives

At the conclusion of this lecture you will:

• Recognize the relationship between skeletally immature bone growth and child specific bone injuries
• Realize that patterns of pediatric sports injuries often relate to the vulnerability of the growth plate to force
• Be familiar with common musculoskeletal injuries in young athletes seen in the lower and upper extremities
• Recognize complications and rehabilitation issues following specific injuries occurring in the skeletally immature athlete
Children and Sports injuries

• Almost 1/3 of injuries from all causes due to sports

• ↑ participation of kids in organized sports
Risk Factors

Intrinsic Risk Factors
- Growth
- Anatomy
- Muscle/Tendon imbalance
- Illness
- Nutrition
- Conditioning
- Psychology

Extrinsic Risk Factors
- Training
- Technique
- Footwear
- Surface
Increased Stress

- Kids do what adults do
- Kids get tired faster
- Limited strength
- Flexibility issues
- Excess stress / overuse leads to failure
Bone Development

• Greater than 90% of peak bone mass is most likely present by 18 y.o.
• Bone density ↑ by 6-8% each year especially during puberty
• Skeletal age 10-14 appear most important for bone acquisition and is linked with maximal rate of growth

Sabatier et al, Osteoporosis Int, 1996
## Traumatic vs Atraumatic

<table>
<thead>
<tr>
<th>Traumatic</th>
<th>Atraumatic</th>
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<tbody>
<tr>
<td>- Growth plate / Salter Harris fracture</td>
<td>- Apophysitis</td>
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<tr>
<td>- Child-specific fracture</td>
<td>- Osteochondritis Dissecans</td>
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<tr>
<td>- Apophyseal avulsion</td>
<td>- Avascular necrosis (i.e. LCPD)</td>
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The growth plate is weaker than ligaments and tendons!
Physeal Injury

Salter fractures
- Grade 1 to 5
  1 = physeal fracture
  2 = physis and metaphysis
  3 = physis and epiphysis
  4 = metaphysis and epiphysis
  5 = crush injury to physis
Physeal Injury

Exam
- Large effusion
- Tender joint line or physis
- Rule out ligamentous laxity
- Compare vs normal knee

Diagnostic Tests
- X-ray (+/- stress views)
- MRI ***
MRI
Physeal Injury

Complications
- Neurovascular injury
- Compartment syndrome
- Associated ligament injury
- Growth disturbance

Treatment
- Closed reduction and casting 4-6 weeks
- Occasional Closed/Open reduction and pinning
- Follow for growth disturbance
- Epiphysiodesis to prevent angular deformity or leg length discrepancy
Apophyseal Avulsion Fractures

- Fracture is often isolated acute event
- Forceful contraction with eccentric load
- For example acute hyperflexion or sudden deceleration
- GROWTH PLATE FORCES
Avulsion Fractures

**ACUTE INJURIES (203)**

- **IT**: 109
- **AIIS**: 45
- **ASIS**: 39
- **SCPS**: 7
- **IC**: 3

IT ischial tuberosity, AIIS anterior inferior iliac spine, ASIS anterior superior iliac spine, SCPS superior corner of pubic symphysis, IC iliac crest
Avulsion fractures

Anterior inferior iliac spine

Rossi, Dragoni, Skeletal Radiology, 2001
Avulsion fractures
Anterior Superior Iliac Spine

Rossi, Dragoni, Skeletal Radiology, 2001
Avulsion fractures
Superior corner of Pubic Symphysis

Rossi, Dragoni, Skeletal Radiology, 2001
Periosteal Sleeve Avulsion of Patella

- Younger athletes 9-12 years old
- Mechanism: forceful quad contraction due to hyperflexion or sudden deceleration
- Unable to actively extend knee
- Palpable gap and swelling distal pole of patella
- Xrays- may see rim of bone separated from rest of patella, patella alta

REQUIRES SURGICAL REPAIR!!!
Medial Apophyseal Avulsion

- Non-operative treatment typically involves casting for 2 to 3 weeks at 90° followed by protected motion with a hinge brace for at least 6 weeks.
- 31 out of 35 healed with fibrous non-union with good function and range of motion.

Treatment of Avulsion Fractures

- May require early open reduction internal fixation (ORIF)
- Depends on size of fragment
- Displacement greater than 2 mm for smaller tendons; greater than 1 cm for larger tendons
- Early range of motion recommended after ORIF
  - 4 days for elbow medial epicondyle
  

- Can affect muscle tendon function and strength if not repaired
Elbow dislocation vs fracture?

Supracondylar fracture
• Aged (5 to 10 y.o.)
• Needs Urgent Surgical ORIF

Posterior dislocation
• Adolescent (13-14 y.o.)
• Rule out fractures (often coronoid), assess for gross ligament injury
Shoulder Dislocation

TUBS
• T – Traumatic
• U – Unidirectional
• B – Bankart Lesion
• S – Surgical

AMBRI
• A – Atraumatic
• M – Multidirectional
• B – Bilateral
• R – Rehab, rehab, rehab
• I – Inferior Capsular Shift
Atraumatic Shoulder Pain

- Think about multidirectional instability
- Swimmers, volleyball, baseball, gymnastics, tennis
- Pain (secondary impingement)
- Popping, instability
- Arm feels dead
- Poor performance
1st Time Dislocators
Robinson et al., JBJS-A, 2006

- Young and male were the most significant determinants
- Sports injury #1 cause 58.7%
- By the end of the fifth year, males had an 85% probability of recurrent instability
- To operate or not to operate - still controversial
Recurrence vs. Age

