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Orthopedic Sports Injuries/Exam

Progress in Pediatrics
September 24, 2021
Daniel C. Farrell MD, FAAOS
Learning Objectives

Pediatric Sports History and Culture

Overview of Common Overuse Injuries and Case Examples

Other Shoulder, Elbow, Hip, Knee and Ankle Common Injuries

Imaging and When to Refer

Practical PE findings and exam

Exercise Is Medicine

- Decreases risk of DM, HTN, CAD, Colon Cancer and Depression
- Helps Control Weight
- Build Bones
- Boost Immune System
- Meet friends, build memories, teach life skills
"For when the One great Scorer comes to write against your name, He marks not that you won or lost But how you played the Game." (Grantland Rice 1930)

Benefits of Sports Participation and Well Being

Motor Development and Physical Fitness

Diversifying Sports Early avoids Burn Out

Learn and Improve Skill
Build Self-Esteem, Have Fun, Make Friends,
Resiliency, Life Skills, don't always win and learning how to lose and win gracefully

History of Pediatric Sports-Teddy Roosevelt and Luther Halsey Gulick
1903 BB and VB organized at YMCA for Youth and started Public Schools Athletic League

• Roosevelt, Gulick, and PSAL goal was to get kids in school and soldier ready
• Teach kids to work together
• Nation building by raising kids with brawn, spirit, self-confidence, and quickness essential for the existence of a strong nation. (Theodore Roosevelt)
Sports Culture Today

• By age 13, 70% of teens drop out of youth sports
• Since 1970, 40% decrease in unstructured play from age 3-11
• Need for more intermural 'fun' social teams for fitness
• Early sports specialization=year-round one-sport training and 5-6 days/week and >hours/week than age in years (8-year-old training >8 hours)
• "playing" through pain encouraged
• More than one team/sport/season (overscheduling)
• Prior injury can predict future overuse injury

Focus changed from raising strong kids to winning

• 14% of schools have decreased PE due to No Child Left Behind Policy
• Age of competitive sports now as young as age 6, vs. Previously age 12
• 2007 AAP recs to focus sports thru age 9 on enjoyment, not competition, building skills, sportsmanship, safety, now puberty to specialize
• encourage one team sport per season
• 2-3 month off sport specific training, and 1-2 days /week off
• Achievement by Proxy Distortion- inappropriate expectation of parents and coaches vs. individual goal of the athlete
What can we do?

- Two trends: Increased Overuse Injuries and Obesity
- Competitive sports may be harmful under age 9 (France Elite Soccer School has no games, Brazil has no organized sports under age 9)
- Encourage sport variety and not early specialization, now AAP recommends wait until at least 12
- Increased Overuse injuries (year-round athletes with no diversity at risk), identify overcompetitive families and try to focus on the importance of the sport for your patient
- US Sport structured to identify and promote superstars, and not encourage fun and fitness league.
- Underuse (increased obesity) burn out and quit and lose benefits of exercise, when kids get cut often quit sport altogether.
- Obesity trend tripled since 1980. Kids often continue same activity lifestyles as adult and if quit, often stop all exercise leading to increased weight gain.
- Focus on wellness, health benefits, and fitness (outside of PE)

Youth Sports Injury Statistics
(Reference: Pediatric Sports Injuries, Knuth, MD, Pediatrics in Review Symposium, 2019, AAOS)

- Over 2 million High School Athlete Injuries
- Over 500,000 physician visits, 50% injuries overuse in middle and high school students, 20% baseball players ages 8-12 and 45% age 13-14 present with arm pain in youth baseball season
- Over 30,000 hospitalizations, 21% TBI in US sports or recreational activities related
- Over 3.5 million under age 14 seek care for sports related injuries each year, 40% tx in hospitals for age 5-14
Overuse Injury Prevention

- General Fitness Essential for Participation
- Multiple Sports for Fun, vs Early Intense Single Sport
- Shorten duration activity, modify play to ensure safety
- Shift focus away from "winner takes it all" attitude
- Ensure pre-participation physicals
- Proper hydration, adult supervision and officiating and avoid maximum weight with exercise training and smaller reps

