More Than Just Just Growing Pains?
Common Pediatric and Adolescent Overuse Injuries and Management Strategies

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Objectives

• Understand the effects of growth and development on injuries and rehabilitation in the young athlete

• Understand the pathophysiology and mechanism of common acute and overuse injuries in the young athlete

• Understand conservative treatment strategies for common injuries of the young athlete and when to refer for specialty management
Epidemiology

- 27 million children age 6 to 18 participate in team sports in the US
- 60 million participate in some form of sport
- 44 million participate in more than 1 sport

- Almost 50% of all injuries sustained in sport are overuse injuries
- Overuse injuries likely underestimated due to poor data collection
  - Overuse injuries are epidemic secondary to adult training regimens
    - Early sport specialization
Pediatric and Adolescent Overuse Injuries

• Need to understand the population
• Not just “little adults”
  • Factors that influence growth development and injury
    • Skeletal Maturity
  • Physiology
  • Strength
  • Psychological Maturity

• Knowing stage of development can help to narrow down differentials
Growth and Development in the Young Athlete

• Middle Childhood (6-9 years)
  • Maturation of throwing and kicking patterns
  • Entry level sports (soccer, baseball, softball)
  • Coed sports
    • Males and females can still compete with parity
    • Males slightly stronger
    • Females better balance
    • Running gait and speed are equal
Growth and Development in the Young Athlete

- Late Childhood to Early Adolescence (10-15yrs)
  - Onset of Puberty
  - “Growth Spurt”
  - Tanner Stage 3

- Differences emerge among the sexes
  - Anatomical changes
    - Peak height velocity for males 14 yrs vs. females 12 yrs
    - Skeletal maturity for males 16 yrs vs. females 14 yrs
  - Performance and sports abilities

- Skill acquisition and development are easiest in this stage
Early Adolescence

• Significance of puberty and peak height velocity
  • The Growth spurt
    • Bone growth can exceed soft tissue accommodation
      • Hamstrings
      • Hip flexors
      • Quads
      • Gastrocs
        • Decreased flexibility of muscles can impact growth centers
    • Decreased Coordination
Growth and Development in the Young Athlete

• Late Adolescence and Adulthood (16-20 years)
  • Increases in strength and size more gradual
  • “Late Bloomers” may continue to have late childhood issues/pathology
  • Eventual skeletal maturity
Overuse Injuries

- Repeated mechanical loading exceeds the remodeling capability of the structure under stress
- Cumulative trauma that alters tissue structure in the absence of inflammation
- Imbalance between loading and recovery over time
  - Two main mechanisms
  - Moderate intensity loading over extended periods when recovery time is not sufficient
  - Repeated high-intensity, short-duration loading even when recovery is planned and provided
Concerning Signs and Symptoms

- Post exercise pain that remains > 24 hours after exercise
- Joint effusion
- Localizable pain
- Disruption of ADLs or sleep due to pain
- Need for NSAIDs
Risk Factors for Overuse Injuries

• Growth is ultimate risk factor
• Children’s bony growth centers are weak and break down more frequently than ligaments or tendons
• School age athletes push to adapt to sports at the same time their bodies are stressed due to rapid growth
• Cartilage is at increased susceptibility to repetitive microtrauma
• Muscle-tendon imbalance during period of growth (bone grows faster than tendon)
Intrinsic and Extrinsic Factors

- Other Intrinsic Factors
  - Previous injury
  - Previous level of conditioning
  - Anatomic factors
  - Menstrual dysfunction
  - Psychologic and developmental factors – athlete specific

- Extrinsic Factors
  - Training progression
  - Equipment/footwear
  - Sport technique
  - Psychologic factors – adult and peer influences
Risk factors for injury (distant from outcome) - Injury mechanisms (proximal to outcome)

Internal risk factors:
- Age (maturation, aging)
- Gender
- Body composition (e.g., body weight, fat mass, BMD, anthropometry)
- Health (e.g., history of previous injury, joint instability)
- Physical fitness (e.g., muscle strength/power, maximal $O_2$ uptake, joint ROM)
- Anatomy (e.g., alignment, intercondylar notch width)
- Skill level (e.g., sport, specific technique, postural stability)

