Throwing-Related Injuries of the Subscapularis in Professional Baseball Players

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Introduction
Injuries to the shoulder are a common cause of missed playing time in professional baseball athletes. These injuries predominantly involve the supraspinatus tendon or the glenoid labrum. The purpose of this project is to describe a series of throwing-related injuries to the subscapularis muscle-tendon complex that have been previously unreported amongst baseball players. Additionally, it is the goal to describe a mechanism of injury as well as a treatment program for athletes with this injury.

Methods
A retrospective review of shoulder magnetic resonance imaging (MRI) scans of players from 1 Major League Baseball organization over the course of 5 years was performed to identify cases with findings suggestive of a subscapularis injury. The MRIs were graded and the medical records were reviewed to assess clinical findings, treatment plans, and follow-up. In the injured cohort, preinjury baseline measurements of shoulder motion including external rotation at 90° of abduction were compared to measurements from a non-injured baseball athlete cohort to evaluate whether decrease external rotation is a risk factor for this injury.

Results
A total of 133 MRI scans of the shoulder were evaluated. Eleven of the 133 MRIs demonstrated signal changes suggestive of subscapularis injury. Ten of these 11 patients had clinical findings supporting a diagnosis of throwing-related subscapularis strain. There were 4 grade I, 4 grade II, and 2 grade III injuries. All injuries occurred in the inferior half of the subscapularis at the myotendinous junction. Risk of subscapularis injury increased with lower levels of dominant arm external rotation (odds ratio, 0.89; 95% CI, 0.82-0.94; P < .001). A threshold of dominant arm external rotation of <106° demonstrated sensitivity of 0.700 (95% CI, 0.392-0.897) and specificity of 0.951 (95% CI, 0.888-0.982) for subscapularis injury. All players were treated conservatively; only 1 did not return to play. Of the remaining players, the mean number of days missed because of injury was 27 (range, 11-61 days).

Conclusions
Throwing-related subscapularis injuries occur in the inferior half of the muscle at the myotendinous junction. The subscapularis muscle fibers are oriented along a fan shape because of the relatively narrow insertion on the lesser tuberosity and proximal humerus and broader origin on the scapula with muscle fiber alignment dependent on arm position. When the thrower’s arm is at 90 degrees of abduction and external rotation, the inferior fibers of the subscapularis comes to be aligned in the transverse plane across the glenohumeral joint and are placed on greatest stretch during the late cocking and early acceleration phases of throwing. Our data suggest that there is an increased risk of these injuries with lower levels of dominant arm external rotation as this shorter arc requires greater force production by the subscapularis muscle to achieve the same peak throwing velocity.

<table>
<thead>
<tr>
<th>MRI Tear Grade</th>
<th>Number of Patients</th>
<th>Mean Number of Days Missed (SD)</th>
<th>Median Number of Days Missed</th>
<th>Range of Days Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>20.5 (6.7)</td>
<td>18</td>
<td>15-30</td>
</tr>
<tr>
<td>2</td>
<td>3a</td>
<td>27.0 (24.3)</td>
<td>15</td>
<td>11-55</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>40.5 (29.0)</td>
<td>40.5</td>
<td>20-61</td>
</tr>
</tbody>
</table>

a One player with a grade 2 tear did not return to play and is excluded from this analysis.

MRI = magnetic resonance imaging
SD = standard deviation

Range of Days Missed for Players With Tears

Stretching of the subscapularis myotendinous junction in pitching. Anterior (A) and anterolateral (B) views of the subscapularis muscle and tendon with the arm in the late cocking phase of throwing demonstrate stretching of the myotendinous junction over the humeral head (arrows).

Empirical and modeled probability of subscapularis injury as a function of dominant arm external rotation at 90° of abduction (D ER 90).

Location of throwing-related subscapularis injuries. Sagittal (A) and axial (B) T2-weighted magnetic resonance images with fat suppression demonstrate the injured myotendinous junction of the subscapularis along the inferior half of the muscle (thick arrows). (C) Axial image superior to (B) demonstrates a normal subscapularis tendon (thin arrow).