Most Common Sports with Injuries

- Basketball 19.5% - ACL, Patellar tendonitis, lateral ankle sprain
- Football 17.1% - head and neck, AC sprain, stingers, burners, Mallet and Jersey finger injuries
- Baseball/Softball 14.9% - Little League Elbow (age 10-15)>200 pitch/week
- Soccer 14.2%, ankle sprain, ACL, mechanism plant and twist, knee effusion, tibial plateau fx
- Rollerblading 5.7% Hockey 4.6 %
- Gymnastics-back injuries, spondylolysis, vertebral stress fx
- According to CDC >50% of sports injuries in children are PREVENTABLE
Sport Specialization and LE Risk Studies

Table 1: Sport Specialization and Lower Extremity Injury Risk Studies[^3][^5][^14][^16]

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Data Collection</th>
<th>Size (n) Patient Population</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalence of sport specialization in high school athletes: A 1-year observational study[^3][^14][^16][^17]</td>
<td>Cross-sectional study, UK 3</td>
<td>Survey</td>
<td>380; high school athletes</td>
<td>High specialization correlated to overuse knee injuries. Playing 1 sport vs. 8 or more is more likely to report knee injuries (OR 2.3), overuse knee injuries (OR 2.5), hip injuries (OR 2.7)</td>
</tr>
<tr>
<td>Specialization patterns across various youth sports and relationship to injury risk[^4][^14][^16][^17]</td>
<td>Case-control study, UK 3</td>
<td>Survey; electronic medical record data collection</td>
<td>1,960; injured and healthy athletes aged 7-18</td>
<td>Individual sport athletes playing single sport more likely to have overuse (OR 1.3) and serious overuse injuries (OR 2.4) than those athletes playing single sport.</td>
</tr>
<tr>
<td>The association of sport specialization and training volume with injury history in youth athletes[^2][^14][^16][^17]</td>
<td>Case-control study, UK 3</td>
<td>Survey</td>
<td>201; youth athletes age 11-18</td>
<td>Athletes with high level of specialization were more likely to have any injury (OR 1.6) and overuse injury (OR 1.4) in past year. Playing &gt;6 h per week vs. &gt;10 LE overuse injury (OR 1.5)</td>
</tr>
<tr>
<td>Sports-specific intensive training and the risk of injury in young athletes: A clinical case-control study[^2][^14][^16][^17]</td>
<td>Case-control study, UK 3</td>
<td>Survey; electronic medical record data collection</td>
<td>1,960; injured and healthy athletes aged 7-18</td>
<td>Injured athletes older, played more hr/wk. Sport specialization independent risk factor for injury (OR 1.7), controlling for age, hr/wk.</td>
</tr>
<tr>
<td>Sport specialization's association with an increased risk of developing anterior knee pain in adolescent female athletes[^2][^14][^16][^17]</td>
<td>Retrospective cohort study, UK 3</td>
<td>Clinical History and Examination, survey</td>
<td>544; female middle and high school basketball, soccer, volleyball players</td>
<td>Single sport specialization increases risk of patellar tendinopathy (RR 1.5-fold) and increased incidence of knee pain.</td>
</tr>
<tr>
<td>A prospective study on the effect of sport specialization on lower extremity injury rates in high school athletes[^2][^14][^16][^17]</td>
<td>Cohort study, UK 3</td>
<td>Survey; prospective cohort data collection</td>
<td>1,444; high school male and female athletes</td>
<td>Increased incidence in lower extremity injuries in high (RR 1.58) and moderately (OR 1.25) specialized athletes than low specialization athletes.</td>
</tr>
</tbody>
</table>

[^HR]: hazard ratio, [^OR]: odds ratio

AMSSM Recommendations (2014)

