Wilk - GIRD, TROM and Injuries to the Thrower 2016

Recent Advances in the treatment of the overhead athlete

The Overhead Thrower

Introduction

Goals of presentation:

» Discuss rehabilitation concepts of the overhead thrower
  HIT the HIGH POINTS
» Describe several treatment strategies for the shoulder & elbow:
  ✓ ROM in the thrower
  ✓ GIRD & TROM
  ✓ GIRD & TROM - Injuries
  ✓ Rx concepts - stretching
  ✓ Recent advances

Kevin E Wilk, PT, DPT,FAPTA

2016 Baseball Sports Medicine Conference

Faculty Disclosure:

• Theralex Laser – Medical Advisory Board
• LiteCure Laser – Consultant
• AlterG – Medical Advisory Board
• Intelliskin USA – Medical Advisory Board
• Zetrax Medical – Medical Advisory Brd
• Throw Like a Pro – Co-Owner
• Dr PRP – Rehab Advisor
• Educational Grants:
  » Performance Health
  » Joint Active System
  » ERM
  » Bauerfeind Brace
• Book Royalties:
  » CV Mosby, Lippincott, Human Kinetics

GIRD & TROM in the Overhead Thrower: Evaluation & Treatment

Kevin E Wilk, PT, DPT,FAPTA

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The Overhead Thrower

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  ✓ GIRD & TROM - Injuries
  ✓ Rx concepts - stretching
  ✓ Recent advances
GIRD & TROM in Throwers

Introduction:

✓ Definition:
✓ Recognition:
  » how to measure IR/ER
  » retroversion
  » capsular tightness
  » scapular position
✓ Cause of GIRD
✓ Effects of GIRD:
  » shoulder biomechanics
  » injury risk
✓ Effects of GIRD & TROM on injury:
✓ Treatment for GIRD & TROM:

Should GIRD Be a Concern?

GIRD & TROM in Throwers

Introduction:

✓ Definition:
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✓ Cause of GIRD
✓ Effects of GIRD:
  » shoulder biomechanics
  » injury risk
✓ Effects of GIRD & TROM on injury:
✓ Treatment for GIRD & TROM:
GIRD: 14.5 years old baseball pitcher & shortstop

Initial Right PROM:
ER: 148
IR: 27
TROM: 175
Initial Right PROM:
ER: 148
IR: 27
TROM: 175

Initial Left PROM:
ER: 123
IR: 61
TROM: 184

GIRD: 14.5 years old baseball pitcher & shortstop

Dec 2014

3 wks Rx R PROM:
ER: 138
IR: 54
TROM: 192

Dec 2014

3.5 yrs later follow up – playing SS painfree, not pitching
Still playing
Biomechanics of the Shoulder Joint Complex During Throwing

Windup  Cocking  Acceleration  Deceleration  Follow-through
The Thrower’s Shoulder

Range of Motion

Adaptations in the overhead thrower’s shoulder

Adaptations are Good!

The Thrower’s Shoulder

Loss of Internal Rotation

*Important Concepts

✓ The loss of internal rotation: an adaptation seen in proficient overhead throwers – that is necessary, essential & beneficial

* We are not sure how much of this adaptation is beneficial & when becomes problematic

αGIRD  sGIRD
The Thrower’s Shoulder

Overview

- Excessive Motion especially External Rotation
- Requires stability
- Inherent hyper-laxity
- Allows tremendous mobility

Fine line:
Too loose & just right !!!

GIRD Update

Introduction:

- Definition:
- Recognition:
  » how to measure IR/ER
  » capsular tightness
  » scapular position
- Cause of GIRD
- Effects of GIRD:
  » shoulder biomechanics
  » injury risk
- Effects of GIRD on injury:
- Treatment for GIRD.
The GIRD Concept

Rehab of the Thrower
GIRD Concept

GIRD Theory
Glenohumeral Joint
Internal Rotation Deficit
Burkhart, Morgan, Kibler: Arthroscopy '03

