Rehabilitation following UCL Repair in the Overhead Throwing Athlete
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2017 AOSSM Conference Faculty Disclosure:

- Theralase Laser – Medical Advisory Board
- LiteCure Laser – Consultant
- AlterG – Medical Advisory Board
- Intelliskin USA – Medical Advisory Board
- Zrtoz Medical – Medical Advisory Brd
- Throw Like A Pro – Co-Owner
- Dr PRP – Rehab Advisor
- Educational Grants:
  » Empi Medical
  » Joint Active System
  » ERM
  » Bauerfeind Brace
- Book Royalties:
  » CV Mosby, Lippincott, Human Kinetics

American Sports Medicine Institute
Birmingham, Alabama
asmi.org
Elbow Injuries in Sports

Introduction

- Number of elbow injuries appear to be increasing
- Repetitive high forces – overhead athlete
  - 22% of all baseball injuries
- Macrotraumatic forces – dislocation / fractures / tears
- Thrower’s “not all or none”

Rehabilitation Program Must Be Specific For Each Type of Athlete
Beckett et al: AJSM ‘14

- Assessment of scapular & hip joint in preadolescent (7-12 yrs) & adolescent (13-18 yrs) in baseball players
  - High rate of scapular dyskinesis in adolescent players compared to pre-adolescent
  - Also poor single leg squat test
  - Higher coracoid process distance – correlated to dyskinesis

UCL RECONSTRUCTION REHAB
Lower Extremity Strengthening

- 1281 UCL procedures, 1265 reconstructions
- Follow-up on 79% (743 patients)
- 95% baseball players (89% pitchers)
- Average follow-up: 49.1 months
- 83% returned to same level (recon)
- 63% of repairs returned to same level competition
- Return to competition: 11.6 months
- ITP initiated – 4.4 months

Linking UE & LE

RTP – when they’re ready
179 UCL reconstructions included in study

148 returned to play 83% returned to same level

Only 5 pitchers were not able to return to play

Return to competition: 20 months

Length of career 3.9 months

Pitchers performance improved after surgery

• 80 active minor league pitchers

• 40 UCLr compared to 40 normal

• PROM, radar gun ball velocity, & biomechanics were analyzed

• Conclusions: no sign stat diff in any area tested

Pitchers sustain injuries at the highest rate

61% of all team injuries pitchers compared to position players

72% of all pitchers injuries are to their shoulder/elbow

Specific risk factors increase injuries

- Pitching when fatigued, or pitch too much (volume), improper throwing mechanics, or max effort - all increase injury risk

- GIRD & GERI is predominantly due to boney adaptations

- ~83% boney & ~17% due to soft tissue

Maintaining motion in throwing shoulder when healthy isn’t difficult

Specific exercises & stretches are important

Surveyed all Minor League Baseball Players

4,052 respondents (2,145 pitchers)

29/30 teams responded

100% responses in 29 teams

331 players had UCLr (8%)

Pitchers: 300/2145 (14%)

Position players: 31/1907 (2%)

Avg age at time of surgery 21

Surveyed all Major League Baseball Players

1,036 respondents

30/30 teams responded

100% responses in 30 teams

166 players had UCLr (16%)

Pitchers: 85%

Position players: 5%

49% UCLr received concomitant surgery
• UCLr in the State of NY from 2002 to 2011
  ✓ UCLr increased by 193%
  • UCLr mean age 17-18 & 19-20 yrs of age
  • Private insurance patients were 25% more likely to undergo a UCLr than those with Medicaid
  • The number of institutions performing UCLr doubled

Risk Factors for Injuries

Youth Baseball Pitchers

- Pitching when fatigued
- Pitching too many innings/year
- Not enough rest from throwing at end season
- Too many pitches in game, week, year
- Pitching consecutive days
- Poor pitching or throwing mechanics
- Playing on multiple teams, leagues

Don’t Perform Throwing Programs When Fatigued!

