Pitching Flaws & UCL Injuries

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Team Physician, Chicago White Sox and Bulls

What is the UCL?

Primary restraint to valgus force at 30°-120°

3 Bundles
- Anterior Bundle
- Anti/Post Bands
- Posterior Bundle
- Transverse Bundle

Hypertrophy in MLB Pitchers

I (and/or my co-authors) have something to disclose.

Detailed disclosure information is available via:

- The course syllabus, or
- AAOS Disclosure Program on the AAOS website at http://www.aaos.org/disclosure
Pitching Flaws and UCL Injuries

Pitch Cycle

Anterior Bundle

15° Elbow Flexion

100° Elbow Flexion
Scope of the Problem

PearlDiver Database Study

2007 – 2011

790 patients underwent UCLR

695 males, 95 females

Avg annual incidence:
3.96 per 100,000 for the overall population
22 per 100,000 for patients aged 15 to 19 years.

Overall average annual growth was 4.2%.

Incidence of UCLR in the 15- to 19-year-old group increased at an average rate of 9.12% per year (P < 0.001).
Pitching Flaws and UCL Injuries

However, could not report on:

- Graft choice
- Surgical technique
- Management of ulnar nerve
- Concomitant Arthroscopy

Public Data

No central location to access all data
Has to be created by an individual

Many recent studies using public data
- RTS following ACLR in NHL Players (Erickson 2014)
- RTS following ACLR in NFL QB (Erickson 2014)
- RTS following ACLR in NBA Players (Harris 2013)
- RTS following MFx in NBA Players (Harris 2013)

Rate of Return to Pitching and Performance After Tommy John Surgery in Major League Baseball pitchers

Created a database of all UCLR in MLB players from 1974 until 2013

179 MLB Pitchers underwent UCLR
83% RTS in MLB
97.2% RTS in MLB minors
1 in 3 MLB Players will undergo UCL reconstruction at a cost of $200 million in lost salary with time on DL.

235 MLB pitchers underwent UCLR
- 31 pitchers (13.2%) underwent revision UCLR
- 37% underwent revision within 3 years of index UCLR
- 26 revisions had more than 2 years of follow-up
- 17 pitchers (65.4%) returned to pitch at least 1 MLB game
- 11 (42.3%) returned to pitch 10 or more games
- Average length of recovery: 20.76 months for players who RTS in MLB

MLB pitchers undergoing revision surgery had a statistically shorter career after revision surgery, pitched fewer innings, and had fewer total pitches per season compared to controls.
12/28/2016

UCL Epidemic

Can we identify players at risk for UCL injury?

Can we apply modifications to reduce injury risk?

Are pitching mechanics modifiable by the time athletes reach an elite level or have they been self-selected?

Risk Factors

Risk factors for UCL injuries in pitchers

- Modifiable Factors
  - Shoulder Motion
  - Mechanics
  - Other Injuries
  - Pitch Type
  - Number of Pitches

- Non-Modifiable Factors
  - Height
  - Weight
  - Velocity

Pitching Flaws and UCL Injuries

505 examinations on 296 pitchers for 8 consecutive years (2008-2005)

Measured pROM of throwing/non-throwing shoulder

49 elbow injuries and 8 elbow surgeries in 38 players

Missed 2551 days

Pitchers w/ deficits of >5° in total rotation had a 2.6 times greater risk for injury

Pitchers w/ deficit of >5° in flexion had a 2.8 times greater risk for injury

No difference with regard to GIRD

Deficits in Glenohumeral Passive Range of Motion Increase Risk of Elbow Injury in Professional Baseball Pitchers: A Prospective Study


Am J Sports Med 2014;42:2375, originally published online June 18, 2014

DOI: 10.1177/0363546514533930
Supine shoulder PROM was assessed in 115 pitchers
Two trials of ROM were measured preseason
Arm injuries were prospectively tracked

33 injured and 82 uninjured pitchers

Side-to-side differences of:
Horizontal adduction >15° - 4x more likely to be injured
Internal rotation >13° - 6x more likely to be injured

**Pitching Flaws and UCL Injuries**

**Table 2** Injury proportions by body site and diagnosis by age group

- **Body site**
  - Shoulder
  - Elbow

- **Diagnosis**
  - Strain/teardrop
  - Rotator cuff
  - Biceps (shoulder)
  - Biceps (elbow)
  - Flexor/pronator
  - Labral/fracture
  - Impingement
  - Ulnar collateral ligament
  - Epiphyseal (shoulder)
  - Apophysial (elbow)
  - Other musculoskeletal
  - Injury

**Probabilities and Odds Ratios**

<table>
<thead>
<tr>
<th>Factor</th>
<th>With Risk</th>
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<th>Odds Ratio</th>
<th>95% CI</th>
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<tr>
<td>EOE</td>
<td>20 (75.0)</td>
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<td>Full flexion abduction</td>
<td>28 (93.0)</td>
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<td>19 (63.0)</td>
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**Table 3**

**Performance statistics**

- **ROM**
  - Throwing
  - Nonthrowing

- **Pitches with restricted elevation**

**Notes**

- **Arm injuries were prospectively tracked**
- **33 injured and 82 uninjured pitchers**
- **Side-to-side differences of:**
  - Horizontal adduction >15° - 4x more likely to be injured
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Increased Volume of Throwing May be required to achieve Dominant HRT in the injury group.

