Examination and Treatment of Common Shoulder Injuries in Overhead Athletes

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Objectives

At the conclusion of this presentation, the participants will be able to:
- Identify proper biomechanics and common faults in overhead athletes
- Examine common biomechanical faults in overhead athletes and how these assist in the examination of shoulder injuries
- Examine and identify the literature for prevalence, prognosis, and evidence to support techniques and treatments that are related to shoulder injuries in overhead athletes
- Identify and implement common techniques and treatments for shoulder injuries related to overhead athletes

How would you examine and treat?

- 18 year old baseball pitcher with shoulder pain. Pain began 3 weeks ago with insidious onset. He states the pain is on the lateral and posterior aspect of the shoulder. He states that the pain is prominent when he pitches. There is no catching, locking, popping sensations.

The Throwing Athlete

- To prevent, examine and treat injuries what must we know?
- What are normal biomechanics and common pathomechanics in the throwing athlete?
- What is the prevalence and incidence of injury?
- Why commonly do injuries occur?
- What are the most effective examination and treatment techniques?

Normative Characteristics

- ROM
  - Distinguishing
    - Excessive ER and decreased IR at 90 deg. abduction
    - IR: 120-10 deg. IR: -10 deg.
    - Begins early with greatest change between 13-14 yrs.
    - IR is ~7 deg greater and ER is ~7 deg less in dominant UE compared to non-dominant
    - Why the change in dominant vs. non-dominant?
    - Osteo vs. soft tissue changes
    - GIRD vs. TROM

(Fasciole 98, Fiedig 99, Mulligan 03, Wilk 17)
Laxity
- TRAM increased compared to “normal”
  - Joint laxity
  - Acquired vs. congenital
  - 61% of pitchers have + sulcus sign bilaterally (Bigliani 97)
  - Posterior translation actually greater than anterior
  - Total translation equal bilaterally
- The thrower’s shoulder
  - Underlying joint laxity + acquired joint laxity

Scapular Position
Clinical implications of scapular dyskinesis in shoulder injury: the 2013 consensus statement from the ‘scapular summit’
W Ben Köle, Paula M Ludewig, J PW W McClure, Lori A Mcheter, Klaus Bak, Aaron D Scato
- Depression, anterior tilt, protraction
  - May contribute to pathology
  - SICK scapula (Kibler 2013)
  - Scapular dyskinesis is prevalent in a “high percentage” of shoulder injuries
  - Shoulder impingement is affected by scapular dyskinesis
  - Examination of shoulder dyskinesis should be included in all shoulder injuries
  - A treatment strategy including restoring scapula position should be included in a more comprehensive program

Scapular Position
- Depression, anterior tilt, protraction
  - BUT: asymptomatic throwers rest normally in increased anterior tilt (20°) and protraction (39°) (Escamilla 2009, Ludweg 2009)
  - After acute bout of throwing:
    - Increased protraction
    - May worsen across season – similar to GH IR changes
  - Adaptive scapular position affects:
    - Muscle force generation loss: serratus anterior and lower trap
    - Increased anterior IR correlated with loss of IR

Strength
- IR slightly weaker, IR slightly stronger (Hurd 2011, Picha 2016, Mulligan 2003)
  - Comparing dominant to non-dominant UE in asymptomatic shoulders
  - RTC Strength loss
  - Across season – from 3-20%
  - DO NOT PERFORM A STRENGTH PROGRAM
  - Cumulative RTC fatigue
  - After single bout of throwing ~10% loss in all planes
  - Fatigue for up to 2 days after a game
  - Scapulothoracic
    - Pitchers much stronger compared to position players

Proprioception
- Mechanoreceptors (capsule/ligament)
  - Enhances joint stability
  - Instability present there is a decrease in joint position detection and other muscle patterns
  - Mechanoreceptors in the GH capsule and coracohumeral ligament directly influences muscle activity
- Joint position sense significantly more accurate in the non-dominant vs dominant when starting at 75% max IR and moving into IR (Sarfan 2001)
  - Significant decreases after throwing to fatigue (Tripp 2007)
  - Sensorimotor changes resolve as early as 10 minutes later
  - Overall diminished proprioception in dominant arm that improves toward end range (Sarfan 2001)
The Picture of an overhead athlete
- Expect anatomical and physiological differences
- A prevention intervention must be based on unique characteristics of pitchers