Predisposed athlete → Susceptible athlete → INJURY

Exposure to external risk factors:
- Human factors (e.g., teammates, opponents, referee)
- Protective equipment (e.g., helmet, shin guards)
- Sports equipment (e.g., skis)
- Environment (e.g., weather, snow and ice conditions, floor and turf type, maintenance)

Inciting event:
- Joint motion (e.g., kinematics, joint forces and moments)
- Playing situation (e.g., skill performed)
- Training programme
- Match schedule
Other Risk Factors

• Early Sport Specialization
  • Year long single sport play
  • School leagues, club leagues, travel leagues
  • Performance schools and private coaches
• Unrealistic parental expectations
• Old school thought process to play through pain as necessary
  • “No pain no gain”
Common Overuse Injuries

• Shoulder
  • Little leaguers shoulder
• Wrist
  • Distal Radius Stress Syndrome
• Elbow
  • Little leaguer’s elbow
  • Panner’s disease
• Hip
  • Iliac crest, ASIS, AIIS, Greater trochanter, Lesser trochanter, ischial tuberosity
• Knee
  • Osgood Schlatter Disease
  • Siding Larsen Johannsen Disease
  • Osteochondritis Desiccans
• Ankles
  • Severs disease, islein disease
  • Kohlers disease, Frieberg disease
WRIST
Distal Radial Stress Syndrome

• Chronic overloading of the distal radial physis
  • When wrist used as weight bearing joint
• Occurs most commonly in gymnasts
  • “Gymnast’s Wrist”
  • Estimates as much as 25% of non-elite gymnasts
    • Also in tumblers and cheerleaders
• Complications: early closure of radial physis resulting in long ulna = positive ulnar variance
Distal Radial Stress Syndrome

• History
  • Insidious onset of radial sided wrist pain
  • Chronic mild swelling
  • Decreased ROM in extension

• Exam
  • Mild radiocarpal synovitis and soft tissue swelling
  • Decreased active and passive ROM
  • Tenderness of distal radius

• XRAYS – sclerosis and widening of the distal radial growth plate with ill defined border
Distal Radial Stress Syndrome

- Management
  - Rest
  - Immobilization
    - Usually requires prolonged rest from activity (8-12) months
  - PT for forearm, shoulder, core
  - Operative management with physeal closures
    - Resection of physeal bridge
ELBOW
Little leaguer’s Elbow

- Global term to describe injuries to the medial side of the elbow
- Most common overuse injury in throwers
  - Epicondyle apophysitis, epicondyle avulsion fractures, and ulnar collateral ligament injuries
  - High valgus torque of throwing generates tensile and shearing stresses at the medial elbow
  - Cartilage is vulnerable to the repetitive microtrauma of throwing
    - Occurs in 8 to 15 yos
Little Leaguer’s Elbow

• Risk Factors
  • > 80 pitches per game
  • More than 8 months of competitive pitching per year
  • Fastball speed > 85mph
  • Continued pitching despite arm fatigue/pain
  • Participating in pitching showcases
Little Leaguer’s Elbow

- **History**
  - Elbow pain in throwing arm
  - Decreased throwing velocity, accuracy, distance

- **Physical**
  - Medial elbow tenderness
  - Pain with valgus stress
  - Instability with valgus stress

- **XRAYS** – physeal widening, avulsion or fragmentation of the medial epicondyle
Little Leaguer’s Elbow
Little Leaguer’s Elbow

• Management
  • Rest from pitching
  • Activity modification
  • PT for shoulder ROM, shoulder girdle strengthening, core strengthening

• Surgical Repair
  • ORIF for medial epicondyle avulsions
  • UCL reconstruction
Little Leaguer’s Elbow

- Prevention - Pitch Count Limits
  - **13-16** – 95 pitches per day
  - **11-12** – 85 pitches per day
  - **9-10** – 75 pitches per day
  - **7-8** – 50 pitches per day

