Evaluation and Treatment for the Symptomatic Overhead Thrower

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UW Sports Medicine Symposium
Objectives

- Identify risk factors in overhead throwers
- Gain an understanding of how to address risk factors in the rehabilitation setting
- Identify phases of the baseball pitch
- Gain an understanding of the difference between normal and abnormal mechanics
- Incorporating interval throwing
- Case Examples
Overhead Throwing Related Injuries

- Shoulder Impingement/Instability
  - Cuff
  - Labrum
- UCL pathology
- VEO (valgus extension overload)
- Flexor-pronator tendonitis
- Growth plates (youth)
Epidemiology Studies

- 1996 Survey for USA Baseball
  - 28 orthopaedic surgeons and baseball coaches
- 1997-1998 study
  - 200 pitchers each spring (300 total subjects)
  - 8-12 year old pitchers
- 1999 (USA Baseball)
  - 500 pitchers in spring
  - 9-14 year old pitchers
USA Baseball Medical & Safety Advisory Committee

- Regulate pitch count and type of pitch
- No breaking pitches in competition until puberty
- Develop and maintain proper mechanics
- Commit to year-round physical conditioning as bodies develop
- Pitchers should not pitch for more than one team in overlapping seasons
- Pitchers should not participate in any throwing drills or any stressful overhead activities for at least 2-3 months
# Pitch Count Limits

<table>
<thead>
<tr>
<th>Age</th>
<th>Max Pitches / Game</th>
<th>Max Pitches / Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>8–10</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>11–12</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>13–14</td>
<td>75</td>
<td>125</td>
</tr>
<tr>
<td>15–16</td>
<td>90</td>
<td>2 games / week</td>
</tr>
<tr>
<td>17–18</td>
<td>105</td>
<td>2 games / week</td>
</tr>
</tbody>
</table>
Ages to **LEARN** types of pitches

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastball</td>
<td>8</td>
</tr>
<tr>
<td>Change–Up</td>
<td>10</td>
</tr>
<tr>
<td>Curveball</td>
<td>14</td>
</tr>
<tr>
<td>Knuckleball</td>
<td>15</td>
</tr>
<tr>
<td>Slider</td>
<td>16</td>
</tr>
<tr>
<td>Forkball</td>
<td>16</td>
</tr>
<tr>
<td>Splitter</td>
<td>16</td>
</tr>
<tr>
<td>Screwball</td>
<td>17</td>
</tr>
</tbody>
</table>
### Pitch Types and Elbow Stress

- **Kinetic Comparison**
- **Collegiate Baseball Pitchers**

<table>
<thead>
<tr>
<th>Kinetic Parameter</th>
<th>Fastball</th>
<th>Slider</th>
<th>Curve</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varus Torque (Nm)</td>
<td>82</td>
<td>81</td>
<td>79</td>
<td>71</td>
</tr>
<tr>
<td>Flexion Torque (Nm)</td>
<td>40</td>
<td>37</td>
<td>41</td>
<td>32</td>
</tr>
<tr>
<td>Proximal Force (N)</td>
<td>1056</td>
<td>1145</td>
<td>998</td>
<td>910</td>
</tr>
</tbody>
</table>
Ulnar Collateral Ligament

**UCL Reconstruction in HS Baseball Players**
(Petty, Cain, Andrews. AJSM 7/2004)

Throwing History-Risk Factors (using criteria from USA Baseball)

- 23% had inadequate w/u prior to pitching
- 62% failed to get **adequate rest b/w outings**
- 42% had **extreme overuse in a short period**
- 67% threw breaking pitches before the recommended age
- 73% had a fastball > 80 mph
- 69% failed to get **adequate rest (>2 mos)**
- Players averaged 3 risk factors
Are you Special?