Microinstability
- Gross instability is possible
- More commonly cumulative microtrauma secondary to microinstability of the GH joint is seen
- RTC tendinitis/tendinopathy
- Internal impingement
- Secondary and subacromial impingement
- Labral lesions
- Throwingers normally have a great amount of laxity
- Need to be mobile enough to perform, but stable enough to be safe
- Dynamic stability must offset passive laxity and instability

Purpose of Understanding Throwing Shoulder Biomechanics
- Effective mechanics with throwing
- Prevent injury
- Improve performance
- Decrease fatigue
- Decrease energy expenditure
- Improve control
- Reduce force on tissues and joints

Adapted from Escamilla 2017

Phases of Pitching
- Windup
- Stride
- Arm cocking (Highest Load placed on the shoulder)
- Arm acceleration
- Arm deceleration (Highest velocity)
- Follow through

Why be concerned with mechanics?
- If mechanics are flawed, increases the kinetics during the movement
- Any flaw in any phase can increase shoulder forces

Windup
- Back foot plants against the rubber
- The knee lift should place the pitcher in balanced position
- The posting leg should be slightly flexed
- Body weight should be on the ball of the foot

Adapted from Escamilla 2017
Stride

- Stride length should be 80-90% of the pitcher’s height
- At foot contact the throwing arm should be in a “T” position
- Lead foot in a “closed” position (toes point in 5-25 degrees) (Escamilla 1998, Flesig 1999)

- Moderate shoulder activity (DiGiovine 1992)
- If foot position is “opened” increases shoulder anterior force by 15-20% (Escamilla 98)


- This phase begins at lead foot contact and ends at shoulder maximal external rotation
- Body should be stretched in direction of target
- As the pelvis and upper body rotate along the longitudinal axis, energy transfers to the shoulder and arm
- As phase progresses the forearm and hand lag behind producing a maximal external rotation of 165-180 degrees

- Shoulder remains abducted at 80-100 degrees
- At the end of this phase the elbow is flexed 80-90 degrees
- Inadequate ER, decrease in throwing velocity
- Increased ER, increased injury risk (impingement, SLAP, RTC)

Arm Cocking

- Moderate to high activity noted in the shoulder musculature (DiGiovine 1992, Flesig 1996, Escamilla 2002)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>MVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serratus ant</td>
<td>106 %</td>
</tr>
<tr>
<td>Middle trap</td>
<td>51 %</td>
</tr>
<tr>
<td>Lower trap</td>
<td>38 %</td>
</tr>
<tr>
<td>Levator Scap</td>
<td>72 %</td>
</tr>
<tr>
<td>Infraspinatus</td>
<td>74 %</td>
</tr>
<tr>
<td>Teres minor</td>
<td>71 %</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>49 %</td>
</tr>
<tr>
<td>Subscapularis</td>
<td>99 %</td>
</tr>
<tr>
<td>Pec Major</td>
<td>56 %</td>
</tr>
<tr>
<td>Lat Dorsi</td>
<td>50 %</td>
</tr>
</tbody>
</table>

- Shoulder compressive forces (Flesig 1994, Escamilla 2002)
- Can be as high as 70-80% body weight
- Poor position, scapular risk of impingement (Myers 2005)
Arm Acceleration

- Rotator cuff muscles demonstrate high levels of activity. Humeral head and scapular stabilization is critical in this phase.
- Amateurs demonstrate higher muscle activity in infraspinatus, teres minor, and supraspinatus (Gowan 1987)
- In contrast, professionals demonstrate more muscle activity in subscapularis, serratus anterior, and latissimus (Gowan 1987)
- Max Shoulder IR angular velocity 6,250 - 8,540˚/sec (Escamilla 1998, Flesig 1999)
  - (If this were performed for 1 sec the shoulder would make 20 full revolutions)

Arm Deceleration

- Critical in minimizing risk of injury
- Large muscle groups dissipate the energy of the pitching arm
- Trunk should continue to flex forward and upper trunk continues to rotate
- Throwing hand should end at the lead knee or ankle

Muscle Activity (% MVC)

