Overuse Injuries in the Throwing Athlete

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Assistant Professor of Adolescent and Sports Medicine
Disclosure

Neither I, Jonathan Santana DO, nor any of my family members have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition with the presentation.
Biomechanics of Throwing
Baseball in the Age of Specialization

- UCL reconstruction has doubled in high school baseball players
- 25-38% of all youth pitchers will develop either elbow or shoulder pain during a baseball season
- 9-14 yo have a 5% incidence of serious injury requiring surgery or retirement from baseball

5.7 million children under the age of 13 participate in organized youth baseball
Intrinsic Risk Factors

• Bone plasticity
• Ligament laxity
• Open epiphyseal growth plates
• Underdeveloped musculature
Extrinsic Risk Factors

• Pitching when fatigued
  – Throwing too many pitches > innings
• Not enough rest from throwing at end season
• Pitching then catching in the same game
• Playing on multiple teams & leagues
• Climate
• Pitch type
Pitching with Arm Fatigue

- Average > 80 pitches = 4x risk of surgery
- Pitch competitively > 8 months/year = 5x likelihood of injury

Pitching regularly with fatigued arm likely to have an injury and potentially need surgery! 36x

Olsen SJ, et al. AJSM. 2006
Does Geographic Location Matter on the Prevalence of Ulnar Collateral Ligament Reconstruction in Collegiate Baseball Pitchers?

Jason L. Zaremski, MD, CAQSM, MaryBeth Horodyski, EdD, ATC, LAT, FNATA, Robert M. Donlan, DO, CAQSM, Sonya Tang Brisbane, BS, MPH, and Kevin W. Farmer, MD
Investigation performed at Orthopaedics & Sports Medicine Institute, University of Florida, Gainesville, Florida, USA

<table>
<thead>
<tr>
<th></th>
<th>SEC</th>
<th>Big Ten</th>
<th>Total Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3002</td>
<td>2313</td>
<td>5315</td>
</tr>
<tr>
<td>Pitcher Years</td>
<td>1457</td>
<td>1118</td>
<td>2575</td>
</tr>
</tbody>
</table>

**Northern HS Pitchers**
- 178 (12.2%)
- 975 (87.2%)
Total: 1153

**Southern HS Pitchers**
- 1279 (97.8%)
- 143 (12.8%)
Total: 1422

NOTE: 12 SEC Schools and 10 Big Ten Schools

**Table 3: Injury Risk by Conference**

<table>
<thead>
<tr>
<th></th>
<th>SEC</th>
<th>Big Ten</th>
<th>Total Years</th>
<th>Risk Difference</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.9/1000 player-years</td>
<td>13.3/1000 player-years</td>
<td>7.8/1000 player-years</td>
<td>5.5%</td>
<td>1.71</td>
<td></td>
</tr>
</tbody>
</table>

\[ x^2 = 1.45, p = 0.23 \]

**Table 4: Injury Risk based upon Location High School Play**

<table>
<thead>
<tr>
<th></th>
<th>Southern State</th>
<th>Northern State</th>
<th>Risk Difference</th>
<th>Risk Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5/1000 player-years</td>
<td>25.3/1000 player-years</td>
<td>19.1/1000 player-years</td>
<td>6.2%</td>
<td>1.32</td>
</tr>
</tbody>
</table>

\[ x^2 = 0.89, p = 0.35 \]
Shoulder Injuries
Little League Shoulder

- Proximal humeral epiphysitis
- Occurs most commonly between 12 and 15 years old
  - During rapid growth spurt
- History suggest recent increase in throwing regimen
- Physical:
  - Tenderness to palpation over physis
    - Lateral aspect
  - Weakness in abduction and IR
- Imaging:
  - X-rays: Normal early in process
    - May show physeal widening, metaphyseal sclerosis
    - Should obtain comparison views
Little League Shoulder

Treatment

• Rest from throwing 2-3 months
• Progressive throwing program
• Formal physical therapy
Multidirectional Instability

- Atraumatic glenohumeral instability in two or more directions
  - Due to weakness of the joint capsule and rotator cuff muscles

History
- Anterolateral shoulder pain with throwing
- May complain of popping or catching

Exam
- Anterior and posterior drawer
- Load and shift test
- Positive sulcus sign
  - Strong indicator
Multidirectional Instability

- Imaging
  - X-ray:
    - Normal majority of time
    - Rule out proximal humeral physeal fracture