- Overuse injuries are often underreported
- Prior injury is a predictor of future injury
- Females should be evaluated for menstrual abnormalities
- Parents & coaches should be educated on sports readiness & goals should be set accordingly
- Early specialization may not lead to long-term success
- Sport diversification should be encouraged due to overuse injuries & burnout
Upper Extremity Injury Prevention

- Prevention
  - Preseason strengthening and graded return to throwing program at least 6-8 weeks prior to 1st practice
  - Focus on scapular stabilizing, rotator cuff, hip, trunk, & lower extremity strengthening
  - Address deficits in the off season
  - Rest from overhead throwing at least 3 months out of the year
  - Follow pitch counts & rest days
    - Monitor all teams
  - Proper mechanics
    - Close attention to technique & monitored by coaches
    - No high velocity (>80mph), curve balls or sliders until skeletally mature (~14 years old)
    - Stop if having pain & get evaluated promptly

Overuse Injuries

- Ligaments are functionally stronger than bone and kids are more likely to sustain fractures rather than sprains
- Muscle Overload/Repetitive Micro Trauma
- Strain in muscle tendon insertion
- Unable to withstand further load, stress, collagen cross-links break, and shear forces cause collagen fibril to slide
- Overtraining-more is not better
Case #1
- 14 year old male with L knee pain x 1 year
- Pain is located over anterior knee
- Hurts more with running, jumping, squatting
- Front of knee seems swollen at the area of pain

Sinding Larsen Johanssen (Patellar Apophysitis)
- Cases & Common Presentations
  ◦ Ages 10-13 years old
  ◦ Pain present/worse with running, jumping, climbing, kneeling

- Physical Exam
  ◦ Tenderness over inferior pole of the patella

- Imaging
Case #2
- 10 year old female with anterior knee pain x 2 weeks
- Pain occurs with running, kneeling, climbing
- Pain is located at inferior aspect of patella (superior to tender area in Osgood Schlatter)

Common Sources of Knee Pain
- Patellofemoral Pain
- Medial Collateral Ligament
- Meniscal Injury
- Osgood-Schlatter's Lesion
- Lateral Collateral Ligament
- Fracture of the Patella
- Sinding-Larsen-Johansson
- Fat Pad Impingement
- Patellar Tendinopathy
Apophysitis - repetitive overuse inflammation or stress injury around growth plates where muscle and tendon attach in children and teens.

**Risk Factor:** active, rapid growing kids and teens, with some inflexibility and weakness often seen with athletes who push thru pain

**Symptoms:** pain, swelling and tenderness where muscle tendon attaches. A bump can be seen over knee, heel, elbow, hip and pelvis
- Pain worse with activity and improves with rest
- Pain with activity, and possible limp - key to dx early!

**Diagnosis:** History and Physical Exam, evaluation of strength and flexibility, and x-ray may show open growth plate where there is pain

**Treatment:** ice, pain medications with anti-inflammatories (NSAIDS), reducing activity (gym, free play, or team sports)
- Surgery rarely needed, severe cases may need absolute rest or immobilization
- Once improving need to address stretching and strengthening exercises and rehab prior to return to play
Return to play once no pain with sport specific movement and limp resolved. Refer if injury not improving.

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**Return to Play**

- Ability to return to play at pre-injury level
- "Feeling well does not equal to healed well"
- Swelling and pain usually resolve in days-weeks and is the first step to returning
- If only 70-75% recovered, inviting new injury
- Progression includes pain free full ROM and strength, functional drills, endurance, and agility as well as sports specific skills
Common Shoulder Injuries

- Dislocation vs. Separation
- Apophysitis
- Labrum Bicep complex
- Fracture
- Rotator Cuff Dysfunction

Clavicle Fractures

- Deformity, neurovascular exam, imaging?