GIRD

Wilk - GIRD, TROM and Injuries to the Thrower 2016
Rehab of the Thrower

**GIRD Theory**
- **Glenohumeral Joint**
- **Internal Rotation Deficit**
  - *Burkhart, Morgan, Kibler: Arthroscopy '03*

**Loss of Internal Rotation**
- **GIRD Concept - Morgan**
- GIRD: GH Internal Rotation Deficit
- Loss of IR compared to non-throwing shoulder
- Shoulder at risk = GIRD > 20 degrees
- Treatment: stretching posterior capsule
  - Non-responders – capsular release
  - Posterior Inferior Capsulotomy
  - Morgan CD: Unpub '05
  - Burkhart et al: Arthroscopy '03

Current Concepts

**Arthroscopy '03**

*The Disabled Throwing Shoulder: Spectrum of Pathology Part I: Pathoanatomy and Biomechanics*

Stephen S. Burkhart, M.D., Craig D. Morgan, M.D., and W. Bar None, M.D.
**The GIRD Factor**

- Athletes have GIRD without symptoms
- **Symptomatic:** sGIRD players
- **Asymptomatic:** aGIRD players
Internal Rotation Deficit

Loss of IR Due to Several Factors:

1. Osseous adaptations - 1st Cause of the IR loss

   Superimposed other factors:
   - Scapular posture – anterior tilt
   - Posterior muscular tightness
   - Shoulder fatigue

2° Contributing Factors

5. Posterior capsular thickness/thickness

Osseous Adaptation and Range of Motion at the Glenohumeral Joint in Professional Baseball Pitchers

From Optimax Sports, Glenwood, Nebraska, Orthotic Sport Institute, Birmingham, Alabama, Tampa Bay Devil Rays Baseball Club, Tampa Bay, Florida, and University of Florida Shands Clinic, Gainesville, Florida.
Crockett, Gross, Wilk, et al: AJSM ‘02

- 25 professional baseball pitchers
- Compared to 25 subjects (never played baseball)
- Assessed laxity, ROM and CT scan
- Average ROM
  - Throwers: ER 129º, IR 61º
  - Non-throwers: ER 119º, IR 7º
- Total motion: NS side-to-side
- Laxity: NS side-to-side

CT scan: humeral retroversion:
- Throwing side: 40º
- Non-throwing side: 2º

CT scan: humeral retroversion:
- Throwing side: 17º deg diff
- Non-throwing side: 2º

Control group (NT): 22º = bilateral

**TABLE 1**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dominant (Mean SD)</th>
<th>Non-dominant (Mean SD)</th>
<th>Significance</th>
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<tr>
<td>Humerual head</td>
<td>40 (9.9)</td>
<td>23 (10.4)</td>
<td>P &lt; 0.001</td>
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<tr>
<td>Shoulder retroversion (deg)</td>
<td>14 (5.3)</td>
<td>11 (5.4)</td>
<td>P &lt; 0.01</td>
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<td>External rotation at 90°</td>
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<tr>
<td>Absorption (deg)</td>
<td>102 (9.9)</td>
<td>86 (8.5)</td>
<td>P &lt; 0.001</td>
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<tr>
<td>External rotation in the sagittal plane (deg)</td>
<td>62 (7.4)</td>
<td>71 (9.3)</td>
<td>P &lt; 0.001</td>
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<tr>
<td>Total motion (deg)</td>
<td>189 (12.6)</td>
<td>189 (12.7)</td>
<td>Ns</td>
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<tr>
<td>Anterior laxity</td>
<td>1.30</td>
<td>1.24</td>
<td>Ns</td>
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<tr>
<td>Inferior laxity</td>
<td>1.30</td>
<td>0.96</td>
<td>Ns</td>
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</tbody>
</table>

HHRT: GRT = 2.8:1 Ratio

# Not statistically significant.

* Numeric classification (mean) achieved by assigning a number (1 to 3) to the corresponding manual translation grades (1 to 3) for anterior and posterior humeral head translation.

