Rehabilitation of the Female’s Throwing Shoulder

Kevin E. Wilk, PT, DPT, FAPTA

Female’s Throwing Shoulder

Introduction

• Fast pitch (windmill) pitching
• Intercollegiate teams: In 2016 1,679 NCAA teams - ~31,000 players
• 30 million people playing softball in USA
• Fast pitch softball – (US Olympic team)
• Adolescent females playing fast pitch >2 million

Fast pitch (windmill) softball compared to male baseball
• 30,874 college softball players
• 50,000 college baseball players
• Major differences:
  • Pitch counts:
    » Softball: 6 games (7 innings) same pitcher
    • Could throw 1200-1500 pitches/weekend

Female’s Throwing Shoulder

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Female’s Throwing Shoulder

Introduction

• Number of shoulder injuries increasing
  » Pitchers
  » Position players

• Numerous contributing factors; laxity, strength, biomechanics, frequency, type of throws, etc

• Weight of baseball: 5.5 oz
  » Size of ball
  » Mass of ball

Female’s Throwing Shoulder

Introduction

• Windmill style pitch: 80 mph
• Softball specifics:
  » Size: 12 inch (9-9.24 oz)
  » Weight: 6.25-7.0 oz (5-5.25 oz)
• Mound to home plate: 43 feet
• Different types of pitches:
  » 2 seam fastball
  » 4 seam fastball
  » Change up
  » Rise ball
  » Curve ball
  » Screw ball

77 mph fast pitch softball pitch (107 mph) - velocity
The Overhead Thrower

Introduction - Injuries

- Shoulder & elbow injuries are common in baseball – and appear to be increasing
- In professional baseball:
  - 28% of all injuries occur to the shoulder joint
  - 22% of all injuries occur to elbow joint
- Length of injury time is increasing – days on the disabled list days

- In youth baseball – 50% of players (9-14) complained of elbow or shoulder pain
Lyman et al: Am J Spts Med ‘02
- UE 75% time lost college baseball players

Loosli, Requa, Garrick: AJSM ‘92
- Injury of 8 college teams during NCAA tournament
- Shoulder most common joint injury
  - 45% injuries shoulder/elbow
  - Shoulder tendonitis: most common injury
  - Half of the pitchers missed time during the season because of injury

Shoulder Lesions in Baseball & Softball Players

Female Softball vs Male Pitching

Crockett, Wilk, Andrews ’00

Shoulder Injuries in Baseball

Male Lesions

- Internal impingement
  - Undersurface rotator cuff fraying
  - Glenoid labrum
    - Fraying
    - SLAP lesions (peel-back)
- Biceps Pain
- Rotator Cuff Pathology

Shoulder Lesions in Baseball

Male Lesions

- Internal impingement
  - Anterior capsular laxity
  - Posterior or anterior pain
  - Weakness of ER, supraspinatus
  - Poor posture
  - Altered mechanics of pitching
  - “Inability to get loose”
Shoulder Injuries in Softball

**Female Lesions**

- Increased laxity
  - Glenohumeral joint hyper-laxity
  - Less defined AIGHL complex
  - Less rotator cuff injury (SS↑)
  - Biceps pain
  - Superior labrum fraying
  - Complaints of inflammatory pain

Shoulder Injuries in Baseball

**Female vs Male Throwers**

- Crockett, Wilk, Andrews: Unpublished
  - 32 male throwers compared to 18 female softball
  - Age-matched (mean age 22±5 yrs)
  - Arthroscopic procedure (same phys)
  - Females: 54% concomitant procedures
  - 72% labral debridement, 12% repair
  - 59% biceps complaints
  - 46% RTC debridement
  - Males: 98% concomitant procedures
  - 69% labral debridement, 32% repair
  - 72% RTC debridement

Biomechanics & EMG

Windmill Pitching

- Higher EMG activity of the biceps during the windmill throw than the overhead throw
- 38% vs 19% EMG activity
- (reported as high as 73% Oliver)
- Highest activity occurred from 9:00 to follow through (eccentrics)
Windmill Softball Pitch
Barrentine, et al JOSPT '98

4 phases of pitch
✓ Windup
✓ Stride
✓ Delivery
✓ Follow through

Wind-up phase
Arm in hyperextension
Foot push-offs
Initiate forward translation of body
Windmill Softball Pitch
Biomechanical Analysis

**Stride phase**
- Emphasis on forward translation of body
- Excessive shoulder flexion (180°)
- Linear velocity of hips

**Delivery phase**
- Trunk rotation 430 deg/sec
- Torso rotation 650 deg/sec
- Arm flexion & IR 5,000 deg/sec
*Shoulder flex 3x BW
*Superior forces 98% BW

**Follow through phase**
- Gradually dissipate forces
- Max shoulder post force 59% BW
- Elbow compression force 56% BW

**EMG Analysis**
Maffert: AJSM '97
- From 6 to 3 o’clock
  » Infraspinatus 93% MVIC
  » Supraspinatus 78% MVIC
  » Ant. Deltoid 38% MVIC
Windmill Softball Pitch
EMG Analysis – Maffert: AJSM ’97

• From 3 to 12 o’clock
  » Posterior deltoid 102%
  » Teres minor 87%
  » Infraspinatus 87%

• From 12 to 9 o’clock
  » Subscapularis 81%
  » Pectoralis major 575
  » Posterior deltoid 52%