Rowe 1980

![Bar chart showing recurrence rates vs. age groups: <20 yrs, 21-30 yrs, 31-40 yrs, >40 yrs. The chart indicates a higher recurrence rate in the <20 yrs age group compared to the other age groups.]
Rule Out Complications

- Hill Sachs Lesion
- Bankart Lesion
- SLAP tear
- MR Arthrogram test of choice
Apophysitis

Knee: Osgood Schlatter’s Disease

- Repetitive forces on quads and patellar tendon cause microavulsion fractures in tibial tuberosity
- Typically 12-14 y.o.
- Treatment - conservative
Radial Wrist Apophysitis

- Gymnastics may increased loading on wrist up to 16 times
- 59/80 (56%) of gymnasts complain of wrist pain
- 73% had abnormal radiographs of the distal radial physis
- Positive ulnar variance > 1 mm distance more than radius associated with degenerative disease of the wrist

Treatment for Apophysitis

- Rest, modify activity. How long? 6 to 8 weeks
- Sling or immobilize if significant pain
- Include low impact activity and conditioning
- Focus on strength and flexibility while healing

Examples:
1. Hip and quads strengthening program, core stability
2. Overhead and Throwing athlete rehab
   - Long ball toss, Medicine balls, Rotator cuff, Periscapular exercises
Osteochondritis Dissecans

- Typically affects the dominant extremity
- Onset of symptoms between 11 to 16 yo
- Gradual onset of lateral elbow pain and flexion contracture
- X-ray and MRI
Osteochondritis Desiccans

- Avascular necrosis of fragment
- Usually lateral aspect of medial femoral condyle or lateral femoral condyle
Osteochondritis Deccicans

Hx - Vague knee pain; may have locking symptoms
Dx - X-rays (divot)
MRI (Stage lesion)
Treatment: outcome based classification system based on patient age and the stability, location, and size of the lesion
Stages of OCD

- Grade 1 – In situ lesion, no cartilage breech
- Grade 2 – In situ lesion, cartilage breeched, low signal behind (stable)
- Grade 3 – Lesion, cartilage breeched, high signal behind (unstable)
- Grade 4 – Loose Body

DiPoala Classification (Arthroscopy, 1991)
Osteochondritis Dissecans
Osteochondritis Dessicans

Treatment
- Refer to Orthopedics if surgical
- Surgical approach determined by age of patient and stage of lesion
- Fixation vs Excision

If Excise,
- Microfracture
- Osteochondral auto/allograft / Autologous chondrocyte implantation
ACL Tears in the Young Athlete

Classification
- Partial
- Complete (midsubstance)
- Tibial eminence avulsion fracture
- Surgical reconstruction via pediatric orthopedist
Diagnosis

Femur

ACL Torn

PCL

Tibia
Physeal Sparing ACL Reconstructions

Non-transphyseal ACL reconstructions

“Over the top” Femoral Fixation Method

Partial transphyseal ACL reconstruction
Tibial Spine Avulsion Fractures

- Occurs in young children 8-14
- Often biking injury
- Type 1 (non-displaced)
- Type 2 (partially displaced)
- Type 3 (displaced): urgent fixation recommended over immobilization in extension
Anterior Knee Pain Still # 1

- Patellofemoral pain
- Patellar instability
- Apophysitis
- Tendinopathy (patellar, quadriceps)
- Bursitis
- Iliotibial band friction syndrome
- Plica
Plica Syndrome

- Medial knee pain after activity
- May have history of direct trauma
- Snapping over medial femoral condyle
Plica Syndrome

TREATMENT:

• RICE, NSAIDS
• Steroid injection into plica
• Last resort: Arthroscopic excision of plica
Discoid Lateral Meniscus

- Seen in 3%, usually asymptomatic
- Thicker and less blood supply than normal meniscus
- Pain, clicking sensation over lateral aspect of the knee
- Initial treatment: conservative
Discoid Lateral Meniscus

- Thickness and diminished blood supply cause it to be prone to tearing
- Classification based on coverage of lateral tibial plateau surface:
  - complete, incomplete, Wrisberg types (attaches posteriorly to the PCL)
- Surgical options: saucerization (reshaping) vs. total meniscectomy
Slipped Capital Femoral Epiphysis (SCFE)

- Groin or knee pain
- Male predominance
- Peak onset approximately age 11
- High BMI
- 20-50% bilateral
- Classification by mechanical stability
Slipped Capital Femoral Epiphysis (SCFE)

- Early complications include chondrolysis and AVN
- Late: OA and hip disfunction (FAI)
- Immediate ortho referral and NWB status
- Treatment is surgical: in situ screw fixation
Legg-Calvé-Perthes Disease

- Idiopathic and self-limiting AVN of the femoral head
- Male predominance of 5:1
- 1st decade (4-8 age)
- 18-24% bilateral (female)
- Sequence of AVN, resorption, collapse and repair
Legg-Calvé-Perthes Disease

- Presents with painless or painful limp
- PE: Lack of internal rotation and abduction
- Diagnosis: AP and Frog leg lateral x-rays
- Outcome: improves with younger age and early intervention
- Treatment is containment depending on age and severity, rarely surgical
Take Home Messages

• Most things are treated conservatively
• PRO - Children have better capacity to heal (i.e. bone remodeling, easier rehab)
• CON – Children have longer natural history for complications to develop (growth disturbance, osteoarthritis)
• Treat it RIGHT the first time!!!
References