<table>
<thead>
<tr>
<th>Muscle</th>
<th>% MVC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraspinatus</td>
<td>37%</td>
</tr>
<tr>
<td>Teres Minor</td>
<td>64%</td>
</tr>
<tr>
<td>Supraspinatus</td>
<td>39%</td>
</tr>
<tr>
<td>Subscapularis</td>
<td>60%</td>
</tr>
<tr>
<td>Post Deltoid</td>
<td>69%</td>
</tr>
<tr>
<td>Latissimus</td>
<td>59%</td>
</tr>
<tr>
<td>Upper Traps</td>
<td>53%</td>
</tr>
<tr>
<td>Middle Traps</td>
<td>35%</td>
</tr>
<tr>
<td>Lower Traps</td>
<td>70%</td>
</tr>
<tr>
<td>Serratus Ant</td>
<td>51%</td>
</tr>
<tr>
<td>Rhomboids</td>
<td>45%</td>
</tr>
<tr>
<td>Levator Scap</td>
<td>33%</td>
</tr>
</tbody>
</table>
Kinematics

- Dynamic muscular control
  - Deltoid
    - Prime mover of abduction
  - Subscapular
    - Ache to anterior translation
  - Long head biceps
    - Anterior stabilizer
    - Reduces subacromial pressure
  - Force couples
    - Infraspinatus/teres minor
    - Reduces post translation
    - Lower trap/serratus anterior
    - Reduces superior translation

Common Faults

- Rushing the motion
- Flailing arm behind back
- Low elbow or shoulder
- Striding across the body
- Dead front side
- Short arming during follow through

Rushing The Motion

- Moving the body forward early causing it to be ahead of the throwing arm
- Prevents arm from getting into a high cock position
- Negatively affects control causing pitches to be high or inside
- Adds stress on medial capsule elbow and anterior shoulder
- Usually seen in all levels of pitching

Flailing Arm Behind the Back

- Adds stress to anterior shoulder capsule, rotator cuff muscles, and medial stress on elbow
- All levels, usually seen in high school and college pitchers

Low Elbow Or Shoulder

- Caused by wrist or arm hooking, improper hand break, or rushing the motion
- Leads to loss of velocity
- Pitcher throwing upward plane
- Usually throws high or inside
- Adds stress on medial elbow and rotator cuff muscles
- Usually throws high or inside
- Adds stress on medial elbow and rotator cuff muscles
- Seen in all levels of pitching

Striding Across The Body

- Caused by: body being out of balance during leg lift, swinging leg out/opening hips) or not opening enough (closing hips)
- Inhibits proper hip, trunk, and shoulder horizontal rotation
- Decreases velocity and affects control
- Adds stress on shoulder musculature and rotator cuff
- Adds stress on shoulder musculature and rotator cuff
- Usually seen in all levels of pitching
Dead Front Side

- Caused not leading with glove or arm, not driving lead arm down
- Prevents appropriate trunk rotation and trunk extension
- Adds stress on entire throwing arm since pitcher is not throwing with rest of body
- Usually seen in youth, high school, and collegiate pitchers

Short Arming At Follow Through

- Caused by: wide arm path, decreased trunk flexion or arm extension
- Prevents long arc of deceleration
- Early arm fatigue
- Loss of velocity
- Adds stress on the rotator cuff, biceps, and forearm
- Adds stress on the rotator cuff, biceps, and forearm
- Usually seen in youth and high school pitchers

Common Injuries

- Subacromial Impingement
- Rotator Cuff Tendonitis
- Biceps Tendonitis
- Periscapular Strain
- SLAP Tear
- Anterior Instability
- Acromioclavicular Injury
- Multi-Directional Instability
- Pectoralis Major Strain

Prevalence

- Shoulder Injury
- Subacromial Impingement
- Rotator Cuff Tendonosis
- Biceps Tendonitis
- Periscapular Strain
- SLAP Tear
- Anterior Instability
- Acromioclavicular Injury
- Multi-Directional Instability
- Pectoralis Major Strain

