Nonoperative Treatment of Ulnar Collateral Ligament Injuries in the Throwing Athlete

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Faculty Disclosure

- Consultant – Stryker Endoscopy
- Consultant – Venture MD
- Research Support – Arthrex
- Board/Committee Membership –
  - Orthopaedic Learning Center BOD
  - MLB Medical Advisory Committee
  - MLB Elbow Research Study Group
  - AOSSM Fellowship Committee

History

17 y.o. RHD elite high school pitcher
- Acute R medial elbow pain while throwing one pitch
- Unable to throw

19 y.o. RHD elite collegiate pitcher
- Progressive right medial elbow pain and stiffness for 6 months

25 y.o. RHD pro pitcher
- Right medial elbow pain and stiffness after 6 plus innings
- Able to recover by next start

Elbow Injury

... Injury to the Ulnar Collateral Ligament
WHAT’S the BIG DEAL?

... Epidemiology

Elbow Injuries in Professional Baseball: Epidemiology from the Major League Baseball Injury Surveillance System

Michael G. Ciccotti MD
Keisha Pollock PhD
Michael C. Ciccotti MD
John D’Angelo MA
Christopher Ahmad MD
Dave Altchek MD
James Andrews MD
Frank Curriero PhD

MLB, 2012
MLB, 2016

<table>
<thead>
<tr>
<th>Level of Play</th>
<th>N (%)</th>
<th>Age (Mean)</th>
<th>Days Missed (Median)</th>
<th>Required Surgery</th>
<th>Re-Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>2,753</td>
<td>22.8(1.2)</td>
<td>27.9(13)</td>
<td>46% (17.7%)*</td>
<td>61% (2.2%)*</td>
</tr>
<tr>
<td>Major</td>
<td>637</td>
<td>28.9(3.9)</td>
<td>37.8(13)</td>
<td>32% (18.3%)*</td>
<td>19% (0.0%)*</td>
</tr>
<tr>
<td>Total</td>
<td>3,390</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Percent calculated within Level of Play

Epidemiology of Professional Baseball Elbow Injuries

<table>
<thead>
<tr>
<th>Minor &amp; Major League</th>
<th>Frequency</th>
<th>Requiring Surgery</th>
<th>Days Missed Non-Surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bat Position</td>
<td>N (%)</td>
<td>(Mean) (Median)</td>
<td></td>
</tr>
<tr>
<td>Hitter (Batter)</td>
<td>314 (45.8%)</td>
<td>15.9 (8.9)</td>
<td></td>
</tr>
<tr>
<td>Position Player</td>
<td>516 (56.8%)</td>
<td>19.2 (10.9)</td>
<td></td>
</tr>
<tr>
<td>Base Runner (Offense)</td>
<td>24 (0.7%)</td>
<td>13.5 (4.0)</td>
<td></td>
</tr>
<tr>
<td>Batter (Offense)</td>
<td>437 (13.7%)</td>
<td>3.1 (6.0)</td>
<td></td>
</tr>
<tr>
<td>Not Classified</td>
<td>1,444 (43.8%)</td>
<td>148 (10.0%)</td>
<td>27.6 (15.6)</td>
</tr>
</tbody>
</table>
Epidemiology of Professional Baseball Elbow Injuries

**Predictable Series of Events in Throwers**

- Progressive osseous changes
- Peri-elbow muscle weakness
- Peri-elbow Soft Tissue contracture
- Flexor-Pronator Strain in Late Cocking/Acceleration/Follow-thru phases of throwing
- **UCL** injury can occur
- Ulnar Nerve Irritation/symptomatic subluxation

General population is not routinely exposed to this "cascade of events"... but throwers are!

**UCL Injury in the Overhead Athlete**

**WHAT’S the BIG DEAL?**

... Epidemiology confirms the importance of UCL injury in throwing athletes

**HOW BAD IS IT?**

... Spectrum of Injury

- Injury in-continuity
- Partial Tear
  - Proximal
  - Mid-Substance
  - Distal
- Full Tear

Extremely difficult to determine degree of injury by physical exam... but perhaps imaging can help?

**Anatomic Stabilizers**

- Cadaveric studies indicate the Anterior Band of the UCL is the primary valgus restraint (30-120 deg)
Stress Ultrasound Evaluation of Medial Elbow Instability in a Cadaveric Model

Michael C. Ciccotti MD
Sommer Hammoud MD
Christopher Dodson MD
Steven Cohen MD
Levon Nazarian MD
Michael G. Ciccotti MD

Methods

- 12 cadaveric elbows
- Baseline stress ultrasound (SUS) of the medial elbow at 30 degrees of flexion both at rest and with applied Telos valgus force (15lbs)
- Sequential sectioning of medial elbow structures was then carried out
- SUS with Telos valgus stress (15lbs) performed at each step of sectioning