Clavicle Fracture

- Mechanism of injury
  - Fall on point of shoulder
  - Fall on outstretched hand
  - Direct force
- Presentation
  - Severe pain
  - Guarding
  - Difficulty carrying affected arm

Orthopedic surgery referral

- Significantly angulated fracture
- Severe tenting of skin
- Neurovascular compromise
- Persistent pain
- Failure to form callus
- Fracture location

Picture courtesy of Royal Children's Hospital Melbourne

Picture courtesy of FRPMED
Evaluation

- Swelling
- Tenderness
- Step-off
- Range of motion
- Scarf test
- Imaging
- Rockwood classification

Acromioclavicular (AC) Sprain

- Mechanism of Injury
  - Blow to top of shoulder
  - Fall on lateral or posterior shoulder

- Presentation
  - Pain on top of shoulder

Refer to Ortho if Grade III or higher
**Rockwood Classification**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Extension of the acromioclavicular ligaments</td>
<td>Orthopedic treatment</td>
</tr>
<tr>
<td>II</td>
<td>Break of the acromioclavicular ligaments</td>
<td>Surgery treatment</td>
</tr>
<tr>
<td>III</td>
<td>Break of the acromioclavicular and coracoclavicular ligaments</td>
<td>Surgery treatment</td>
</tr>
<tr>
<td>IV</td>
<td>Break of the acromioclavicular and coracoclavicular ligaments Acromioclavicular joint dislocation with posterior movement of the clavicle</td>
<td>Surgery treatment</td>
</tr>
<tr>
<td>V</td>
<td>Break of the acromioclavicular and coracoclavicular ligaments Acromioclavicular joint dislocation</td>
<td>Surgery treatment</td>
</tr>
</tbody>
</table>

Table courtesy of Journal of Medicine and Life

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**Management: Shoulder Reduction, Imaging, Sling, and PT Rehabilitation**

- **Grade I:** 2-3 days
- **Grade II:** 1-2 weeks
  - Ice
  - Rehabilitation exercises
  - Range of motion
  - Strengthening

---

**Glenohumeral Dislocation**

- **Mechanism of Injury**
  - Shoulder abducted and forcefully externally rotated and extended
  - Fall on outstretched arm
  - Blow to posterior shoulder

- **Presentation**
  - Severe discomfort
  - Generalized weakness

**Evaluation**

- Gross deformity
- Crepitus?
- Neurologic evaluation
  - Axillary nerve
  - Imaging

- Demonstrate multidirectional instability
  - Load and shift test
  - Impingement tests
  - Kennedy-Hawkins
  - Neer impingement test
Estimates of Shoulder Dislocation by Age

Figure 1: Total weighted estimates of all shoulder dislocations in the United States between 2002 and 2006 from the National Electronic Injury Surveillance System demonstrating the overall distribution by age. (Reproduced with permission from Zacchilli M, Owens BD: Epidemiology of shoulder dislocations presenting to emergency departments in the United States. J Bone Joint Sura Am 2010:92[3]:542-549.)

Labrum Bicep Complex

RISK FACTOR:  
SYMPTOMS:  
DIAGNOSIS:  
TREATMENT:  
WHEN TO REFER:
Management of Skeletally Immature Shoulder Instability

![Image of treatment algorithm for anterior shoulder instability in the skeletally immature patient]

Figure 5

The authors’ recommended treatment algorithm for anterior shoulder instability in the skeletally immature patient.

**Source**

Management of Shoulder Instability in the Skeletally Immature Patient


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**Brachial Plexus Injury ("Burner" or "Stinger")**

- **Mechanism of Injury**
  - Traction most common
  - Compression

- **Presentation**
  - Immediate burning pain down arm
    - Dysesthesia
    - Numbness
    - Weakness

**Evaluation**

- Rule out C-spine injury
- Neurological exam
- Imaging
  - Plain films
  - MRI
- Consider nerve conduction study

**Management**

- Rest
- Observation
- NO physical therapy
Case #3

- 12 year old right hand dominant baseball pitcher has 2 weeks of right shoulder pain
- Hurts when throwing, particularly if trying to throw hard
- Has been icing and taking ibuprofen but pain is still present
- Had pain at the end of last season that went away when the season finished