*Statistically significant incidence at P<.05

Prevalence

<table>
<thead>
<tr>
<th>Injury</th>
<th>Baseball</th>
<th>Softball</th>
<th>Swimming</th>
<th>Tennis</th>
<th>Volleyball</th>
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<tbody>
<tr>
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<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Periscapular strain</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>11</td>
<td>3</td>
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<tr>
<td>SAIS</td>
<td>12*</td>
<td>25</td>
<td>6*</td>
<td>32</td>
<td>8*</td>
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<tr>
<td>SLAP Tear</td>
<td>7</td>
<td>15</td>
<td>1</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>RTC</td>
<td>19</td>
<td>37</td>
<td>8*</td>
<td>25</td>
<td>5*</td>
</tr>
<tr>
<td>Biceps Tendonitis</td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>7*</td>
</tr>
<tr>
<td>Anterior Instability</td>
<td>7</td>
<td>12</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Acromioclavicular</td>
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<td>0</td>
<td>5</td>
<td>3</td>
<td>0</td>
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<td>AC injury</td>
<td>5</td>
<td>10</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Pec Strain</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

Prevalence

- 1998-2007 Shoulder to elbow injuries 2:1
- 2007-now Shoulder to elbow injuries 1:1.8
- Why the difference?
  - Increase velocity
  - Specialization
  - Less surgery on shoulder now than on elbow

Prevalence

- Kranjnik et al 2010 shoulder injuries in HS baseball and softball

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Baseball</th>
<th>SB</th>
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<tr>
<td>Mechanism %</td>
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<td>39</td>
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<tr>
<td>Overuse/chronic</td>
<td>24</td>
<td>39</td>
</tr>
<tr>
<td>Position %</td>
<td>38</td>
<td>15</td>
</tr>
<tr>
<td>Center field</td>
<td>13</td>
<td>8</td>
</tr>
<tr>
<td>Catcher</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>First base</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
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Prevalence

- Kranjnik et al 2010 shoulder injuries in HS baseball and softball

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<thead>
<tr>
<th>Parameter</th>
<th>Baseball</th>
<th>SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non contact</td>
<td>43</td>
<td>39</td>
</tr>
<tr>
<td>Overuse/chronic</td>
<td>24</td>
<td>39</td>
</tr>
<tr>
<td>Position %</td>
<td>38</td>
<td>15</td>
</tr>
<tr>
<td>Center field</td>
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<td>15</td>
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<tr>
<td>First base</td>
<td>6</td>
<td>15</td>
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</tbody>
</table>

The Throwing Athlete

- Why do they incur injury?
  - Muscle fatigue
  - Muscle weakness or imbalance
  - Alterations in throwing mechanics
  - Loss of motion
  - Soft tissue flexibility
  - Altered static stability
  - Performing at maximal effort for a prolonged period of time

Shoulder Injury

- Multifacet and complex problem

Impingement

- External impingement not commonly seen in younger throwers
- Internal impingement (Walsch, 1992)
  - Under surface of infraspinatus or supraspinatus impinge on posterior superior glenoid labrum
  - Torn margins may tear due to shear
  - Hypovascularity in articular surface impedes healing
Impingement

- Contributing Factors [Myers, 2006]
  - Demonstrates excessive external rotation
  - Internal rotation deficit
  - Posterior shoulder tightness vs osseous changes
  - Muscle weakness
  - Scapular dyskinesis
  - Previous anterior capsule or labral injuries

Secondary Impingement

- As external rotation occurs anterior capsule and band of IR Glenohumeral ligament are lengthened to resist humeral head translation
- If capsular injury internal impingement may cause excessive humeral head translation

Biceps Tendon Injuries

- General function/Role
  - Flexion
  - ER/IR depending on shoulder position (Rodosky 1994, Sakurai, 1998)
  - Elbow flexion
  - Supination
  - Tension in the long head produces all of the motions above at the same time.

