Anterior shoulder capsular tears in professional baseball players

Lawrence V. Gulotta, MD*, Daniel Lobatto, MD, Demetris Delos, MD, Struan H. Coleman, MD, PhD, David W. Altchek, MD

Sports Medicine and Shoulder Service, Hospital for Special Surgery, New York, NY, USA

Background: Tearing of the anterior capsule of the shoulder is a rare but debilitating injury for throwing athletes. However, there is very little in the literature to guide its diagnosis and treatment. In this case series, we outline our experience with anterior capsular tears of the shoulder in professional baseball players.

Methods: Five professional baseball players were diagnosed with midsubstance tears of their anterior capsule. A trial of rest and rehabilitation failed in all patients, and they eventually underwent surgery. These patients were retrospectively reviewed. The presenting symptoms and findings were documented, and outcomes were assessed by the player’s ability to return to play.

Results: The mean age was 33.5 years (range, 31-37 years), and all patients presented with anterior shoulder pain and the inability to throw. No patient had an acute traumatic injury. Magnetic resonance imaging provided the correct diagnosis in 4 patients, and the diagnosis was made with diagnostic arthroscopy in the fifth. Three underwent arthroscopic repair, and 2 underwent open repair of the anterior capsule. Of the 5 players, 4 (80%) returned to their preinjury level by a mean of 13.3 months (range, 8-18 months).

Conclusions: Anterior capsular tears can occur in older throwing athletes. Surgical repair, whether arthroscopic or open, can yield good results in most patients.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Throwing athletes; baseball; shoulder; shoulder capsule

Anterior capsular lesions of the shoulder are often associated with traumatic glenohumeral instability episodes. However, repetitive microtrauma of the shoulder without frank dislocation can also lead to capsular attenuation or discrete capsular tears. This entity is poorly understood and not well characterized. Case reports have described lesions of the anterior capsule in the absence of frank instability in overhead athletes. However, they have never been described in a series of baseball players.

Midsubstance tears of the anterior capsule without discrete instability have been observed by the senior author (D.W.A.) in a subset of professional throwing athletes. These athletes tend to be older overhead throwers. They had no history of a discrete instability episode, yet nonetheless they reported shoulder pain and apprehension in the throwing position that resulted in decreased throwing ability and overall performance.

This case series is the first, to our knowledge, to report on midsubstance glenohumeral capsular tears in professional baseball players. In this case series, we report on the outcomes of 5 professional athletes and hope that by...
presenting our experience we can increase awareness of this clinical phenomenon and enhance decision making.

Methods

This study is Health Insurance Portability and Accountability Act compliant.

Patients

We retrospectively reviewed the database of the senior author (D.W.A.) inclusive of the years 1995-2012 seeking the charts and records of patients who were diagnosed with isolated mid-substance anterior capsular tears. Five professional baseball players were identified who fulfilled the criteria. All reported anterior shoulder pain and the inability to maintain velocity in their pitches (ie, “dead arm”). Additional inclusion criteria were as follows: a minimum of 1 year of postoperative follow-up and no documented history of prior glenohumeral dislocation or subluxation event. Because this was a retrospective review, patient consent was not needed for inclusion in this study.

Preoperative evaluation

All patients were evaluated preoperatively by the senior author (D.W.A.). Shoulder range of motion (ROM) and strength were recorded. Provocative maneuvers for instability testing, including load-and-shift tests, apprehension-relocation tests, and tests for laxity such as the sulcus test were performed and recorded. All patients underwent preoperative magnetic resonance imaging (MRI) of the affected shoulder before surgery (Figs. 1 and 2). All players were initially treated with a trial of rest and rehabilitation. This consisted of at least a 6-week period of not throwing. During that time, the shoulder was rehabilitated with a concentration on restoration of internal rotation, rotator cuff strengthening, and periscapular muscle strengthening and coordination. Before attempting to return to competition, all patients went through an interval throwing program. However, none of them were able to return to their previous level of performance after nonoperative treatment, and all elected to undergo surgical repair.

Examination under anesthesia

All patients underwent thorough shoulder examination under anesthesia in the operating room before the surgical procedure. The load-and-shift test was performed with the patient in the supine position with the shoulder abducted to 90° to evaluate for shoulder laxity. Grading was recorded according to the classification of Altchek et al.1

Operative technique

Open repair

Open repair of the capsular tear was performed for lesions that were determined to be difficult to access by arthroscopic means (2 of 5 patients, 40%). This was the case for tears that were laterally based. Once diagnostic arthroscopy was completed and the decision was made to proceed with open repair, a standard deltopectoral approach to the shoulder was used to gain access to the joint. The subscapularis was split longitudinally in line with its fibers. If necessary, a portion of the inferior subscapularis tendon was taken down off its insertion on the lesser tuberosity to gain access to the inferior capsule. This was performed in 1 patient. The capsular tear was identified, and the capsular edges were repaired in side-to-side fashion with suture. Plication was not performed so as to minimize the risk of over-constraining the shoulder.