- Throwing distance direct correlation to MPH
- Dr. Michael J. Axe (April 2009 – Sports Health)
- Identify elite or gifted players at early age
- Less emphasis placed on how fast you can throw
- Does not require special equipment
Benefits of Throwing for Distance

- Athletes 3 or more SD above the mean (exclusive group)
- Recommend 2 years subtracted from age to determine pitching volume
  - Method of protecting “gifted athletes”
  - Concern about growth plate and ligament health
- Annual or semi-annual method of tracking progress
- Useful if using interval throwing program

- Prospective 3 year study (2005-07)
- 169 MLB Pitchers
- PROM assessed in Spring Training
- GIRD sign
  - >18 degrees R vs L
  - Significantly higher rate of injury
- TM outside 7 degrees diff. higher risk too
- If both present = 1.5x greater risk of injury
Reinold & Gill: 06-08

- Effect of Throwing (SEASON)
  - 117 MLB pitchers
  - ROM
    - No change in IR (pitchers who stretched frequently)
    - Significant decrease in IR and TM (didn’t stretch)
    - 5 degree increase in ER for both groups
  - Strength (all players performed shoulder program)
    - Decrease ER 3 - 4%
    - Decrease ABD 16 - 21%

- Significant INCREASE in strength in pitchers who have never performed shoulder program
Dines et al (AJSM 2008)

- Loss of IR and Elbow Injury
  - 29 baseball players (UCL insufficiency)
  - Matched to 29 players without UCL
  - Sign diff Shoulder IR PROM
    (29 degrees vs. 13 degrees)
Youth Baseball Player?

- No known studies examining effects of stretching program on shoulder ROM
- No known studies examining effects of baseball specific conditioning program enhancing muscle strength
- Escamilla et al (current – ASMI)
  - Examine Effects of 4 week program
  - Throwing velocity
  - Shoulder ROM/Strength
4 Week Program

- 34 subjects (11-15 y/o)
- 3x/week (12 sessions - 75 minutes each)
- 10 minute warm up
- 30 minutes strength and stretch
- 30 minutes long toss
- 5 minute stretching
Results

- 4% increase in velocity (control no change)
- 3 of 8 strength measures increased
  - SSPS, Hoiz ABD, ER (greatest)
  - 1 of 8 measures for control (ER)
- 14 degree decrease in IR (control 8 degrees)
  - Did not include sleeper stretch
- Further studies needed!
What about Hips/LE’s?

- In a 2001 study (Matsuo et al)
- High velocity throwers were able to plant and extend the lead knee appropriately to provide stability to the pitching motion
- In addition, the Lexington Clinic was provided an outline evaluating kinetic movements. They included a .89 correlation between throwing velocity and lower body strength.
Prone Hip AROM

  - Differences > 16 degrees between sides for either IR or ER are indicative of significant clinical findings
  - Difference > 30 degrees between hip IR and ER are indicative of significant clinical findings
Moving in the Right Direction

- Madison Area Youth Baseball
  - Currently using USA Baseball Guidelines
- General sense - professionals working together
- Open to the idea - pre-season screenings and direct access
Pre-Season Youth Screens

- Throw for distance
- Functional Screen (Modified Gray Cook)
  - Shoulder/Hip ROM
  - Spine Mobility
  - Upper Quarter Strength
  - Balance Point
  - In-Line Lunge
  - Trunk Stability Test(s)

- Biomechanical Analysis?
Indications for Biomechanical Analysis

- When do we perform analysis?
- Is it justified to conduct motion analysis with limited resources available?
- Is it appropriate to perform motion analysis at the first encounter with the patient?
When to Perform Analysis?

- Symptoms should not influence velocity
  - Should be able to pitch $\geq 50\text{-}60\%$

- Keep NM skeletal impairments in perspective
  - Significant weakness
  - Mobility limitation
  - Balance

- Timing of Season
Is it Justified with Limited Resources?

- Specificity of Analysis
  - Mound
  - Throwing Distance
  - Target

- Limited to 2D analysis
  - Side (Sagittal Plane)
  - Front or Back (Coronal Plane)

- Yes
  - Normative data has significant range
  - Limit Error with consistency of measurement
Pitching Phases

- Wind Up
- Stride
- Arm Cocking
- Arm Acceleration
- Deceleration
- Follow Through

Whiteley R., Baseball Throwing Mechanics as They Relate to Pathology and Performance – A Review. 
Wind Up

- Begins with initiation of movement and ends when the leg reaches max height
- May include slight cocking or turning of back to batter
- **Key to wind-up is good balance position “Balance Point”**
Wind Up

- Things to look for:
  - Smooth
  - Straight forward
  - Eyes on target
  - Balance in all planes
Stride

- Starts: Lowering of lift leg
- Ends: Foot contact
- Ball and glove separate same time as dropping of lift leg
- Down-out-up motion back toward 2nd base
- Stay “on top of ball” with hand
Stride – Foot Contact

- Stride Offset: +/- 10cm on either side of “line”
  - Line = center of stance foot to home plate