• From 9 o’clock to ball release
  » Pect major 76%
  » Subscapularis 75%
  » Serratus anterior 61%

Comparison Between Elite Female & Male Baseball Pitchers

Fleisig et al: J Appl Biomech ’09
• 11 elite female & 11 elite male baseball pitchers
  ✓ Female biomechanics were similar
  ✓ Females shorter stride, more open stride, less peak angular velocity at shoulder and arm, and less arm/ball velocity
The Female Thrower’s Shoulder

**Subjective Complaints**

- “Dead arm syndrome”
- Pain anteriorly and posteriorly (superior)
- Clicking in front of shoulder
- Diffuse shoulder weakness
- Tired arm

**Increased Laxity**

- Less developed AIGHL (AB & PB)
- Poorly defined hammock effect
- Large rotator cuff interval
- Greater laxity (A-P), also inferiorly (+ suture)
- Greater demands on dynamic stabilization

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**Wilk, Macrina, Porterfield et al: 2015**

**Pitchers Shoulder ROM (‘05-‘14)**

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<thead>
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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>
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<tr>
<td>Total Rotational ROM:</td>
<td>184.3</td>
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**Wilk et al: 2015**

**Softball Pitchers Shoulder ROM (‘12-15)**

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N=826

N=63

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Wilk - Rehabilitation of the Female Overhead Athlete
2016
### GH Joint PROM Comparison

**Female vs Male Players**

- Females have more ER motion
- Females exhibit sign. more IR motion
- Males tend to exhibit GIRD
- Females exhibit more horz adduction
- But Females have less ER motion with horz adduction

### Wilk et al: 2015

**Softball vs. Baseball Pitchers Shoulder ROM (’12-15)**

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### Total Rotational Motion Concept

**ER + IR = Total Motion**

*“Envelope of Motion”*

**Wilk AJSM ‘02**

Total Rotational Motion is equal bilaterally (within 5 degrees)
The Female Thrower’s Shoulder

Long Head Biceps Complaints

- Clicking over anterior shoulder
- Especially with external rotation
- Localized tenderness and pain
- Source of anterior pain (groove pain)

The Female Thrower’s Shoulder

Rotator Cuff Pathology

- Not typical internal impingement lesion
- Less rotator cuff pathology
- Less impingement pain
- Rotator cuff and labral fraying (superiorly)

The Female Thrower’s Shoulder

Rehabilitation Guidelines

- Increased laxity
  » Dynamic stabilization
  » Co-contraction drills (RS)
  » Proprioception
- Biceps tendon hypermobility
  » Monitor symptoms
  » Limit ER to neutral
  » Watch throwing activity
The Female Thrower’s Shoulder
Assessment – PROM

GLENOHUMERAL JOINT STABILITY
Inferior Restraints

- Sulcus test
  1: 1cm
  2: 2cm
  3: 3cm
  SGHL / CHL

O’Brien SJ
The Female Thrower’s Shoulder
Assessment – GH Joint Laxity

Shoulder Examination
SLAP Tests

Biceps Load Test

My Biceps Load Test

The Female Thrower’s Shoulder
Assessment – SLAP

Shoulder Examination
SLAP Tests

Biceps Load Test I

Resisted Supination ER Test
The Female Thrower’s Shoulder

Assessment – Biceps Brachii

Treatment: Calm Inflamed Tissue Down

Wilk - Rehabilitation of the Female Overhead Athlete
2016
The Female Thrower’s Shoulder
Dynamic Stabilization Drills

Rhythmic Stabilization Drills

The Female Thrower’s Shoulder
Dynamic Stabilization Drills

Rotator Cuff Strengthening Exercises
The Female Thrower’s Shoulder
Strengthening Exercises

The Female Thrower’s Shoulder
Scapular Muscle Training

The Female Thrower’s Shoulder
Serratus Anterior Muscle Training

The Female Thrower’s Shoulder
Serratus Anterior Muscle Training
The Female Thrower’s Shoulder

Key Points

- Participation in female sports increasing – especially softball
- Injuries are on the increase
- Pitching demands are different
  - windmill
- Unique shoulder injuries
- Position players often injured

Softball Pitchers 10 Program

The Female Thrower’s Shoulder

Key Points

- Injuries to females are different than seen in the males shoulder
- Females exhibit greater mobility – poorly developed IGHLC: laxity concerns
- Biceps Pain Common
- Emphasis on dynamic stabilization, scapular control
- Post-operatively – closely monitor motion (go slow!!)

Volleyball – Shoulder Injuries
Suprascapular Neuropathy

Overview - Volleyball

- **Lajtai et al: AJSM '09**
  - N=84 muscle atrophy present in 30%
  - Pain with hitting 63% of players
  - No nerve compression found

- **Lajtai et al: AJSM '12**
  - N=35 infraspinatus atrophy 34%
  - 93% of players weaker on hitting side

- **Witvrouw et al: Br J Sports Med**
  - 25% involvement in pro players
  - Association between ROM & involvement

- **14 healthy asymptomatic volleyball players (D1 level) were assessed**
- **Greater abduction and horizontal adduction when compared to tennis serve or throwing**
- **May contribute to traction injury to Suprascapular nerve**
• 14 healthy college volleyball players (D1 level) were assessed
• High forces applied repetitively may cause a variety of shoulder lesions
• Straight ahead spike generated highest force