- Treatment
  - No throwing for 4-6 weeks
  - Physical therapy
    - Rotator cuff and scapulothoracic strengthening
  - Surgical
    - No improvement in 6 months with normal compliance
    - Return to throwing 4-6 months
Internal Impingement of Shoulder

The rotator cuff tendon and posterior superior labrum are pinched between the greater tuberosity of the humeral head in the posterior superior glenoid rim
• Leads to rotator cuff tendinosis or possible labral tear

History and Exam
• Insidious pain
• Posterior superior shoulder pain with external rotation and abduction
  – Posterior lateral portion of the acromion
• Decreased strength or pain with forward flexion of the shoulder
  – Improved with scapular retraction relocation
Internal Impingement of Shoulder

Treatment

- Non surgical
- Rest from throwing until patient can throw with no pain
  - ~2-4 weeks

- Physical therapy
  - GIRD, rotator cuff and scapular strengthening
Scapular Dyskinesia

- Alteration or deviation in the normal resting or active position of the scapula during shoulder movement

- History
  - Pain/tenderness around the scapula
  - Snapping or popping sensation
  - Loss of strength with shoulder and arm use

- Exam
  - Asymmetrical posture (effected side usually sits lower)
  - Winging of the scapula with range of motion
  - Instability of the shoulder

- Treatment
  - Physical therapy
Labral Tear

Superior Labrum from Anterior to Posterior tears

Mechanisms
• Due to tightness of the posterior glenoid ligaments which shifts the glenohumeral contact point posterosuperiorly and increases the shear force on the superior labrum
• Increases the strain on the anterior band of the IGHL and thus compromises stability of shoulder

History
• Vague deep shoulder pain
• Mechanical symptoms of popping and clicking
• Weakness, easy fatigue, and decrease athletic performance
Labral Tear

Exam
• O’Brien’s test
• Biceps Load II
• Dynamic labral shear test

Radiology
• X-ray: Normal
• MRI Arthrogram

Treatment
• Non Operative: Rest, PT, NSAIDS
• Operative: High level throwers
  – 86% full recovery and RTP
Elbow Injuries
Little League Elbow

- Medial epicondyle apophysitis seen in mostly 9-12 yo
- Caused by traction of the flexor pronator musculature at the apophyseal insertion
- Valgus overload or overstretch injury
- Medial epicondyle is the last elbow physis to close at 14-17 yo

**History:**
- Pain on the medial side of the elbow when throwing (in late cocking and acceleration phase)
Little League Elbow

Physical
• Tenderness over the medial epicondyle
• Difficulty fully extending the elbow
• No valgus instability

Imaging
• X-rays: Mostly negative
  – May demonstrate widening or fragmentation of the medial epicondyle
Little League Elbow

Treatment

• Rest (4-6 weeks)
• Apply ice to help with swelling
• Physical therapy to strengthen the core and lower extremities
• Refine throwing technique
• Return to throw program
Medial Epicondyle Avulsion Fracture

- Similar presentation to medial epicondylitis but seen in older athletes
- Usually there is an acute event
- Treatment is usually immobilization for 4 weeks
- Surgical indications
  - >5mm displacement
  - Ulnar nerve involvement
  - Open fracture

- Return to play
  - Non operative: 10-12 weeks
  - Operative: 7-8 months
Lateral Elbow Pain

Panner’s Disease
- Lateral elbow pain in throwers younger than 10 years old
- Benign and self limiting

Osteochondritis Dissecans
- Compression of the capitellum
- Adolescent: 12-17yo
- Physical:
  - Radiocapitellar compression test
  - Mechanical symptoms
    - Locking
    - Catching
    - Decrease range of motion
Lateral Elbow Pain

Treatment

• Panner’s Disease and early OCD
  – Rest (~6 months)
  – Activity modification and physical therapy

• OCD lesions
  – Surgical
    • Drilling
    • Debridement
    • Transplantation
Olecranon Stress Fracture

Rare elbow injury

Location
• Predominantly involves the epiphyseal plate

Mechanism of injury
– Olecranon posteriomedial impingement
– Triceps traction force
– Valgus extension overload

Physical exam
• Mild swelling over olecranon
• Localized tenderness
• Pain with resisted elbow extension
• Pain with deceleration motion of throwing
Olecranon Stress Fracture

Imaging
• X-ray: Mostly normal
  – Physeal widening, delayed fusion or fragmentation
• MRI

Treatment
• Rest
• No throwing for 6-8 weeks
• Gradual return to throwing
Ulnar Collateral Ligament Injury