- Relative to the anatomic position of the long head of the biceps facilitation of IR or resistance of ER occurs
- Based on the anteromedial force vector on the glenohumeral axis of rotation
- When the arm elevates between 10-45 degrees facilitation of IR occurs and it is resisted due to the posterior rotational force vector to the GH rotation axis
- When the arm elevates (45-90°) tendon repositioned posteriorly resisting ER and provides an anterior and compressive force to the humeral head

Biceps Tendon Injuries

- In throwers
  - Moderate MVC of biceps present in stride and arm cocking phases (DiGiovine 1992)
  - If chronic instability present activation of biceps, supraspinatus, and infraspinatus as compared to non-injured throwers (Glousman 1988)
  - May contribute to SLAP lesions Type II “Peel Back Phenomenon” (Burkhart 1994, 1998)
  - Arm deceleration phase increased biceps activity (DiGiovine 1992, Escamilla 1998)
Rotator Cuff Injuries

- Load sharing capabilities (suspension bridge analogy) (Burkhart 1992, Kedgley 2007)
- Lesions are common in overhead athletes
- Undersurface vs interstitial injury
- If torn and repaired very difficult to return to play
- Biomechanics are essential to understand and possibly prevent

GIRD

- Osseous or soft tissue?
  - Retrotorsion present in young throwers increasing in IR, decrease in IR, no change in TROM (Greenberg 2017)
  - Due to retrotorsion not soft tissue (Hibberd 2014)
  - Need to assess TROM vs isolating IR and ER

Little Leaguer’s Shoulder (Yamashiro 2017)

- Average age 14
- Increase demands?
- Increase distance throwing?
- Onset of pain is gradual
- Higher incidence if GIRD is present (3.5X)
- Pain in proximal humerus
- Duration of symptoms 2.6 months RTP 4.2 months
- Control Symptoms: BIOMECHANICS and STRENGTH

External Impingement/ rotator cuff tendinopathy (Burton 2nd ed)

Examination

- Comprehensive history
  - History of symptoms (comprehensive)
  - Where (as specific as possible)
  - When pain increases (Phase of movement)
  - How does the athlete usually perform the movement
  - Intensity
  - Take breaks
  - What alleviates/ aggravates
    - Feelings of weakness, fatigue, instability, stiffness, clicking or popping
  - Current age
  - Years throwing
  - Level of competition
  - Time of season
  - Innings pitched (this year and last)
Shoulder examination

- Posture
  - Cervical to feet
  - Suspect “what’s tight/ what’s weak”
- ROM
  - Total ROM (IR & ER) (Wilk 2002, Ellinbecker 2002, Meister 2005) should be equal bilaterally (with 5 degrees)
  - Watch positioning (Wilk 2012)
    - At 45° - Mean Dom ER 102°, vs non-Dom ER 96°
    - At 90° - Mean Dom ER 132°, IR 52° vs non-Dom ER 127°, IR 43°
  - Loss of flexion increased risk of elbow injury 2.8X (Noonan 2016)
- Cyriax end feel assessment and tissue assessment

Strength assessment

- Shoulder
- Rotator Cuff
- Scapula
- Core
- Hips

- Single leg squat correlated with scapular dyskinesia (Beckett 2014)

- MMT vs Biodex?

- Common for overhead athletes to have ER weakness
- Determine ratios ER/R and ER/ABO

Scapular dyskinesia

- https://www.youtube.com/watch?v=pEY93k5XXL0
- Kibler Scapular Slide Test
  - 3 positions: each measure from the spinous process to the inferior angle
    - Arms at side
    - Hands on hips
    - 90 deg abduction with full internal rotation
  - >1.5 cm difference from injured to noninjured shoulder + finding
  - Good intra-rater reliability
  - 1.5 cm difference from injured to noninjured shoulder + finding

Objective

Diagnostic values tests for impingement (Cook 2007)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neer</td>
<td>75-89</td>
<td>31-68</td>
<td>1.28-2.19</td>
<td>0.35-52</td>
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<tr>
<td>Hawkins-Kennedy</td>
<td>72-92</td>
<td>25-66</td>
<td>1.22-2.11</td>
<td>0.18-42</td>
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<tr>
<td>Painful Arc</td>
<td>33-74</td>
<td>81</td>
<td>1.73-3.89</td>
<td>0.32-82</td>
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<tr>
<td>Cross-body adduction</td>
<td>23-82</td>
<td>28-82</td>
<td>1.13-1.27</td>
<td>0.64-93</td>
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<tr>
<td>Speed’s</td>
<td>28-69</td>
<td>56-83</td>
<td>1.56-2.23</td>
<td>0.55-74</td>
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<tr>
<td>Internal rotation stress test</td>
<td>88</td>
<td>96</td>
<td>22</td>
<td>0.12</td>
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<tr>
<td>Drop arm</td>
<td>8</td>
<td>97</td>
<td>2.66</td>
<td>0.94</td>
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<tr>
<td>Empty can</td>
<td>63</td>
<td>55</td>
<td>1.4</td>
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<tr>
<td>Full can</td>
<td>66</td>
<td>64</td>
<td>1.83</td>
<td>0.53</td>
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Lift off test and IRLS test for Subscapularis