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<th>Age 7-16</th>
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<th>Required # of Days</th>
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<td>76+</td>
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<td>1-20</td>
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<td>0 calendar days</td>
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Source: Little League Baseball, [www.littleleague.org](http://www.littleleague.org)
HIP
Iliac Crest Apophysitis

- Fusion to the crest occurs at an average age of 16 in boys and 14 in girls, with ossification beginning laterally and anteriorly and advancing posteriorly
  - it more commonly affects the anterior crest
  - Frequently seen in long-distance runners and gymnasts
  - Also been reported in wrestlers, dancers, lacrosse players, and football players.
A. Anterior Pelvic View

B. Posterior Pelvic View
Iliac Crest Apophysitis

• **History**
  - 2 to 8 weeks of gradual activity-related pain.
  - Pain with coughing or sneezing, due to muscle traction at the apophysis.

• **Exam**
  - Tenderness over the iliac crest
  - Tightness in the iliotibial band, hip flexor, or rectus femoris.
  - With the patient lying on the unaffected side, resisted hip abduction will produce pain at the iliac crest.

• **XRAYS** - may show widening of the affected portion of the iliac apophysis or discontinuity between the anterior one third of the apophysis and the posterior two thirds
Iliac Crest Apophysitis Management

• Restricted weightbearing
• limited activities
• Rest for 3-4 weeks
  • Complete relief of symptoms can result with just activity modification and rest
• Local cortisone injections shown to have no benefit
• When pain-free, the patient can start a lateral abdominal and hip abductor stretching and strengthening rehabilitation program
• If sprinting or running is allowed too early, there is a risk of anterosuperior iliac spine avulsion, which may require repair
Ischial Apophysis

- The apophysis appears between the ages of 13 and 15 and fuses to the pelvis between 16 and 25.
- Eccentric contractions of the hamstrings with the hip flexed and the knee extended can result in apophysitis or avulsion fractures.
- Avulsion fractures of the ischial tuberosity are the most common site of pelvic avulsions in athletes.
  - Soccer and female gymnasts at highest risk.
Ischial Apophyseal Injuries

- **History**
  - Audible “POP” is often heard during an acute injury
    - Athletes hold their hip in an extended position, allowing minimal hamstrings tension

- **Exam**
  - Ecchymosis, swelling, tenderness, and a palpable lump at the ischium are often present

- **XRAYS** - will show a displaced ischial tuberosity

- **Management**
  - Little data regarding treatment decisions between an operative and nonoperative approach for ischial avulsions
  - Surgical treatment may be needed if the displacement is greater than 1 cm or if a painful fibrous nonunion occurs
KNEE
Osgood Schlatter Disease

- Tibial Tubercle Apophysitis
  - Seen in running and jumping athletes during periods of rapid growth
- Most common overuse injury seen in young athletes
  - Boys 10 -15
  - Girls 8-12
  - It is bilateral in 25-50% of patients
Osgood Schlatter’s Disease

- Clinical Features
  - History
    - Young athlete complains of pain/painful enlargement of the tibial tuberosity
    - Pain worse with activity, especially run/jump
  - Exam
    - Tender tibial tuberosity
    - Tight quads +/- hamstrings
      - may be related to lower limb malalignments: pronated feet, genu valgum, patella alta, and torsional abnormalities
Osgood Schlatter’s Disease

- Use of Imaging
  - Use in severe or persistent cases to rule out other problems
  - Not used to make the diagnosis in most cases
  - May show fragmentation of the anterior tibial tuberosity
Osgood Schlatter's Disease

• Treatment
  • Relative Rest
  • Cross training that is non-painful
  • Ice
  • NSAIDs
  • Cho-pat strapping
  • Hamstring/quad stretching/strengthening
  • Padding to prevent pressure on the tibial tuberosity are also useful
    • Spontaneously resolves once the physis closes
    • In rare cases, surgical excision of the bone fragment or free cartilaginous in skeletally mature patients who remain symptomatic despite conservative measures.
Sinding-Larsen-Johansson Disease