# Numeric classification (mean) achieved by assigning a number (0 to 2) for sulcus sign testing.
Wyland, Pill, Shanley et al: AJSM’12

• Analyzed 32 professional pitchers (mean age 23 yrs)
• Proximal humeral “retrotorsion” (HRT) & glenoid retroversion (GRV)
• HRT & GRV significantly greater on throwing side vs non-throwing side
  ✓ HRT:GRV 2.3:1 (T), 7:1 (NT)

Humeral Retroversion Throwers
Bilateral Differences

Pieper: AJSM ’98 (9.4*, up to 29*, painful grp less retrov)
Overhead athletes osseous adaptations

Pieper: AJSM ’98 (9.4*, up to 29*, painful grp less retrov)
Whiteley et al: JOSPT ’09 (Ultrasound 11.9°)
Hibbard et al: AJSM ’14 (Ultrasound - age dependent)
Myers et al: AJSM ’12 (validation study – ultrasound)
Myers et al: Sports Health ’11 (injury related – college age)
Tokish et al: J Spts Sci Med ’08 (radiographs) (11.2°)
Humeral Retroversion Throwers
Bilateral Differences – 34 studies

Nakase, et al: AJSM '16 (Ultrasound) (14°)
Itami, et al: AJSM '16 (CT scan) (16°)
Noonan: AJSM '16 (Ultrasound) (15°)
Saka et al: OJSM '15 (CT scan) (10°)
Hibberd et al: AJSM '14 (Ultrasound) (16°)
Oyama et al: Clin Biomech '13 (US) (12-14°)
Whiteley et al: Sci Spots Med '10 (Ultrasound) (11°)
Wyland et al: AJSM '12 (Ultrasound) (13°)
Myers et al: AJSM '12 (Ultrasound) (13°)
Myers et al: Sports Health '11 (US) (13°)
Polster et al: AJSM '13 (CT scan) (10.9°)

Humeral Retroversion Throwers
Bilateral Differences

Reagan, Meister, Horodyski, Wilk, et al: AJSM '02 (10°)
Osbahr, Cannon, Speer: AJSM '02 (10°)
Chart, Litchfield, et al: JOSPT '07 (10.6°)
Pieper: AJSM '98 (9.4°, up to 29°, painful grp less retrov)

Overhead athletes osseous adaptations

Meister, Kaminski, Day: AJSM '05

- Rotational ROM changes in the GH joint in Little Leaguers’ (Adolescent) Baseball Players
- 294 players were analyzed (age 8-16)
- Measured ER & IR @ 90 deg. abd. & Flex.
- Examined total motion concept:
  - Peak changes in motion: ER & IR changes at 12 & 13 D
  - Elevation changes at 13 & 14 D & ND
- Motion changes occur due to adaptation
  - Total motion equal bilaterally through the years
  - Increase ER & decrease IR observed with age
• Influence of age on GIRD, humeral retrotorsion, retrotorsion adjusted GIRD & TROM on healthy baseball players
  - 52 youth aged (6-10 yrs of age)
  - 52 junior high school (11-13 yrs)
  - 70 junior varsity (14-15 yrs)
  - 113 Varsity (16-18 yrs)

  - GIRD & retrotorsion increased with age while retrotorsion adjusted GIRD & TROM remained unchanged –
  - GIRD is primarily attributed to retrotorsion & not due to soft tissue tightness

• Humeral torsion risk factor for shoulder/elbow injuries in professional baseball pitchers
• Relationship between GIRD & retrotorsion
• 222 pitchers assessed in spring training
• IR, ER & TROM, retrotorsion assessment (US)
• GIRD = 15° ≥, TROM 10° ≥
  - 60 pitchers exhibited GIRD (27%)
  - GIRD pitchers exhibited greater retrotorsion (19°) compared to Non-GIRD (12°)
  - IR was affected retrotorsion but not ER
Wilk, Macrina, Porterfield, et al:
Spring Training 2015

- Assessed 129 professional pitchers
- All asymptomatic & throwing
- ER @ 90 deg abd: 129.5
- IR @ 90 deg abd: 59.3
- TROM Dom Side: 184.3
- TROM ND side: 185.9
- TROM Diff: 1.6 degrees
  - GIRD: 16 pitchers (12%)
  - TROM >5 deg: 18 pitchers (14%)

Ultrasound Retroversion Corrected ROM

Why is the humeral retroversion of throwing athletes greater in dominant shouldres than in nondominant shoulders?