Youth Baseball Player

- Excessive throwing when not pitching
- Throwing curveballs or sliders
- Too much Pitching
- Improper conditioning
- Not following proper conditioning guidelines
- Not following safe practice guidelines at showcases
- Too much throwing with not enough rest!
Don’t Rush Through the Interval Throwing Program

- Pitching at maximum effort
  - “too many pitches at 100% effort”
- Excessive retromotion
  - “excessive ER – increases velocity”
- Pitching too many innings
  - “over utilization”
- Pitching when fatigued
  - “alteration in normal throwing mechanics”
- Pitching beyond the player’s capabilities
  - “types of pitches, velocity, innings, reliever vs”

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Elite Baseball Pitcher
Risk Factors for Injury

- Peak pitch velocity independent predictor (p<.001)
- Mean velocity, body mass & age 2nd predictors

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Chalmers, Erickson, Romeo: AJSM ’16

- Fast ball pitch velocity helps predict UCLr in MLB pitchers
- Data base study design using Pitch Fx
- MLB pitchers from 4/2/07 – 4/14/15
- 1327 pitchers included
  ✓ 309 (26.8%) underwent UCLr (145 had pre injury velocity recorded)

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Submax Throwing is Good
Glenohumeral Passive Range of Motion & the Correlation to Elbow Injuries in Professional Baseball Players: An 8 year Prospective Study (AJSM 2014)

Methods & Materials
- 505 pitcher-seasons were included in this study
- 6,060 total PROM measurements taken
- 296 individual pitchers were included
- 46 pitchers were assessed in three or more consecutive seasons
- 80 were assessed in two seasons
- 170 were assessed only once
- 220 pitched right-handed & 76 left-handed
- All subjects were asymptomatic when tested and had no surgeries within two years prior to testing
- Same two examiners performed PROM assessment each year

Results

<table>
<thead>
<tr>
<th>Specific Type of Injuries</th>
<th># of Injuries</th>
<th>Days on DL</th>
<th>% Days on DL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elbow Strains:</td>
<td>15</td>
<td>566</td>
<td>22.4%</td>
</tr>
<tr>
<td>UCL</td>
<td>12</td>
<td>781</td>
<td>30.5%</td>
</tr>
<tr>
<td>Inflammation</td>
<td>9</td>
<td>298</td>
<td>11.8%</td>
</tr>
<tr>
<td>Surgery</td>
<td>6</td>
<td>352</td>
<td>14.0%</td>
</tr>
<tr>
<td>Stress Reaction</td>
<td>4</td>
<td>309</td>
<td>12.2%</td>
</tr>
<tr>
<td>Neuritis</td>
<td>3</td>
<td>203</td>
<td>8.3%</td>
</tr>
<tr>
<td>Contusion</td>
<td>1</td>
<td>19</td>
<td>0.7%</td>
</tr>
</tbody>
</table>

50 2528

Conclusions & Clinical Relevance
- Based on the results of this study:
  - Pitchers with a throwing shoulder deficit in TRM had a 2.3x risk of sustaining an elbow injury
  - Pitchers with a dominant shoulder loss of Flexion exhibited a greater risk (2.8x) risk of an elbow inj
  - GIRD did not correlate with elbow injuries
  - Strong trend for increase ER incr risk UCL inj
- Clinicians need to be aware of this and plan a preventative & rehabilitation program that addresses these findings – this to prevent &/or treat elbow injuries in the overhead pitcher

Noonan, Thigpen, Bailey, et al: AJSM ’16
- Humeral torsion risk factor for shoulder/elbow injuries in professional baseball pitchers
- Protective or Harmful
- 255 pitchers prospective study ROM, Retro US
  - 60 injuries were recorded (24%) 30 shldr 30 elb
  - Players who sustained shoulder injuries exhibited less retro torsion compared uninj (4°)
  - Players who sustained elbow injuries exhibited an increase in humeral retro torsion by 5°
Sports Illustrated

- How many MLB stars came from warm-weather and cold-weather states?

MLB Pitchers > 200 Wins

Elbow Injuries in Sports

UCL Injuries

Traumatic UCL Injuries

Repetitive Overhead Stresses
Elbow Dislocation
"Throw Like A Pro" App

Injury Prevention

**Little League Pitch Count Rule (since 2007)**

- Pitches allowed per game:
  - 17-18 yrs 105 pitches
  - 13-16 yrs 95 pitches
  - 11-12 yrs 85 pitches
  - 9-10 75 pitches
  - 7-8 50 pitches

- Days rest after pitching (14 and under):
  - >66 or more pitches 4 days
  - 51-65 pitches 3 days
  - 36-50 pitches 2 days
  - <21-35 pitches 1 day
Olsen, Fleisig, Dun, Loftice, Andrews: 
Am J Sports Med ’06