Centers of Ossification in the Proximal Humerus

Figure 2: Illustration demonstrating the centers of ossification in the proximal humerus. The ossification center of the humeral head is typically identified after age 6 months. The ossification centers of the greater tuberosity and lesser tuberosity are identified by age 7 months to 3 years and by age 2 to 5 years, respectively. Fusion occurs between ages 5 and 7 years to compose the proximal humeral epiphysis. (Adapted with permission from O’Brien SJ, Voos JE, Neviaser AS, Drakos MC: Developmental anatomy of the shoulder and anatomy of the glenohumeral joint, in Rockwood CA, Matsen FA, Wirth MA, Lippitt SB, Fehringer EV, Sperling JW, eds: The Shoulder, ed 4. Philadelphia, PA, Saunders, 2009, pp 1-31.)
Nonsurgical Treatment Outcomes in Skeletally Immature With Open Physes and Anterior Glenohumeral Instability

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients</th>
<th>Other Pathology</th>
<th>Management</th>
<th>Nonoperative Recurrence Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cordsubi et al.</td>
<td>14 (age, 13 y)</td>
<td>8 GT fractures, 3 Hagl</td>
<td>Sling, NWB x 4 wk; No immobilization (8 patients); sling or Velpeau dressing x 6 wk (1 patient), sling or Velpeau dressing x 6 wk (4 patients)</td>
<td>21%</td>
</tr>
<tr>
<td>Marais et al. 46</td>
<td>11 (age, 13 y)</td>
<td>NR</td>
<td>NR</td>
<td>100%</td>
</tr>
<tr>
<td>Postacchini et al. 34</td>
<td>3 (age, 13 y)</td>
<td>NR</td>
<td>NR</td>
<td>53% in 13 y age group; 92% in 14-17 y age group</td>
</tr>
<tr>
<td>Denez et al. 35</td>
<td>15 total (6 aged 13 y)</td>
<td>NR</td>
<td>All patients had 1-6 wk immobilization, 10 had physical therapy after immobilization</td>
<td>52% (0 patients)*</td>
</tr>
<tr>
<td>Wagner and Lyne 37</td>
<td>9 total (6 aged 13 y, 10 total shoulders)</td>
<td>No Hill-Sachs lesions on radiographs</td>
<td>Velpeau immobilizer x 4 wk, sling x 2 wk</td>
<td>67% (4 of 6 patients aged 13 y had recurrence; 8 of 10 shoulders (80%) had recurrence)*</td>
</tr>
<tr>
<td>Lamport et al. 36</td>
<td>12 (age 14 y)</td>
<td>None (patients with concomitant fracture or nerve lesions were excluded)</td>
<td>Immobilization with Gilchrist bandage x 2-3 wk</td>
<td>None</td>
</tr>
</tbody>
</table>

Total: 64 (56 shoulders) | 8 GT fractures, 3 Hagl, none reported in 5 of 7 studies | NA | 49% (31 of 64 patients) overall in the literature

*Three of 13 shoulders tested did not meet the criteria for treatment

Table 1: Nonsurgical Treatment Outcomes in Skeletally Immature Patients With Open Physes and Anterior Glenohumeral Instability

Source: Management of Shoulder Instability in the Skeletally Immature Patient


---

Little League Shoulder (Humeral Epiphysitis)

- Common Presentations
  - Ages 11-16 years old
  - Mechanism of injury: Repetitive torsional stress

- Physical Exam
  - Tenderness over proximal humerus
  - Usually will have positive impingement signs

- Imaging
  - Xray Shoulder (AP, axillary, scapular Y views) may show widening of the proximal humeral epiphysis
Case #4  Year Round, All Star, Travel Team Pitcher with no injury or swelling, with > 200 pitches/week, and worse with throwing, better after day off

- 12 year old right hand dominant baseball catcher with right elbow pain
- 2 months of elbow pain that is getting worse
- Initially was a pitcher but stopped due to pain and now catching but continues to have pain

Little League Elbow (Medial Condyle Apophysitis)