- Usually see in adolescents
- UCL is main stabilizer from valgus stress in elbow
- History
  - Presents with medial elbow pain
  - Acute injury but may have arm fatigue prior to event
- Physical
  - Valgus stress at 0 and 30 degrees
    • Laxity and pain
- Imaging
  - MRI arthrogram
  - Dynamic US
Ulnar Collateral Ligament Injury

Treatment

• Sprain:
  – Nonsurgical
  – PRP
  – Strength training of arm flexors and scapulothoracic muscles

• Tear:
  – Surgical: repair or reconstruction (Tommy John Surgery)
  – Return to throwing:
    • Repair: 6 months
    • Reconstruction: 14-18 months
Injury Prevention
## Pitch Limit and Rest Period

### Rest Chart

**High School Pitch Count (Grades 9 through 12):**

<table>
<thead>
<tr>
<th>Pitch Count</th>
<th>Rest Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30 pitches</td>
<td>0 days rest</td>
</tr>
<tr>
<td>31-45 pitches</td>
<td>1 day rest</td>
</tr>
<tr>
<td>46-65 pitches</td>
<td>2 days rest</td>
</tr>
<tr>
<td>66-85 pitches</td>
<td>3 days rest</td>
</tr>
<tr>
<td>86-110 pitches</td>
<td>4 days rest</td>
</tr>
</tbody>
</table>

**Junior High Pitch Count (Grades 7 and 8):**

<table>
<thead>
<tr>
<th>Pitch Count</th>
<th>Rest Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-20 pitches</td>
<td>0 days rest</td>
</tr>
<tr>
<td>21-35 pitches</td>
<td>1 day rest</td>
</tr>
<tr>
<td>36-50 pitches</td>
<td>2 days rest</td>
</tr>
<tr>
<td>51-65 pitches</td>
<td>3 days rest</td>
</tr>
<tr>
<td>66-85 pitches</td>
<td>4 days rest</td>
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</tbody>
</table>
## MLB and USA Baseball Recommendations

<table>
<thead>
<tr>
<th>AGE</th>
<th>DAILY MAX (PITCHES IN GAME)</th>
<th>REQUIRED REST (PITCHES)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 Days</td>
</tr>
<tr>
<td>7-8</td>
<td>50</td>
<td>1-20</td>
</tr>
<tr>
<td>9-10</td>
<td>75</td>
<td>1-20</td>
</tr>
<tr>
<td>11-12</td>
<td>85</td>
<td>1-20</td>
</tr>
<tr>
<td>13-14</td>
<td>95</td>
<td>1-20</td>
</tr>
<tr>
<td>15-16</td>
<td>95</td>
<td>1-30</td>
</tr>
<tr>
<td>17-18</td>
<td>105</td>
<td>1-30</td>
</tr>
<tr>
<td>19-22</td>
<td>120</td>
<td>1-30</td>
</tr>
</tbody>
</table>
## Age Recommended for Various Pitches

<table>
<thead>
<tr>
<th>Pitch Type</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastball</td>
<td>8 ± 2</td>
</tr>
<tr>
<td>Changeup</td>
<td>10 ± 2</td>
</tr>
<tr>
<td>Curveball</td>
<td>14 ± 2</td>
</tr>
<tr>
<td>Knuckleball</td>
<td>15 ± 3</td>
</tr>
<tr>
<td>Slider</td>
<td>16 ± 2</td>
</tr>
<tr>
<td>Forkball</td>
<td>16 ± 2</td>
</tr>
<tr>
<td>Screwball</td>
<td>17 ± 2</td>
</tr>
</tbody>
</table>

Recommended Injury Prevention Guidelines

• Watch and respond to signs of fatigue
• No overhead throwing of any kind for at least 2-3 months/year (4 months is preferred)
• No competitive baseball pitching for at least 4 months/year
• Follow guidelines for pitch count limits and rest days
• Avoid pitching on multiple teams
• Avoid pitching and catching in same game
• Avoid using radar guns
“I’ve been given an opportunity as the only one right now to be inducted into the Hall of Fame with Tommy John Surgery. It’s an epidemic..... I want to encourage the families and parents that are out there that this is not normal to have a surgery at 14 and 15 years old....baseball is not a year-round sport... they’re competing and maxing out too hard, too early, and that’s why we’re having these problems. Please, take care of those great future arms.”

–John Smoltz, Hall of Fame Pitcher 2015
Thank You
 References