Diagnostic values tests for rotator cuff integrity (Cook 2007)

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>-LR</th>
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</thead>
<tbody>
<tr>
<td>Neer</td>
<td>83</td>
<td>31</td>
<td>1.69</td>
<td>0.33</td>
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<tr>
<td>Hawkins-Kennedy</td>
<td>88</td>
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<td>Rent test</td>
<td>91.96</td>
<td>75-97</td>
<td>3.64-32</td>
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<td>Lift-off</td>
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<td>IRLS</td>
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<td>96</td>
<td>24.25</td>
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<tr>
<td>Empty can</td>
<td>77</td>
<td>68</td>
<td>2.4</td>
<td>0.33</td>
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<tr>
<td>Full can</td>
<td>77</td>
<td>74</td>
<td>2.96</td>
<td>0.31</td>
</tr>
</tbody>
</table>

Lift off test and IRLS test for Subscapularis
**Biceps Load Test II - SLAP**

**Figure 1.** In the biceps load test the forearm is supinated during the biceps muscle contraction with the shoulder in abduction and external rotation.

**Kim Test**

A - With the patient in a sitting position with the arm 90 degrees of abduction, the examiner holds the elbow and lateral aspect of the proximal arm, and a strong axial loading force is applied.  
B - While the arm is elevated 45 degrees diagonally upward, downward and backward force is applied to the proximal arm.  
A sudden onset of posterior shoulder pain indicates a positive test result, regardless of accompanying posterior clunk of the humeral head.

**Jerk Test**

A - An axial force is applied to the arm in 90 degrees of abduction and internal rotation.  
B - The patient’s arm is horizontally adducted while axial load is maintained.

---

**Objective**

**Diagnostic values tests for SLAP tear (Cook 2007)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yergason</td>
<td>13-43</td>
<td>79-96</td>
<td>1.70</td>
<td>3.00</td>
</tr>
<tr>
<td>Speed’s</td>
<td>9-100</td>
<td>11-75</td>
<td>1.23</td>
<td>6.32</td>
</tr>
<tr>
<td>Anterior slide</td>
<td>8-13</td>
<td>84</td>
<td>1.04</td>
<td>1.14</td>
</tr>
<tr>
<td>Crank</td>
<td>9-46</td>
<td>56-83</td>
<td>1.04</td>
<td>4.61</td>
</tr>
<tr>
<td>Biceps load</td>
<td>91</td>
<td>97</td>
<td>29.29</td>
<td>.09</td>
</tr>
<tr>
<td>Biceps load II</td>
<td>90</td>
<td>97</td>
<td>26.38</td>
<td>.11</td>
</tr>
</tbody>
</table>

**Diagnostic values tests for other labral pathology tear (Cook 2007)**

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>- LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kim test</td>
<td>80</td>
<td>94</td>
<td>1.13</td>
<td>.00</td>
</tr>
<tr>
<td>Jerk (post/inf)</td>
<td>73</td>
<td>98</td>
<td>13.33</td>
<td>.21</td>
</tr>
<tr>
<td>Crank</td>
<td>14.9</td>
<td>90-93</td>
<td>1.43</td>
<td>.09-95</td>
</tr>
</tbody>
</table>
Objective

- Diagnostic values tests for joint laxity [Cook 2007]

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>+ LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apprehension</td>
<td>53</td>
<td>99</td>
<td>53</td>
<td>47</td>
</tr>
<tr>
<td>Anterior</td>
<td>64</td>
<td>99</td>
<td>64</td>
<td>36</td>
</tr>
</tbody>
</table>

Combination of Tests

- Rotator Cuff Tear [Park, 2005]
  - Drop arm, painful arc, ERRT
    - All 3 (+) + LR 1.37 (rule in, specificity)
    - All 3 (-) - LR 0.16 (can’t rule out)