- Risk factors for developing shoulder & elbow injuries in adolescent baseball pitchers
- Compared 95 pitchers who had surgery to 45 pitchers who never had a significant injury
- Risk factors:
  - Pitched more months per year
  - Games per year
  - Innings per game
  - Pitches per game
  - More starting pitchers
  - Participated in showcases
  - Pitched at higher velocity
  - Pitched more often & when fatigued
  - Used NSAIDs & ice
  - Injured group was taller & heavier

Treatment of UCL Injuries in The Overhead Throwing Athlete

Non-Operative Rx
Operative Rx

Stop Pitching
Rehab
Successful Outcome

Rehabilitation Following UCL Reconstruction

Our Current Program (2017)

- Phase I: Acute Post-Op Phase:
- Phase II: Subacute Phase:
- Phase III: Advanced Phase:
- Phase IV: Return to Activity Phase:
Rehabilitation Following UCL Repair

- **Phase I: Post-Op Phase (weeks 0-8):**
  - Protect the healing tissue (UCL)
  - Gradually restore motion
  - Decrease inflammation & pain
  - Prevent muscular atrophy
  - Scapular, GH joint, leg, core program

- **Phase II: Subacute Phase (weeks 9-12):**
  - Continue ROM & stretching
  - Isotonic strengthening program (Throw 10)
  - Scapular & Glenohumeral joint
  - Fine tune muscular ratios
  - Core & Leg program

Rehabilitation Following UCL Repair with Internal Brace

- **Week 1: Posterior splint 5-7 days**
  - Shoulder isometric exercises
  - Scapular exercises

- **Week 2: ROM Brace (30-110°)**
  - Continue shoulder exercises isotonics
  - Initiate elbow & wrist exercises

- **Week 3-4:**
  - Thrower’s Ten Program
  - Week 4-5 full PROM

- **Week 5-6:**
  - Advanced Thrower’s Ten Program

Rehabilitation UCLr Throwers

- **Phase III: Advanced Phase (weeks 13-16):**
  - Advanced isotonic program
  - Strength, power, & endurance
  - Advanced thrower’s ten program
  - Plyometrics
  - Continue stretching & ROM program

- **Phase IV: Return to Activity Phase: 4 mos**
  - Thrower’s ten program
  - Plyometrics
  - Interval throwing program (ITP)
  - Light stretching program

- **Return to Competition: 9-12 mos**

Rehabilitation UCLr Throwers

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- **Week 5-6:**
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**UCL Repair Internal Brace Rehab**

- Week 6:
  - Advanced Thrower’s Ten Program
  - Plyometrics 2 hand drills
- Week 8:
  - Plyo 1 hand drills
  - Hitting week 10
- Week 11-16:
  - ITP Phase I (week 10-11)
  - ITP Phase II (wk 14-15)
- Week 16-21
  - Return to play

**UCL RECONSTRUCTION REHAB**

**UCL Strain with PROM**

- Wrist & hand isometrics day 1
- Isometrics UE week 1-2
- Active ROM week 2-3
- Isotonics program week 3-4
- Thrower’s Ten program week 4/5
- Weight lifting week 10-12
- Sports (golf) week 11
- Plyometrics
  - Two hand drills week 12
  - One hand drills week 14

**Thrower’s Ten Program**
**Bilateral Extremity Exercises**

**UCL RECONSTRUCTION REHAB**
- Rotator Cuff Strengthening

**Manual Resistance Techniques**

**UCL RECONSTRUCTION REHAB**
- Rotator Cuff Strengthening

**UCL RECONSTRUCTION REHAB**
- Strengthening Drills - MR Elbow/Wrist Flex C/E
Elbow Rehabilitation in Athletes
Dynamic Stabilization

Davidson et al: AJSM ’95

UCL RECONSTRUCTION REHAB
Strengthening Drills

Advanced Thrower’s Ten Program

Thrower’s Ten Program

Standing Full Can

Lateral Raises

Tubing ER/IR

Throwing ER/IR

www.asmi.org

Sidelying ER

Prone Full Can

Prone Horz Abduct

Prone Row into ER

D2 PNF Flexion
Thrower’s Ten Program

- Prone rowing
- Elbow Flex/Ext
- Push-Ups
- Sup/Pron & Wrist Flex/Ext

UCL RECONSTRUCTION REHAB
Advanced Thrower’s Ten

Dynamic Stabilization Exercises
Scapular NM Control Drills

Dynamic Stabilization Exercises

UCL RECONSTRUCTION REHAB
Strengthening Drills

ASMI
Rehab Overhead Athlete
Return to Play Criteria – ITP 1

✓ Full sport specific non painful ROM
✓ Satisfactory Clinical Exam
✓ Strength which meets the criteria
✓ Appropriate rehab progression completed
✓ Functional Testing - satisfactory
✓ Successfully has completed rehab program
✓ Satisfactory subjective KJOC functional scoring