JSES '06
Validity of measuring humeral torsion using palpation of bicipital tuberosities

Abstract

The magnitude of humeral torsion (HT) affects the internal and external rotation range of motion at the shoulder. Currently, imaging is required to quantify the HT angle. However, factors such as cost and non-availability of imaging, can limit its use. Measurements of humeral torsion (HT) is an indirect approach that has been used. This study aimed to examine the validity of palpation for measurement of HT using real-time ultrasound imaging. Twenty-six right shoulders were measured with the TRED unit. The mean difference between the two methods was 1.9 degrees with 95% limits of agreement of -9 to 12 degrees. Pearson's correlation coefficient between the two methods was 0.88. In a clinical setting, palpation appears to be a practical alternative to US imaging for measuring HT.
• 39 professional baseball pitchers
• Retroversion corrected PROM
• Ultrasound to determine retroversion

✓ Bilateral difference in humeral retroversion 17.2°
✓ IR PROM: 54° (TROM: 4° diff bilateral)
✓ IR retroversion corrected PROM: 44.8
✓ Retroversion accounted for 83% of the ER/IR (TROM) bilateral difference
Ultrasound Evaluated PROM
Retroversion Adjusted ROM

- 28 professional baseball pitchers
- Goniometer ER/IR measurements (0°, 30°, 45°, 90°, horizontal adduction, ER during horz adduction)
- Ultrasound to determine retroversion
  ✓ Strong correlation between shoulder IR at 90° abduction & retroversion
  ✓ Other motions did not correlate
  ✓ Trend toward correlation ER at 90° & ER during horizontal adduction

Reinold, Wilk, Reed, Crenshaw, Porterfield: AJSM ’08

- Studied effects of throwing on PROM
- Evaluated 48 pitchers immediately following throwing
- Shoulder motion adaptations:
  » Loss of (D) IR
  » Increase of (D) ER
  » Loss of (ND) IR
- Elbow adaptations: loss of ext.
- LOM was present 24 hrs, 48 hrs – not at 96 hrs

The Thrower’s Shoulder
Why the loss of IR

✓ During ball release & deceleration phase of pitching
✓ Large distraction forces – 1x BW
  Fleisig: J Biomech ’99
✓ Significant muscle activity decelerating arm - eccentrics
  » Teres Minor: 84% ± 52 %MVIC
  » Infraspinatus: 37% ± 20 %MVIC
  » Posterior Deltoid: 60% ± 28 %MVIC
  DiGiovine: JSES ’92

Large Eccentric Forces Generated During this Phase
• Scapular angular position assessment at end range internal rotation
• 3-dimensional scapular assessment
• 23 subjects were analyzed
• IR ROM deficit group exhibited significantly greater scapular anterior tilt (9 deg) compared to control group

• GIRD & Scapular Dysfunction
• 43 baseball players (asymptomatic)
• 22 exhibited GIRD 15 deg >
• 21 exhibited GIRD 14 deg <

GIRD 15 deg > exhibited on dominant side: less scapular rotation at 60, 90 & 120 deg – also exhibited more protraction at 90 deg
Wilk, Reinold, et al: CSM ‘07

- Tested 63 professional baseball pitchers
- Assessed scapular protraction/retraction, upward rotation/downward rotation and anterior/posterior tilting
- Compared throwing side to non-throwing side
- Tested in 4 different positions
- Significant differences with scapular tilting
  - At rest: more protraction & anterior tilt
  - At 90 deg abduction & ER: more protr & ant. tilt
  - At 90 deg abduction & IR: more protr & ant. tilt
Macrina, Wilk, Porterfield: CSM ‘07

- Analyzed the effects of fatigue on scapular position in 39 professional baseball pitchers
- Assessed 4 static positions
  » Arm at side
  » Full can
  » 90 deg abd ER
  » 90 deg abd IR
- Compared bilateral differences (T vs. NT)
- Results: significant differences with protraction & anterior tilt in all positions

Scapular Dysfunction & Injury Risk in High School Baseball Players

- Pre-season screening of 246 high school players (mean age 16.6 yrs) playing 10yrs
- Assessed scapula using the SDT described by McClure et al: JAT ‘09
- Examined examiners analyzed video (2)
  ✓ 122/246 identified with scapular dysfunction
  ✓ 2/122 in scap dysf grp their shoulder or elbow
  ✓ 10/124 in the normal scap group - injuries
  ✓ Total of 12 injuries

Shoulder Examination in Athletes (especially Overhead Athletes is an Entire Body Screening/Examination