- Common Presentations
  - 8-15 years old
  - Usually no trauma
  - May complain of weak & ineffective throws
  - Most common in pitchers, followed by catchers, 3rd base, SS, outfield
  - Mechanism of injury= repetitive valgus stress on elbow from overhead throwing

- Physical Exam
  - Tenderness over medial epicondyle
  - Pain with resisted wrist flexion & forearm pronation
Little League Elbow

- Imaging
  - Bilateral Elbow x-rays (AP, lateral & oblique views)
  - May see widening of physis

- Treatment
  - Rest, ice, NSAIDs, immobilization (rarely)
  - Physical therapy: ROM, strength (elbow, shoulder, trunk, lower

Elbow Anatomy

Common Injuries:
1. Apophysitis - most UE injuries are due to overuse, rest, activity mod crucial for recovery as well as education to prevent reinjury
2. Sprain
3. Dislocation
4. Osteochondral Defect
5. Fracture
Recommended Pitch Counts

<table>
<thead>
<tr>
<th>Age</th>
<th>Daily Max (Pitches/Game)</th>
<th>0 Days Rest</th>
<th>1 Days Rest</th>
<th>2 Days Rest</th>
<th>3 Days Rest</th>
<th>4 Days Rest</th>
<th>5 Days Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>+8 yr</td>
<td>50</td>
<td>1-20</td>
<td>21-35</td>
<td>36-50</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>9-12 yr</td>
<td>9-10: 75</td>
<td>1-20</td>
<td>21-35</td>
<td>36-50</td>
<td>51-65</td>
<td>66+</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>11-12: 85</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13-14 yr</td>
<td>95</td>
<td>1-20</td>
<td>21-35</td>
<td>36-50</td>
<td>51-65</td>
<td>66+</td>
<td>N/A</td>
</tr>
<tr>
<td>15-18 yr</td>
<td>15-16: 95</td>
<td>1-30</td>
<td>31-45</td>
<td>46-60</td>
<td>15-16: 61-75</td>
<td>15-16: 76+</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>17-18: 105</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19-22 yr</td>
<td>120</td>
<td>1-30</td>
<td>31-45</td>
<td>46-60</td>
<td>61-80</td>
<td>81-105</td>
<td>106+</td>
</tr>
</tbody>
</table>

N/A = not applicable

Elbow Dislocation

- **Mechanism of Injury**
  - Fall on outstretched hand

- **Presentation**
  - Pain
  - Gross deformity

Evaluation

- Neurologic exam
- Vascular exam
- Sensory exam

- Ulnar nerve most commonly affected

Picture courtesy of Christnerr
• Evaluation and Management:

- Evaluation
  - Mild soft tissue swelling
  - Tender to palpation
  - Normal range of motion
  - Valgus stress testing
  - Tinel test
  - Imaging

- Management
  - Reduction
    - May worsen injury
    - Parvin technique
  - Repeat exam
  - Median nerve injury
  - Imaging
  - Splint and Sling
  - Hospitalization

Elbow Fracture

• Risk Factor:

• Symptoms: diffuse swelling, decreased ROM

• Diagnosis: imaging

• Treatment: Splint/Sling

• When to Refer:
  - Supracondylar Fracture
  - Neurovascular compromise
  - Significant Deformity
Case #5

- 15 year old gymnast with right sided low back pain
- Bothers her with bending forward but worsens with backward bending
- Improves with rest

Spondylolysis
(Stress fracture of pars interarticularis)

- Common presentation
  ◦ Athletes with repetitive extension or rotation of spine
    ◦ Gymnasts, dancers, figure skating, football linemen, rowing
  ◦ Risk factors are family history and spina bifida
  ◦ Most common at L5 followed by L4
    ◦ May be seen in higher lumbar vertebrae but much less frequent

- Physical Exam
  ◦ Midline tenderness
  ◦ Pain with lumbar extension
  ◦ Positive stork test
  ◦ Tight hamstrings
Spondylolysis