Outcomes for Non Operative RC Injury

- Morrison, JBiS 798 A, 1997
  - 636 shoulders with 27 month follow up
  - 413 satisfactory result with NSAIDs and PT
  - 91% - Type I acromion
  - 68% - Type II acromion
  - 64% - Type III acromion

Diagnostic accuracy of clinical examination features for identifying large rotator cuff tears in primary health care

Outcomes for Non Operative RC Injury

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Treatment

- Intervention Strategy
  - Based on clinical evaluation
  - Address all possible deficiencies found at all levels of the kinetic chain
  - Identify areas of weakness in thoracic spine, core, etc
  - Use the algorithm in upcoming slides to guide treatment for the scapular muscles
Shoulder impingement (non-surgical)
- Protection
  - Control inflammation
  - Patient education
  - Maintain integrity of soft tissues
  - Control pain and maintain joint integrity
  - Develop support in related regions
  - Use biology and biomechanics to guide

Controlled motion phase
- Patient ed
- Develop a strong mobility soft tissue structure
- Improve postural awareness
- Modify joint tracking mobility
- Develop balance in length and strength of shoulder girdle mm
- Develop muscular stabilization and endurance

Return to function
- Increase mm endurance
- Develop quick motor response to stresses
- Progress functional activities

Evidence indicates that patients with impingement and rotator cuff symptoms = altered scapular kinematics
If neck pain is present -> altered postural mechanics -> altered scapular kinematics
Primarily identified as limited flexibility in the soft tissue and lack of muscle performance

How much exercise to perform?
- 3 sets of 10
- Considerations
  - Untrained vs trained
  - Neuromuscular adaptive response (3-4 wks) vs morphological changes
  - Overload principle (3-4 sets x 10 reps)

How often?
- 3X/wk
- Off days for catabolic recovery
  - Stretching and working other mm groups
  - Go working on RC in clinic: the HEP stretching and scapulothoracic ev

BIG QUESTIONS
BIG QUESTIONS
BIG QUESTIONS

- Which areas to focus on?
  - Overhead athletes use whole body
  - Functional activities
  - Shoulders
  - Scapular thoracic area
  - Total arm
  - Legs
  - Core
    - Trunk and legs make up 55% of power in a baseball throw

- Overhead athletes use whole body
- Functional activities
- Shoulders
- Scapular thoracic area
- Total arm
- Legs
- Core

BIG QUESTIONS

Which exercises are the best?

- Glenohumeral
  - Scaption with thumb up
  - Press down
  - Shoulder flexion
  - Prone horizontal extension
- Scapular thoracic (Moseley)
  - Scaption with thumb up (upper trap)
  - Press down (lower trap, lat, teres major, pec)
  - Push up plus (latissus)
  - Rowing (rhomboids, middle trap)

Lack of Flexibility

- Which exercises are the best?
  - Rotator cuff Gould and Davies
    - 30/30/30 position (abduction/scaption/ diagonal tilt)
    - Perform: IR/ER
    - Prevents “wringing out” effect of the RC

Lack of Muscle Performance

- Altered muscle activity, strength or changes in timing. Typically seen in the:
  - Serratus Anterior (SA)
    - Decreased activity, strength
  - Upper Trapezius (UT)
    - Hyperactivity and early activation
  - Middle Trapezius (MT)
    - Decreased activity, strength and late activation
  - Lower Trapezius (LT)
    - Decreased activity, strength and late activation

Lack of muscle performance

- Wegner (Man Ther; 2010): isometric shoulder abduction and external rotation significantly greater levels of LT while no changes were noted in the UT and MT
- Cools (Br J Sports Med; 2010): relative weakness in MT, LT in adolescent overhead athletes
- Helgadottir (J Electromyogr Kinesiol; 2011): during arm elevation less activation of SA
Exercises to consider

Rehabilitation of scapular dyskinesis: from the office worker to the elite overhead athlete
Ann M J. Cool, Filip Stryck, Kristof De Mey, Anneleen Maenhout, Birgje Castelein, Eefje Capela

Rehab for flexibility deficits

Borstad (JSES; 2006) & Muraki (Phys Ther; 2009) identified several techniques to improve pec minor length.