- Rubin & Kibler: Arthroscopy ‘02
- Burkhart et al: Arthroscopy ‘03
- Kibler et al: JOSPT ‘09
- Becket et al: AJSM ‘14
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

Evolution
(or is it?)
Assessed 43 asymptomatic professional baseball pitchers (tested over 95 players to date)

- Anterior-Posterior laxity @90 abd (scapular plane)
  - Telos device (10daN)
  - Sonographic imaging

- No significant difference throwing & non-throwing side
- Greater posterior laxity than anterior
- Anterior translation: 2.45mm
- Posterior translation: 5.81 mm
- No correlation between ROM & Laxity
Thomas, Swanik, Higginson et al: JSES ’10

- Bilateral comparison of posterior capsule thickness & correlation to GH ROM & scapular upward rotation in college baseball players
- PCT measured using 10-MHZ transducer & GH ROM measured supine
  - PCT was greater on dominant compared to non-dominant arm
  - Negative correlation between PCT & IR
- What about anterior capsule thickness?
- What about how ER/IR was measured?

ASSESS DON’T ASSUME !!
Treat the clinical findings

ASSESS DON’T ASSUME !!

DONT’ Guess ASSESS !!

Treat the clinical finding

The Pitchers Shoulder Joint

GIRD Concept & Causes

• GIRD is due to numerous contributing factors
• Not just due to osseous adaptations or posterior capsule tightness!
• Numerous factors:
  ✓ humeral retroversion
  ✓ scapular position
  ✓ muscular tightness
  ✓ posterior capsule
Assessment of GH Joint Capsule Posterior/Anterior Translation

Assessment of GH Joint Capsule Posterior/Anterior Translation
Loss of IR Due to Several Factors:

1. Osseous adaptations

Superimposed other factors:

Scapular posture – anterior tilt
Posterior muscular tightness
Shoulder fatigue

5. Posterior capsular thickness/thickness
Assessment of Posterior Translation of the Glenohumeral Joint

- Position arm anterior to scapular plane
- 30-35 deg anterior to coronal plane
- Center humeral head
- Translates posterolateral direction – 35 deg angle

Visual inspection

Humeral Stabilization

Scapular Stabilization

Glenohumeral Internal Rotation Measurements Differ Depending on Stabilization Techniques

Background: The use of glenohumeral internal rotation measurements in overhead athletes has been well documented in the literature. Several different methods of measuring this movement have been described, making comparisons between the results of studies difficult.

Hypothesis: Significant differences in the accuracy of internal rotation range of motion exist when using different methods of stabilization.

Visual inspection

Humeral Stabilization

Scapular Stabilization
Stabilizing humeral head

Palpating scapular coracoid

Visual inspection

Wilk et al: J Sports Health: 1(2) ‘09

• Intra-tester & inter-tester reliability of GH joint IR
• Tested 20 subjects
• 3 methods of IR ROM assessment:
  VI, HS, SS
• 5 trials performed on 5 separate days
• significant differences between the three methods

• Mean difference:
  » VI: 58° SS: 46° HH: 40°
• Intra-tester ICC:
  » VI: .48, SS: .62, HH: .51
• Inter-tester ICC:
  » VI: .47, SS: .43, HH: .45

Scapular Stabilization
Wilk, Reinold: Spring Training '05

- Tested 103 professional baseball players
- 3 methods of IR ROM assessment:
  - Visual inspection
  - Stabilize the scapula
  - Stabilize the humeral head
- Results in significant differences between the three methods
- Mean difference:
  - Mean & Max. diff range was VI & HH 29 deg
  - Max diff was 36 deg.

Wilk, Macrina, Porterfield et al: 2015
Pitchers Shoulder ROM ('05-'14)

<table>
<thead>
<tr>
<th></th>
<th>D</th>
<th>ND</th>
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<tbody>
<tr>
<td>ER at 90° abduction:</td>
<td>131.1</td>
<td>125.1</td>
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<tr>
<td>IR at 90° abduction</td>
<td>53.3</td>
<td>63.2</td>
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<tr>
<td>Total Rotational ROM:</td>
<td>184.3</td>
<td>187.4</td>
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<tr>
<td>Horizontal adduction</td>
<td>42.9</td>
<td>45.2</td>
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<tr>
<td>ER Horz Adduction</td>
<td>32.5</td>
<td>28.1</td>
</tr>
</tbody>
</table>