- Imaging
  ◦ Xrays AP and lateral lumbar spine
  ◦ No obliques
  ◦ MRI/CT lumbar spine
  ◦ Determine what is best at your facility & be sure to talk with radiology

Tx: Brace, PT, Avoid hyperextension and strengthen core and LE flexibility

Bony Prominences of the Hip
Common Hip Injuries

- SCFE (Slipped Capital Femoral Epiphysis)
- Legg Calve Perthes
- Chronic Pelvic Apophysitis
- Avulsion Fracture (14-18 yrs)
- Anteversion
- Snapping Hip

Hip Avulsion-kicking, sprinting, jumping

PE: tender on growth plate, antalgic gait, pain with motion and passive resisted testing, can see bruising/swelling, age 14-18 common

- Muscle attachments and mechanisms of injury
  - ASIS (Sartorius) & AIIS (Rectus femoris)
  - Kicking, coming out of starting blocks
  - Lesser trochanter (iliopsoas)
  - Sprinting, hip flexion
  - Ischial tuberosity (hamstring)
  - Hurdles, splits, high kick
  - Iliac crest (abdominal muscles)
  - Abrupt trunk rotation
  - Change of direction with running

Tx: AP and Frogleg views, Rest and crutches, light isometric stretching, RTP with full strength and no pain with ROM
Lower Extremity

- Chronic-Tibial Stress Fx
- Shin Splints
- Exertional Compartment Syndrome (Rhabdomyolysis)

Common Knee Injuries

- Anterior Cruciate Injury
- Meniscus Injury vs. Discoid
- Osteochondral defect
- Fracture
- Apophysitis
Chronic Adolescent Anterior Knee Pain (AAKP)

- Caused by imbalance of quads and hamstrings
- Poor flexibility, alignment, improper sports training techniques or equipment and overuse

- Symptoms: crackling, popping ascending stairs, standing, or walking after prolonged sitting
- NO clicking, locking, snapping, or giving way of the knee
- Treatment: RICE, bracing, stretching/strengthening PT

Chronic Apophysitis vs. Osteochondritis Dissecans

Osgood Schlatter, SLJ

Osteochondritis Dissecans

- Chronic- Osteochondritis Dissecans
  - Lesion size, location, and grade determine management
  - Early stable lesions managed with rest
  - Surgery should be considered for unstable lesions
Case #6

- 16 year old male soccer player was kicking a soccer ball
- Felt and heard a pop from his hip
- Fell to the ground and had difficulty bearing weight
- Has bruising and swelling of his hip
- Tenderness on palpation of anterior hip
- Decreased strength & flexibility

ACL Lachman Test:

*Figure 2*: Clinical photographs demonstrating hand positioning for the left knee (A) and the right knee (B) during the Lachman test. During the test, one hand stabilizes the femur laterally while the other hand, which is placed medially, translates the tibia.
Positive Lachman Test

Figure 3: Clinical photographs demonstrating a positive Lachman examination before (A) and after (B) application of anterior translation.

ACL-Acute injury with pop, or associated effusion warrants x-ray +/- MRI evaluation

- Other Knee Injuries:
  - Acute-Patella Femoral Dislocation, Acute Distal Femur, Tibial Spine, and Tibial Tubercle Fx
ACL and Meniscus evaluation

A. Clinical photograph showing the lateral McMurray circumduction examination. With the patient’s knee fully flexed, the tibia is internally rotated (white arrow), engaging the posterior horn of the lateral meniscus under the lateral femoral condyle. The knee is then extended (black arrow), entrapping the meniscus. B. Clinical photograph showing the medial McMurray circumduction examination. With the patient’s knee fully flexed, the tibia is externally rotated (white arrow), engaging the posterior horn of the medial meniscus under the medial femoral condyle. The knee is then extended (black arrow), entrapping the meniscus.