Borstad (Phys Ther; 2006) noted in healthy subjects passive horz abd with shoulder at 90 degrees of abduction and ext rot more effective than seated manual stretching with shoulder in neutral position and supine manual stretch performed by the therapist.

However, from a clinical perspective, aside from sitting manual stretching can place shoulder in acromial or internal impingement.

Ellenbecker (Br J Sports Med; 2010) suggested that pec minor be stretched while performing passive retraction and post tilting of the scapula with shoulder in slight elevation and slight ext rot with direct pressure on coracoid process.

Rehab for flexibility deficits

Posterior capsular tightness

Short term and middle term effects have been noted in range of motion and pain reduction.

Sleeping stretch, Cross body stretch, and dorso glides effective in restoring range of motion Maenhout (Am J Sports Med; 2012), Manske (Sports Health; 2010), Cools (Shoulder Elbow; 2012)

Rehab for muscle deficits

For muscle performance issues (follow ex physiology principles)

3 stages for scapular rehab

- Conscious muscle control
- Muscle control and strength for daily activities
- Advance control during sports activities
Conscious muscle control

- Activate LT
- Scapular Orientation: Mottram (Man Ther; 1997), Mottram (Man Ther; 2009)
- Patient palpates the coracoid with contralateral finger and then pulls away the coracoid from the finger moving the scapula back.
- Increased muscle activity

Spinal correction postural exercises
- Correct forward head, increased kyphosis and protraction
- Possible use of therapeutic tape
  - Tape scapula into extension, posterior tilting and retraction ( proprioception )

Muscle control and strength for daily activities

- Increased muscle activity

Muscle control and strength for daily activities

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Muscle control and strength for daily activities

- Closed chain exercises
  - Pushing hands on thighs in upright sitting (Ludewig Am J Sports Med; 2004)
  - Push up exercises should be used with caution given the impingement position (Bihoumbr J Sports Med; 2010, Lunden JSES; 2010)
  - Wall slide and bench slide exercises = increased activities of SA and LT while LT is low (Uhl Phys Med Rehabil; 2010, Ludewig Am J Sports Med; 2004)
  - Endurance based 3-5 sets 12-15 reps 50-60%

Muscle control and strength for daily activities

- Focus on muscle control and co-contraction or muscle strength (dependent upon the clinical exam)
- Mirror daily activities - ex: working on computer using proper posture

Muscle control and strength for daily activities

- Select activation of weaker muscles while minimizing activity of hyperactive muscles
- Decrease use of UT
- Increase use of MT, LT and SA
- Emphasize force couples
  - 3-4 sets X 8 reps 70-80%

Muscle control and strength for daily activities

- Muscle imbalance/ Strength deficit

Muscle control and strength for daily activities

- Muscle imbalance/ Strength deficit

Muscle control and strength for daily activities

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Advanced Control
- Advance to this phase once muscle balance achieved
- Integration of the kinetic chain into the exercise program
  - Swimmers can focus on exercises in prone or supine depending upon activity
  - Throwing athletes perform exercises with external rotation and eccentrics
  - Gymnasts side and prone bridging activities

Other Exercises
- Throwners Ten
- Advanced Throwners Ten (Wilk 2011)
- Stability ball (ER/IR, full can, lateral raises, T’s, Y’s, row in ER, extensions, lower trap, high row into ER, biceps/triceps, Wrist Flex/Ext & Sup/Pron, Sidelying ER
  - Use sustained holds and alternate arms

Other Exercises
- Plyometrics
  - 2 hand
    - Chops, rotational and diagonal throws
  - 1 hand
    - Wall ball
    - Throw against plyoback

Other Exercises
- Rotation with tubing

Other Exercises
- Rotational Lunge
  - Step one leg forward bending the knee
  - Slowly return to a standing position
  - Corrects striding across body and increases stride length

Other Exercises
- Dynamic stability and neuromuscular control
  - Proprioception
    - Efficient response to different stimulation
      - Gravitational and kinesthetic
        - Position
        - Movement
        - Receptive neuromuscular control
        - Closed kinetic chain exercise
        - Plyometrics
Comments and Questions

- THANK YOU!