Wilk, Reinold, Crenshaw: et al: '05

- ER & IR ROM 1999-04 compared to '05~'07
- 1999-04 data n= 472
  - ER 129.3 ± 10
  - IR 61.6 ± 9
  - Total Motion: 190.7° ± 14
- 2005-14 data n= 826
  - ER 131.9 ± 11
  - IR 53.1 ± 12
  - Total Motion: 184° ± 11
Total Rotational Motion Concept (TRM)

ER + IR = Total Motion

“Envelope of Motion”

Wilk AJSM ’02
Total Rotational Motion is equal bilaterally (within +5 degrees)
Total Rotational Motion Concept

Crockett et al: Am J Spts Med ’02
Ellenbecker et al: Med Sci Spts Ex’02
Borsa et al: Am J Spts Med ’05

Total ER/IR ROM was assessed in professional baseball players & elite tennis players
46 professional baseball pitchers (mean age 22)
117 elite junior male tennis players (mean age 16)
Total motion equal bilateral in both groups
  » Baseball pitchers 145±18 degrees
  » Tennis players 149±18 degrees
  • Tennis players had greater IR both D & ND arms

Total Rotation ROM (TRM)

Does it matter where the arc of TRM is?

Where does the majority of the ROM occur?
Total Rotation ROM (TRM)

Does it matter where the arc of TRM is?

Where does the majority of the ROM occur?

N=369

Thrower’s Shoulder ROM

<table>
<thead>
<tr>
<th>Author</th>
<th>ERD</th>
<th>IRD</th>
<th>TRM</th>
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</table>
Does GIRD Cause Shoulder &/or Elbow Injury ??
GIRD Update

Introduction:

- Definition:
- Recognition:
  - how to measure IR/ER
  - capsular tightness
  - scapular position
- Causes of GIRD:
- Effects of GIRD:
  - shoulder biomechanics
  - injury risk
- Effects of GIRD on injury:
- Treatment for GIRD:

Wilk, Macrina, Fleisig, Porterfield, Harker: AJSM '11

- 3 year GIRD study – 1 professional team
- 170 Pitcher Seasons (n=122 pitchers)
- Correlation of spring training shoulder ROM to DL days & surgery (shoulder)
- GIRD: 20 degree or > loss of IR compared to opposite shoulder
- Total Rotation Motion: TROM outside a 5 degree window
- Injuries reported by Medical Team from each professional baseball team

Wilk, Macrina, Fleisig, Porterfield, Harker: AJSM '11

- 3 year GIRD study – 1 professional team
- 33 injuries (30 players)
- Missed games: 1529
- Significantly higher number of players on DL with GIRD (1.9x higher rate) p=0.17
- Significant ROM loss was 12.9 degrees
- Total motion concept (ER + IR): 5 deg > 2.5x higher rate of injury outside TRM
- GIRD & TRROM – 3.5 x greater risk of injury
- GIRD players decreasing each year – why ??
- GIRD is a risk factor – TRROM also risk factor
Wilk, Macrina, Fleisig, Porterfield, Harker: AJSM ‘11

- 3 year GIRD study – 1 professional team
- Correlation of spring training shoulder ROM to DL days & surgery (shoulder)
  ✓ Minor league pitchers were more likely to be injured
  ✓ Major league pitchers miss more games than minor leaguers’ (68 games vs 35 games)
  ✓ (%) injuries fell outside that 5 deg window
  ✓ No relationship between age, yrs of experience to shldr ROM, GIRD, TROM.

The Overhead Thrower

ROM & Injury Risk

n=37 inj

<176=6
n=4

<169°
Increased Risk

176°
Desired ROM

176°
>176=29
n=7

<186°
Increased Risk

170°-185°

n=23

The Overhead Thrower

ROM & Injury Risk

150 160 170 180 190 200 210 220 230 240 250

0 1 2 3 4 5 6 7 8 9 10

0 1 2 3 4 5 6 7 8 9 10
Wilk, Macrina, Fleisig, et al: AJSM ’15

- 8 year GIRD study – 1 professional team
- N=505 Pitcher/ Seasons (n=296 pitchers)
- Correlation of spring training shoulder ROM to DL days & surgery (shoulder & elbow injuries)
  - GIRD did not correlate (p=0.862)
  - TROM did correlate p=<0.05)
  - >ER was protective
  - 77 shoulder injuries
  - Players who had surgery spent 3x more time on DL getting well, 208.5 days on DL
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 retrotorsion compared uninj (4°)
  ★ Players who sustained elbow injuries exhibited an increase in humeral retrotorsion by 5°