No Differences in Elbow Varus Torque between Curveball and Fastball at any level

Difference in torque noted between Fastball and Change Up (Velocity)

No Difference in Kinematics between Normal Group and Players after UCL
**Current Data:**

- Total Arc of Motion Deficits and Flexion Deficits Associated with Increased Risk of UCL Tear
- Horizontal Adduction Deficits (Posterior Capsular Tightness) Potentially Associated with increased risk of UCL Tear
- Decreased Torsion in the ND arm may predispose risk for UCL Tear

**Pitching Motion and Influence of Fatigue**

- 28 males between 13-16 threw a simulated game
- Pitches were videotaped
- The experimental model functioned properly
- Pitchers became fatigued with increasing pitch counts
The Impact of Fatigue on Baseball Pitching Mechanics in Adolescent Male Pitchers

Brandon J. Erickson, M.D., Terrence Sponz, B.S., Peter N. Chaboters, M.D., Patrick Vigorela, B.S., Matthew Leonick, B.S., Charles A. Bush-Joseph, M.D., Nikhil N. Verno, M.D., and Anthony A. Romeo, M.D.

Pitching Flaws and UCL Injuries

- No upper extremity kinematics changed with fatigue
- Hip to shoulder separation significantly increased with increasing pitch counts
- The majority of velocity is generated from the pitcher’s core and legs
- As the core and legs fatigue, the pitcher opens up more during their delivery
- The pitcher then places more stress across the shoulder and elbow, specifically the UCL, to generate force for the pitch
- Hence, trunk weakness may be a factor in UCL tears, and strengthening the core may prevent UCL injuries

Non-Modifiable Factors

Physics Problem: UCL is operating at or near its failure load.

Kinetics of Baseball Pitching with Implications About Injury Mechanisms

Glenn S. Feig, Ph.D, James R. Andrews, MD, Charles J. Dilman, PhD, and Rafael F. Escamilla, MS, CSDS

From the American Sports Medicine Institute, Birmingham, Alabama
In Tommy John Surgery Performed More Frequently in Major League Baseball Pitchers From Warm Weather Areas.

Brandon J. Erickson, Joshua D. Draper, Matthew L. Sharpe, Rhonda S. Joseph, Mark Cusin and Anthony A. Romeo

247 MLB Pitchers Underwent UCLR as of June 1, 2014

State/country where MLB pitcher played
Baseball was used to determine warm vs. cold
Cold states were outside the 33rd parallel; warm states were within it

Risk Factors

139 MLB Pitchers from warm weather areas
108 MLB Pitchers from cold weather areas
A sig higher proportion of MLB pitchers undergoing UCLR are from warm weather areas p<.0001

Fastball Pitch Velocity Helps Predict Ulnar Collateral Ligament Reconstruction in Major League Baseball Pitchers
Peter N. Chalmers, Brandon J. Erickson, Brian Ball, Anthony A. Romeo and Nikki N. Verma
Am J Sports Med published online March 18, 2016

Pitching Flaws and UCL Injuries

% Pitchers with subsequent UCLR

Mean Velocity (MPH)
154 pitchers were included
- MLB pitchers who pitched 1 full season after UCLR
- 135 pitchers did not require revision UCLR
- 19 underwent revision UCLR

<table>
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<tr>
<td>First season after UCLR</td>
<td>80.3 ± 56.6</td>
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<tr>
<td>Pitch count</td>
<td>1468.2 ± 964.1</td>
</tr>
<tr>
<td>Game after UCLR</td>
<td>156.8 ± 142.4</td>
</tr>
<tr>
<td>Pitch count</td>
<td>2917.7 ± 1722.4</td>
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Should We Limit Innings Pitched After Ulnar Collateral Ligament Reconstruction In Major League Baseball Pitchers?

Brandon J. Erickson, Gregory L. Cetlarowitch, Bernard R. Bach, Jr., Charles A. Bush-Joseph, Nithin N. Verma and Anthony A. Romeo


Tried to identify performance factors that were risk factors for undergoing a UCLR

Their model explained 19.9% of the variance in UCL reconstruction surgery, and correctly classified 66.8% of cases

Predictors of UCLR based on this model:
(1) fewer days between consecutive games
(2) A smaller repertoire of pitches
(3) a less pronounced horizontal release location
(4) a smaller stature
(5) greater mean pitch speed
(6) greater mean pitch counts per game
Summary

Little data to suggest that modifiable factors are associated with UCL tear (Shoulder ROM).

Further work needed to determine if injury prevention programs may help.

No usable guidelines regarding innings limits.

Physics will likely give us the answer: Size, Velocity, Volume.

Predictors of Ulnar Collateral Ligament Reconstruction in Major League Baseball Pitchers

Factors associated with a smaller likelihood of UCLR:
1. Increase in mean days between consecutive games
2. Number of unique pitch types thrown

An increase in mean pitch speed or mean pitches per game was associated with significantly higher odds of UCL reconstruction surgery.
Analyzed professional pitchers who had revision UCLR 1974-2014

- 271 underwent primary UCLR
- 40 (15%) had at least one revision UCLR
- 3 had a second revision UCLR

Avg time from primary UCLR to revision: 5.2 +/- 3.2 years

Avg career length:
- After primary UCLR: 4.9 +/- 4.3 years
- After revision UCLR: 2.5 +/- 2.4 years

No risk factors for revision UCLR were identified

Thank You