- Repetitive traction injury at Inferior pole of the patella
  - Lower pole of the patella still partly cartilaginous in adolescents
- Seen in adolescents between ages 10 and 14
Sinding-Larsen-Johansson Disease

- History
  - Insidious onset of pain at the inferior patella

- Exam
  - Tenderness of inferior patella
  - Swelling
  - Pain with knee extension
  - Decreased flexibility of quads, gastrocs, hamstrings

- XRAYs- usually normal, may show spurring or fragmentation at inferior pole of patella
Sinding-Larsen-Johansson Disease

• Management
  • Rest
  • Activity modification
  • Brief immobilization
  • Physical therapy
FOOT
Islein’s Disease

• Apophysitis of the 5th metatarsal
  • Usually seen in girls age 10 and boys age 12, fuses in 2 years
  • Peroneus brevis and peroneus tertius insert proximally on the fifth metatarsal
• Caused by repetitive microtrauma
  • the pull of the peroneus brevis on the weak apophyseal cartilage causes traction apophysitis during rapid growth in adolescents.
• Macrotrauma
  • Inversion injuries to the foot
Islein’s

- History
  - Lateral midfoot pain during weightbearing
    - running, jumping, cutting, and inversion bothersome
    - Pressure on the 5th metatarsal tuberosity from shoe bothersome

- Exam
  - Tenderness at the proximal fifth metatarsal insertion of the peroneus brevis tendon
  - Soft tissue edema, hyperkeratosis, or mild erythema
  - Resisted eversion and extreme plantarflexion and dorsiflexion elicit pain

- XRAYS - best seen with an oblique view
  - small fleck of bone, slightly oblique to the long axis of the metatarsal shaft along the plantar-lateral aspect of the tuberosity.
  - Enlargement of the apophysis, fragmentation, or widening of the chondro-osseous junction may also be seen
Islein’s Treatment

- Symptoms generally resolve when fusion of the apophysis to the metaphysis occurs
- Activity modification
- Weight bearing as tolerated with/without crutches
- Nonsteroidal anti-inflammatories
- Stretching and strengthening exercises
- Immobilization
  - Short leg cast or boot for 2-4 weeks
    - Complications rare, children usually self limit
      - One case in literature of nonunion of apophysis
        - Treated with surgical excision of the fragment
Sever’s Disease

- Apophysitis of the os calcis
  - appears radiographically at 4 to 7 years in girls and 4 to 10 in boys
  - fuses at an average age of 16 years
    - Male athletes are affected more often (75%)
    - 61% of cases are bilateral
Sever’s Disease

- **History**
  - Heel pain associated with athletic activity

- **Exam**
  - Posterior calcaneal tenderness with mediolateral compression anterior to the Achilles tendon insertion
  - Ankle dorsiflexion may aggravate the pain
  - Decreased heel cord flexibility
  - Forefoot pronation with gait

- **XRAYS** - apophysis may appear thickened and fragmented reflective of the mechanical demands
  - Growth disturbances and bone density changes are not typical
Sever’s Management

- Activity modification- discontinuation of running sports
- Gastrocnemius-soleus stretching, dorsiflexion strengthening
- heel cups, soft orthotics, heel wedges, or a rubber heel lift
  - Stretching exercises and orthotics may be slow to resolve symptoms because young athletes are often noncompliant
- Immobilization in a short leg cast or boot quickest generally in about 2-4 weeks
Prevention

• Limiting weekly and yearly participation time, sport-specific repetitive movements (eg, pitching limits), and scheduled rest periods are recommended.
• Careful monitoring of training workload during the adolescent growth spurt is recommended, as injury risk seems to be greater during this phase.
• Preseason conditioning programs can reduce injury rates in young athletes.
• To reduce the likelihood of burnout, an emphasis should be placed on skill development more than competition and winning.
Take Away Points

• Screen for early sport specialization and overtraining during your well child checks and sport physicals
  • Identify children at risk
  • Educate parents
• Know the common overuse injuries that affect different age groups
• Work up kids complaining of pain and prescribe rest from their sport
References