AJSM '13

- Relationship between humeral torsion & UE injury in professional pitchers
- N=25 CT scan to determine humeral torsion
- Strong inverse relationship between (D) humeral torsion & injury severity
- The more torsion less risk for injury
  ✓ Every 10° increase risk of inj 30%

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

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Glenn S. Fleisig, PhD
Kyle Aune, MPH
Ronald Porterfield, ATC
Paul Harker, ATC
James Andrews, MD
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

- Subject demographics:
- 296 subjects: 505 pitcher-seasons
- 38 players sustained 50 elbow injuries
- Accounting for 2,581 days on the DL (avg days on DL 51 days/injury) or 68 avg DL days per player
- Shoulder injuries accounted for 5,606 days on the DL during same time period

<table>
<thead>
<tr>
<th></th>
<th>Overall</th>
<th>Elbow Injury</th>
<th>No Elbow Injury</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.7 ± 4.1</td>
<td>25.2 ± 0.6</td>
<td>24.6 ± 0.3</td>
<td>0.45</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>188.6 ± 5.6</td>
<td>187.9 ± 5.9</td>
<td>188.7 ± 5.5</td>
<td>0.39</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>90.8 ± 10.1</td>
<td>91.0 ± 2.5</td>
<td>90.8 ± 0.7</td>
<td>0.07</td>
</tr>
<tr>
<td>Follow-Up Time (mo.)</td>
<td>49.1 ± 28.8</td>
<td>90.1 ± 5.9</td>
<td>46.9 ± 1.8</td>
<td>0.0008</td>
</tr>
<tr>
<td>Single Injury (days)</td>
<td>51.6 ± 33.4</td>
<td>51.6 ± 33.4</td>
<td>51.6 ± 33.4</td>
<td>0.96</td>
</tr>
</tbody>
</table>

- Significant differences in side-to-side ER & IR PROM were found (p<0.0001)
- ER, IR, TROM, & Shoulder Flexion means & SD below
Results

Specific Type of Injuries:

<table>
<thead>
<tr>
<th>Injury</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

Results

- 52/288 players (18%) exhibited GIRD
  - Only 14% of players with GIRD sustained an elbow injury
  - GIRD did not correlate to elbow injuries (p=0.55)

- 140/288 players (49%) exhibited a dominant TRM deficit
  - Pitchers with a dominant TRM deficit exhibited a 2.3x greater risk of elbow injury (p=0.021)

- 52/287 players (18%) exhibited a dominant flexion deficit
  - Players with a dominant flexion deficit exhibited a 2.8x greater likelihood of elbow injury (p=0.010)

Results

Overall

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>N (%)*</th>
<th>Pitchers Who Were Injured, N (%)†</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIRD</td>
<td>52 (18%)</td>
<td>7 (14%)</td>
<td>0.55</td>
</tr>
<tr>
<td>Dominant Flexion Deficit</td>
<td>52 (18%)</td>
<td>13 (25%)</td>
<td>25 (11%)</td>
</tr>
<tr>
<td>TRM Difference</td>
<td>286 (79%)</td>
<td>50 (16%)</td>
<td>6 (9%)</td>
</tr>
<tr>
<td>Insufficient Dominant ER</td>
<td>133 (46%)</td>
<td>26 (14%)</td>
<td>12 (11%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Odds of Elbow Injury</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominant Flexion Deficit</td>
<td>2.8</td>
<td>0.0010</td>
</tr>
<tr>
<td>Insufficient ER</td>
<td>2.3</td>
<td>0.0021</td>
</tr>
<tr>
<td>Stress Reaction</td>
<td>2.3</td>
<td>0.0019</td>
</tr>
<tr>
<td>Insufficient Dominant ER</td>
<td>1.3</td>
<td>0.50</td>
</tr>
<tr>
<td>GIRD</td>
<td>1.0</td>
<td>0.95</td>
</tr>
</tbody>
</table>
Results