- Stride Foot Angle: 3 degrees open to 30 closed
  - Closed = lead foot toward throwing arm side
  - Direct relationship with degree of “openness” with anterior shoulder forces

- Stride length: 75-90% of height
Stride – Foot Contact

- Knee angle: 125-145 degrees
Stride – Foot Contact

- 90 degrees of elbow flexion
- 90-100 degrees shoulder ABD
- 45-60 degrees shoulder ER
- < 30 degrees horizontal ABD
Stride

- Too long = Decreased trunk and hip rotation
- Too short = Increased UE demand
- Length may change with mound design
- Consider LE strength and flexibility
Arm Cocking

- **Start:** Stride leg foot contact
- **End:** Max shoulder ER
- Shoulder 90-100 ABD
- ER may reach >180 ER
- Elbow 80-90 flex
- Usually some trunk extension
Arm Cocking

- Anatomy at Risk
  - Anterior capsule
  - Pinched labrum / Internal impingement
  - Undersurface cuff tear
Arm Acceleration

- One of fastest motions in all of sports
- Start: Max shoulder ER
- End: Max shoulder IR angular velocity
- Hip rotation initiates movement
- Elbow extended at ball release
- Force at 180 ER at 90 ABD = 40 lbs placed in hand
Arm Deceleration

- Start: Max shoulder IR angular velocity
- End: Max shoulder IR
- Elbow is almost fully extended
- Forearm pronates
- Posterior cuff and biceps control rate of deceleration
Follow-Through

- Start: Max shoulder IR
- End: Arm crosses the chest
- Continuation of all the previous motions
- Increase stresses if not allowing it to happen
- Very little ms activity
Common Pitching Faults

- Poor Balance Point / Concentration
- Timing when starting stride phase
- Increased horizontal ABD
- Inappropriate elbow angle
- Shoulder angle <90 degrees
- Decreased stride length
- Landing with foot open
- Poor follow through
Correction Techniques

- Balance Point – Focus on Target
  - 5 second hold
- Ball separation drill
  - Ball separation with “show ball”
  - Ball separation with stride
- “Flexed T”
  - DBs
  - Weighted Ball
  - Floor Targets
- Arm path follow through
- Stride with spri band / wall
- Medicine Ball (Chop)
Balance Point

- Goal: Improve the “Stable base” and establish a “power platform”
- Equate with scapular setting
- Thrower should feel comfortable
- Minimal energy expenditure
- May introduce alternative balance strategies
Ball Separation Drill

- Goal: Improve the timing between UQ and LQ
- Down and back with hand – Knee drop
- Show the ball to 2\textsuperscript{nd} base and stride to foot contact
- End in “T” position
Stride Drill

- Goal: To increase stride length
- Place more emphasis on LE to generate power
- Monitor for early hip rotation
- Use of band to promote power
- Without band to work on target
Interval Throwing

- Consider with any overhead thrower
- Specificity of training
- Age and position specific guidelines
- Instructional
  - Preseason
  - Non-throwing arm injury
  - Throwing arm (bruise or bone involvement)
  - Throwing arm (tendon/ligament injury -mild )
  - Throwing arm (tendon/ligament injury -moderate, severe, or post op)
Interval Throwing (cont.)

Structure
1. Dynamic Warm Up (break a sweat)
2. Shoulder Stretches (others?)
3. Throwing program
4. Strengthening Exercises
5. Stretches
6. Ice (optional)
Interval Throwing (cont.)

- **4 Phases**
  - Return to Throwing
  - Return to Pitching
  - Intensified Pitching
  - Simulated Game

- **Phases**
  - Number of pitches
  - Distance
  - % speed (fastballs)
  - Type of pitch
Interval Throwing (cont.)

Guidelines ("soreness rules")

- If no soreness, advance 1 throwing step every throwing day

- If sore > 1 hour after throwing, or the next day, take 1 day off and repeat the most recent throwing program workout.

- If sore during warm-up but soreness is gone within the first 15 throws, repeat the previous workout. If shoulder/elbow becomes sore during this workout, stop and take 2 days off. Upon return to throwing, drop down 1 phase.

- If sore during warm-up and soreness continues through the first 15 throws, stop throwing and take 2 days off. Upon return to throwing, drop down 1 phase.
Video Examples
Bibliography

Bibliography

http://www.uwhealth.org/sports-medicine/sports-rehabilitation/10099