Results

<table>
<thead>
<tr>
<th>Delta's (Combined Sectioning Sequences)</th>
<th>Mean Increase in Laxity 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition of Stress</td>
<td>1.1 mm 0.5-1.8 mm</td>
</tr>
<tr>
<td>Transverse Band Cut (1st seq)</td>
<td>0.7 mm 0.2-1.3 mm</td>
</tr>
<tr>
<td>Posterior Band Cut</td>
<td>0.9 mm 0.3-1.3 mm</td>
</tr>
<tr>
<td>Ant. Portion of Ant. Band Cut (1st Seq)</td>
<td>5.0 mm 1.1-2.8 mm</td>
</tr>
<tr>
<td>Post. Portion of Ant. Band Cut (2nd Seq)</td>
<td>1.4 mm 0.6-2.2 mm</td>
</tr>
<tr>
<td>Entire Anterior Band</td>
<td>2.4 mm 2.4-4.3 mm</td>
</tr>
<tr>
<td>Flexor-Pronator Mass Cut (2nd seq)</td>
<td>0.5 mm 0.0-0.9 mm</td>
</tr>
</tbody>
</table>

MR CLASSIFICATION of UCL INJURY

- MRA (Joyner et al, 2016)
  - Type 1 – Low-grade partial UCL tear; edema in UCL only
  - Type 2 – High-grade partial UCL tear; no extravasation of contrast
  - Type 3 – Complete, full-thickness UCL tear; extravasation of contrast
  - Type 4 – Tear/pathology in >1 location (i.e.-ulna & humerus)

Potential Utility of a Combined Ultrasound and MR Arthrography in Imaging of Medial Elbow Pain in Baseball Players

JB Roedl, MD
FM Gonzalez, MD
Adam Zoga, MD
William Morrison, MD
MT Nevalainen, MD
Levon Nazarian, MD

Methods

- 144 throwers with medial elbow pain underwent both US and MRA
- 191 Medial Elbow diagnoses included:
  - UCL tear (53)
  - Flexor-Pronator Injury (59)
  - Osteochondral Injury (48)
  - Ulnar Neuritis (31)

Sensitivity, specificity and accuracy for each diagnosis assessed for US and MRA individually and combined

Radiology, 2016
Conclusions

- For UCL Injury:
  - US alone = 96%(Sen), 81%(Spec), 87%(Accu)
  - MRA alone = 81%, 91%, 88%
  - Combined US + MRA = 96%, 99%, 98%

- For Ulnar Neuritis:
  - MRA alone = 81%, 91%, 88%
  - Combined US + MRA = 84%, 92%, 90%

- For Flex-Pron and Osteochondral Injuries:
  - MRA alone = 94%, 95%, 97%
  - Combined US + MRA = 94%, 98%, 97%

UCL Injury in the Overhead Athlete

Biomechanical Analysis of Elbow Medial UCL Tear Location and It’s Effect on Rotational Stability
Shickendantz et al, MLB TPA 2016 (Unpublished)

- 8 intact cadaveric elbows tested on simulator
- Valgus torques of 2.5Nm and 5.0Nm applied
- Resulting valgus angles applied to:
  - intact
  - partial tears (prox & distal)
  - complete tears (prox & distal)
- Posterior-Distal tears resulted in greatest instability
- Proximal tears may be more amenable to nonop tx

Purpose

- To longitudinally evaluate MLB players over a 10 year period with Stress US to determine if it can be predictive of possible UCL injury and guide treatment

Methods & Materials

- Stress US on 348 professional pitchers at each Spring Training over a 10 year period
- Mean age = 22.8 yrs
- Mean time as pro = 2.5 yrs
- Dominant and non-dominant arms
**Methods & Materials**

- UCL evaluated for:
  - Thickness
  - Hypoechoic focii
  - Calcifications
  - Joint space width at rest and stressed (30°)

**Conclusions**

- Those players with:
  - Dom – Non-Dom Joint Space Gapping > 1.5-2.0mm

  ... may be at higher risk for UCL injury and more likely to require operative treatment

**UCL Injury in the Overhead Athlete**

**HOW BAD IS IT?**

... the goal is to identify the degree of UCL injury ...
... partial tears may be most amenable to nonop treatment

**UCL Injury in the Overhead Athlete**

**HOW DO YOU FIX THAT?**

... Techniques of Nonop Treatment
Nonoperative Principles

**Multidisciplinary Approach**
- Athletic Trainers
- Strength/Conditioning Coach
- Skills Coach
- Team Physicians

Reinold et al, J Ortho Sports Phy Ther 2002
Fleisig et al, J Ortho Sports Phy Ther 2011
Ciccotti & Sheridan, Orthopaedic Rehabilitation of the Athlete 2014

**General Protocol**
- Rest for 3-6 weeks
- Heat/Ice/NSAID
- Modalities
- Continued cardio, core, lower extremity

Nonoperative Principles

**General Protocol**
- Elbow ROM as player comfort allows
- Upper extremity strengthening follows
- Swinging at 4-6 weeks
- Throwing Program at 6-12 weeks

Kibler et al, AJSM 2003

Nonoperative Principles

**Short Toss/Long Toss/Mound Programs**
- Tossing – progressive from 30’ to 180’
- Mound – fastballs first with increasing effort; then off-speed pitches
- Focus on technique throughout