The Specific Surgery the Player Underwent:

<table>
<thead>
<tr>
<th>Surgery</th>
<th>N=</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCL reconstruction</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Ulnar nerve transposition</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Loose bodies removal</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Stress fracture (ORIF)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ORIF Removal</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Arthroscopy</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Totals:</td>
<td>10</td>
<td>100%</td>
</tr>
</tbody>
</table>

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 injury
  - GIRD did not correlate with elbow injuries
  - Trend toward increase elbow injuries with excessive ER

Sweitzer, Thigpen, Shanley, Stranges, Wienke, Storey, Moonan, Hawkins: Arthroscopy '12

- Comparison of glenoid morphology & GH ROM between professional baseball pitchers with & without SLAP repairs
- 58 professional baseball were studied
  - GRV was greater on the dominant side
  - Dominant shoulder exhibited greater ER & less IR
  - Increased GRV may be a protective adaptive change seen in overhead athletes & is not reflected in GH joint ROM measurements
Shanley, Rauh, Michener, Ellenbecker, et al: AJSM ’11

- High school softball and baseball players (N=246)
- Measured ER, IR, Horz Add “start of season”
- 27 shoulder & elbow injuries (9 softball & 18 baseball players)

- Players who exhibited > 25 IR loss of Dom shoulder were 4x more likely to be injured
- TRM of 10 to 20 deg resulted in 1.5-2.0 risk of injury
- IR &/or HAdd loss of motion predictive of arm injuries, not ER or TRM – more predictive for baseball players
- softball & baseball players? What type of injuries??

Stretching Techniques
Sleeper’s Stretch
Sleeper’s Stretch

Sleeper’s Stretch with a Lift*
Modified Side-Lying Cross Body Stretch

Modified Sidelying Cross Body Stretch
McClure et al: JOSPT ‘07

- Randomized controlled comparison for stretching posterior shoulder tightness
- 30 subjects with 10 deg loss of IR compared contralateral side
- Compared sleeper stretch (n=15) to cross body (n=15) to control group (n=24)
- Stretches 5 reps for 30 sec for 4 weeks

✓ Significant improvement in IR in cross body group (20°) compared to control (6°) – sleeper stretch (12°) no sign increase in IR compared to control

Moore, Laudner, McLoda et al: JOSPT ‘11

- 61 Division I baseball players randomized into 1 of 3 groups:
  » muscle energy technique for horz abd
  » muscle energy technique for ER
  » control

✓ A single application of MET for the shldr horz abd provided immediate gain in IR & horizontal adduction

Laudner, Sipes, Wilson: J Athl Trn ‘08

- Effects of sleeper stretch during a season
- 33 Division I baseball players were evaluated (15 pitchers, 18 position players)
- ROM assessed pre & post season

✓ 3 stretches of 30 sec stretch
✓ Stretching produced an increase in IR ROM – however not stat sign
Lintner, Mayol, Uzodinma, Jones, Labossiere: AJSM '07

- 85 professional pitchers enrolled in study
- Divided into 2 groups:
  » Group I: pitchers in stretch program 3 yrs or >
  » Group II: pitchers with < 3yrs in stretch program
✓ Pitchers with 3 yrs or more in stretch program exhibited greater IR ROM (74 vs 54 degrees) & greater TROM 217 vs 194 degrees

Corner Stretch – Pect Minor

Rehabilitation of the Thrower’s Shoulder

- Can you stretch too much ??
  ✓ Stretch into ER ROM ?
  ✓ PROM vs Stretching
  ✓ Stretch into IR?
  ✓ Too much ??

What about the TROM concept?
ROM & Stretching

My Thoughts:

- **Stretching & ROM on healthy players:**
  - Stretch to maintain healthy ROM
  - Hold stretch for 30 sec, 3-4 stretches to maintain
  - Dynamic stretching prior to throwing

- **Stretching & ROM on players with injury:**
  - Stretch to improve motion to desired ROM
  - Consider TROM & GIRD
  - Balance the GH joint PROM
  - Stretch for 30 sec but more stretches, more times per day
  - Determine cause of loss of motion (capsule, muscle, …)

Omaha !!!!
Thank You !!!!