Foot and Ankle

• Acute Sprains

Sever’s Disease (Calcaneal Apophysitis)

- Cases & Common Presentations
  - Ages 8-15
  - Can be unilateral or bilateral
  - Usually occurs after physical activity but as worsens will occur during physical activity and at rest
  - May cause limping
  - Most common in running and high impact activities
  - Worse with cleats, flat feet
  - Pain at insertion of Achilles tendon and plantar fascia
Ankle Injuries

- **Anterior** - Cartilage injury, osteochondritis dissecans (OCD) of Talus, anterior/dorsal foot-midfoot sprain (navicular or Lisfranc)
- **Lateral** - Anterolateral ankle sprain, peroneal tendonitis, Iselin's syndrome, 5th metatarsal fx, tendonitis, distal fibula Salter Harris fx, Lateral Ankle fx,
- **Medial** - Deltoid sprain, posterior tibial tendonitis, accessory navicular, medial malleolus fx
- **Posterior** - Achille's tendonitis, Sever's dz pain on calcaneus

Ankle Exam and Injuries - ligaments attach to epiphysis and are stronger than physis (growth plate) so growth plate fails first

- Sprain
- Apophysitis
- Osteochondral Injury
- Achilles Injury
- Fracture
When to image?

Controversy:
- Ottawa ankle rules 100% sensitive and 40% specific in ADULTS >18.
- Should/cannot be applied to children
- Boutis, et. al (2013) Low Risk Ankle Rule
  - If a child has a low risk exam – tenderness and isolated to the distal fibula and/or adjacent lateral ligaments distal to the anterior tibial joint line x-rays are not needed
  - Boutis, et al. included (low risk) lateral ankle sprains, SHI/II of distal fib, distal fib and lateral talus avulsion fx

Supination / External Rotation
- Anterior tibiofibular sprain
- Lateral short oblique fibular fracture
- Posterior tibiofibular rupture and/or avulsion of posterior malleolus
- Medial malleolar fracture or deltoid ligament disruption

Fractures
- Distal Tibial and Fibular Fx-40% all injuries in skeletally immature, 2nd most common (growth plate) injury and risk of growth arrest
- No obvious fracture on X-rays Sometimes widening
- Focal tenderness to palpation at distal Fibula physis (growth plate)
- Localized soft tissue swelling (+/-)

Salter Harris Fracture

Tachdjian’s Pediatric Orthopedics
Salter Harris 1 Fracture of Distal Fibula-most common

- Cases & Common Presentations
  - Usually inversion ankle injury
  - Swelling
  - May have pain with weightbearing
  - Ankle injury in skeletally immature patient
    - Most occur ages 8-15 years old
    - Physis is the weakest link
  - Often missed and treated as ankle sprain
- Physical Exam
  - Tenderness on palpation of distal fibular physis (1cm above distal tip of the fibula)
  - Tall walking boot & weightbearing as tolerated (use crutches if still has pain while in the boot)
  - Repeat exam in 3-4 weeks
  - Refer displaced fractures to ortho

Other Ankle Fractures

- Maisonneuve-type fracture
- Tillaux

- Pearl
  - If a child is tender over her physis, but x-ray appears negative for fracture, splint and have child follow-up with sports medicine physician or orthopedist.
Ankle Fractures

- A/P, Lateral, and mortise views of ankle
- Try to get patient at neutral positioning of ankle (90 deg)
- Prefer weight bearing if possible

Physical Exam Findings:

- Observe
- Inform how you will examine, start with non-injured extremity with active and passive motion
- Skills tests

Mechanism:
- Twisting Injury
- Eversion

Radiographs:
- AP: SH III
- Lateral: SH IV
- Fibula Fx ≈ 50%
Physical Exam Skills

- Presentation, my______hurts, injury, worse with activity
- Be systematic
- Observe
- Palpate, point tenderness, can reproduce pain functionally
- Check gait symmetry, foot progression, limp, atrophy
- If painful be suspicious for fx and obtain imaging, immobilize and refer

References:


6. Anderson SJ and Harris SS, eds. Care of the Young Athlete, 2nd ed. Elk Grove Village, IL: American Academy of Pediatrics;2010