Fleisig et al, J Ortho Sports Phy Ther 2011
Reinold et al, J Ortho Sports Phy Ther 2002
Slenker et al, AJSM 2014

Nonoperative Principles

**SCAPULA**
**CORE**
**Hip and Legs**
...Kinetic Chain...

Kibler et al, AJSM 2003

Nonoperative Principles

**Monitoring After Return**
- Batting Practice
- Simulated Games
- Rehab Starts – Minor Leagues
- Pitch Counts with progression

Reinold et al, J Ortho Sports Phy Ther 2002
Fleisig et al, J Ortho Sports Phy Ther 2011
Ciccotti & Sheridan, Orthopaedic Rehabilitation of the Athlete 2014
Slenker et al, AJSM 2014
Nonoperative Principles

- **Biologic Treatments**
  - PRP/Stem Cells/Combinations
  - Minimal data available
  - Platelet Rich Plasma mostly
  - Various PRP Regimens (Leukocyte-rich/-poor)
  - Spectrum of post-PRP protocols

  Mishra et al, 2009  
  Rodeo et al, 2009  
  Peerbooms et al, AJSM, 2010  
  Podesta et al, AJSM, 2013  
  Dines et al, AJO, 2016

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UCL Injury in the Overhead Athlete

**HOW DO YOU FIX THAT?**

... Techniques of Nonoperative Treatment continue to evolve

... Biologics may have a role

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Nonoperative Treatment is an appropriate option...

"A trial of nonoperative treatment should be considered in patients with a UCL tear"

Podesta et al, PRP for Partial UCL Tear AJSM, 2013  
Ciccotti, Sheridan et al, Ortho Rehab of the Athlete, 2014  
Noonan et al, Return-to-Play in Pro Baseball, AJSM, 2016

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Treatment of Partial UCL Tears in the Elbow with Platelet-Rich Plasma

Podesta, Crow, Yocum et al, AJSM 2013

- 34 MRI documented Partial UCL Tears
- All failed minimum of 2months nonop tx
- Prospective Baseline and Follow-up Measures:  
  - KJOC Score, DASH and Stress Ultrasound(SUS)
  - All had single, US guided PRP injection + PT
  - 88% RTPP  
  - Avg Time to RTP = 12 weeks (range: 10-15wks)
  - KJOC, DASH and SUS statistically improved

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COACH, WHEN CAN I GO BACK IN?

... Outcomes & Return to Play with Nonoperative Treatment

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UCL Injury in the Overhead Athlete

Return-to-Play Outcomes in Pro Baseball Players after UCL Injuries: Comparison of Operative vs Nonoperative Treatment Based on MRI Findings

- 43 UCL tears evaluated for RTP and RTPP
- MRI graded:
  - I=intact; IIA=partial; IIB=chronic, healed; III=complete
- 8 complete tears
  - All had UCL Recon; 75% RTP; 63% RTPPP
- 35 incomplete tears
  - 7 had UCL Recon; 100% RTP + 86% RTPPP
  - 28 with Nonop; 93% RTP + 93% RTPPP

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### UCL Injury in the Overhead Athlete

**Platelet-Rich Plasma Can be Used Successfully to Treat UCL Tears in Elite Throwers**
Dines, ElAttrache, Conte, Osbahr, Bradley, Ahmad et al, AJO 2016

- **44 Partial UCL Tears**
- **# of PRP injections:**
  - 16 (one); 6 (two); 22 (three)
- **Interval Throwing Program when asymptomatic**
  - **Outcome:**
    - 32 (73%) Excellent/Good; 2 (4%) Fair; 10 (23%) Poor
    - Mean time to Throw = 5 weeks
    - Mean time to RTP = 12 weeks

### MLB Elbow Study Group

### Leave it alone if . . .

- Clinically low grade injury
- MR evidence of:
  - Partial Tear
  - Proximal/Mid-substance
  - No attritional/ degenerative changes
- SUS evidence of:
  - Partial Tear
  - <2mm difference stressed-unstressed injured elbow
  - <1-1.5mm difference stressed from injured to uninjured elbow
- Non-throwing, recreational athlete

### Education & Research

**UCL**

- **I - Epidemiology of Elbow Injuries in Professional Baseball**
- **II - Epidemiology of UCL Injury in Professional Baseball**
- **III - Risk Factors for UCL Injuries in the Professional Pitcher: A Prospective Study**
- **IV – Nonoperative Treatment of UCL Injuries in Professional Baseball**

### Summary

- UCL injury is epidemiologically a big deal . . . particularly in baseball
- There is certainly a spectrum of injury . . partial to complete and imaging may help determine
- Nonop treatment should be considered . . particularly for proximal partial injury
- Outcomes, Return-to-Play and Return-to-Prior Level must all be determined . . for optimal care

### Future Directions

- Evaluation of all levels of baseball players (professional, collegiate, high school and youth)
- Consider other factors that may lead to apparent “epidemic” of UCL injuries
- Identify methods of precisely determining the degree of UCL injury
- Determine long term outcomes of nonoperative treatment using sports specific metrics
THANK YOU.