An Objective Criteria is Important

Criteria Return to Throwing
Shoulder Motion PROM

✓ Full Non-Painful ROM
✓ Shoulder ROM within 5° bilateral
✓ Horizontal adduction 40° ≥
✓ GIRD < 15°
✓ Elbow full non-painful ROM
✓ Wrist full non-painful ROM

Wilk et al: CORR '12
Wilk et al: AJSM '15

Criteria to Return to Throwing
Clinical Exam

✓ Physician Clinical Exam
✓ Satisfactory exam
✓ Special tests
✓ Shoulder Joint
  ✓ SLAP tests
  ✓ Rotator Cuff tests
  ✓ Laxity exam
✓ Elbow Joint
  ✓ UCL testing
  ✓ Ulnar nerve testing
  ✓ …

Return to Throwing Criteria
Biodex -Isokinetics

✓ ER / IR ratios
  ✓ 72 - 76%
✓ ER / ABD ratios
  ✓ 68 - 73%
✓ Torque / BW ratios
  ✓ ER 18 - 23%
  ✓ IR 26 - 32%
✓ Bilateral comparison
  ✓ ER 95-100%; IR 115%

Wilk et al: AJSM ‘93
Wilk et al: AJSM ‘95

Criteria to Return to Throwing
Appropriate Rehab Progression

✓ Plyometrics
  ✓ painfree 2 hand throwing
  ✓ painfree 1 hand throwing
✓ Dynamic stabilization drills
  ✓ RS drills at 90/90)
  ✓ prone ball drops

Return to Throw Criteria
Ball Drop Test

✓ Dynamic stabilization tests
  ✓ Prone ball drops
    ✓ 30 sec test
    ✓ prone on plinth
    ✓ number of releases/catches
    ✓ compare Dom to Non Dom
    ✓ score: %
    ✓ Goal: 90%
    ✓ Expectation; 110%
Return to Throw Criteria

**Ball Drop Test (T Side)**

**Ball Drop Test (NT Side)**

**Ball Drop Test - Error**

**One Hand Ball Throws Against Wall**

- Ball Wall Throws
- Baseball Style Throws
  - 2 lb plyoball
  - baseball style throws
  - 30 sec duration
  - bilateral comparison
- Successful Criteria:
  - no pain
  - proper mechanics
  - no change with fatigue
  - bilateral difference: depends level

**One Hand Ball Throws Against Wall**

- Single leg squat test
  - Floor or 8 in step – 30 sec
  - 10 reps on each leg (want time)
  - bilateral comparison
  - assess depth
  - assess valgus/varus
  - assess lateral trunk movement
  - assess trunk flexion
  - looking for symmetrical motion with no pain &/or dysfunction
Return to Throw Criteria
Appropriate Rehab Progression
✓ Subjective Shoulder Questionnaire & Scoring System

Rehab Overhead Athlete
Return to Play Criteria – ITP II
✓ Full non-painful ROM which fulfills criteria
✓ Satisfactory Clinical Exam
✓ Strength which meets the criteria
✓ Appropriate rehab progression completed
✓ Completed ITP Phase I & flat ground at 75% effort
✓ Functional Testing – satisfactory
  ✓ 20 feet throwing in to plyoback w/ 1 lb at 66%
  ✓ prone ball drop test – 2 lb: 115%
  ✓ ball wall throws for 30 sec
✓ Satisfactory subjective KJOC functional scoring

Return to Throw Criteria Phase II
One Hand Ball Throws Against Plyoback 66%

Criteria to Return to Throwing
Functional Testing

REHAB FOLLOWING UCL SURGERY
Conclusions
✓ Elbow injuries common in the overhead thrower
✓ UCL injuries occur in several situations (throwers, macrotraumatic)
✓ Surgery often indicated for UCL injuries
✓ Rehab must match the surgery
✓ Gradual restoration through rehab
✓ Excellent outcomes: 85% ≥ return sport
✓ Stiffness occurs in less than 2%

Predictable & Reproducible Results