Arthroscopic repair

Most of the lesions were repaired arthroscopically (3 of 5 patients, 60%). Diagnostic arthroscopy was carried out initially, and the extent of the tear was determined. An anterior portal through the rotator interval and an accessory anterolateral portal were used. Repair was carried out in side-to-side fashion through mattress suture repair (1 patient) or with suture anchors in the glenoid for medially based tears (2 patients) (Figs. 3 and 4).

Postoperative management

All patients were placed in a shoulder immobilizer for 3 weeks with immediate elbow ROM. During this time, patient-directed passive elevation in the plane of the scapula was allowed, and scapular isometrics were initiated. At 4 weeks, patients were enrolled in a formal physical therapy program and weaned off of the immobilizer. Between 4 and 8 weeks, concentration was placed on restoration of full active-assisted shoulder motion. Light rotator cuff and periscapular strengthening exercises were also started. Between weeks 8 and 16, more aggressive strengthening started. Patients and their therapists were allowed to begin passive stretching if contractures remained. Shoulder plyometrics were also begun during this phase. At 16 weeks, if motion and strength were symmetric with the contralateral side, then an interval throwing program was started. This program was designed to progress over a period of 7 months.

Postoperative evaluation

All patients were evaluated postoperatively by the senior author (D.W.A.). Shoulder ROM and shoulder strength were recorded.
ROM was tested by the operating surgeon using a handheld goniometer, and strength was subjectively determined. Provocative maneuvers for instability testing, including load-and-shift tests, apprehension-relocation tests, and tests for laxity such as the sulcus test were performed and recorded. The patient’s ability to return to play was evaluated and recorded.4

Results

Preoperative examination

All 5 patients were playing for a Major League Baseball team before their injury. There were 4 pitchers and 1 catcher. The mean age at presentation was 33.5 years (range, 31-37 years). All patients complained of anterior shoulder pain in the late cocking phase of their throwing motion, as well as a drop in their velocity, or the so-called dead arm. Physical examination and shoulder abduction to 90° coupled with external rotation and extension reproduced the presenting anterior shoulder pain in all patients. This pain was lessened with a relocation maneuver in all patients. No patient had frank apprehension with these tests. Two patients had 2+ anterior laxity on load-and-shift testing, and the other three had 1+. Two patients also had 2+ inferior laxity with a sulcus test, whereas the other three had 1+. All patients had 1+ posterior laxity with load-and-shift testing in the office. Motor strength was intact in all patients preoperatively. The mean difference in total arc of internal and external rotation from the involved to the contralateral side was measured. Rotation was performed with the patient supine and the arm in the 90°/90° position. In the affected shoulder, the mean external rotation was 105° ± 10° and the mean internal rotation was 26° ± 12°, for a total arc of 132° ± 15°. In the unaffected shoulder, the mean external rotation was 103° ± 9° and the mean internal rotation was 41° ± 8°, for a total arc of 145° ± 15°.
Patients had a mean of $13^\circ \pm 3^\circ$ less motion arc on the involved side, mostly from loss of internal rotation.

**Preoperative MRI**

All patients underwent preoperative MRI of the affected shoulder before surgery. On the basis of 4 of the 5 preoperative MRI studies, an accurate diagnosis of anterior capsular tear was made (80%). The most consistent finding was extracapsular edema in the region of the inferior muscular fibers of the subscapularis, which was best seen on the T2-weighted or short tau inversion recovery (STIR) coronal images (Figs. 1 and 2). Accurate assessment of the torn ends of the capsule was difficult, and the use of intra-articular enhancement agents such as gadolinium was occasionally helpful.

**Intraoperative findings**

**Examination under anesthesia (load and shift)**

Three of the patients were noted to have 2+ anterior laxity, and 2 were noted to have 1+ anterior laxity. Two patients with 2+ anterior laxity also had 2+ posterior laxity. None of the other patients had pathologic posterior laxity. The contralateral side showed 1+ laxity in all directions.

**Intraoperative characterization of capsular lesions**

All patients had midsubstance tears of the anterior capsule. Two of the tears were based medially, one was in the middle, and two were based laterally. Although the exact location of the tears varied, they all had similar patterns. They were oblique and typically transected the anterior band of the inferior glenohumeral ligament (Fig. 3).

**Concomitant rotator cuff lesions**

Partial articular-sided supraspinatus tears were identified by arthroscopy in 3 of the 5 patients (60%). In 1 of the 5 patients (20%), a single suture anchor was required for repair of the rotator cuff because the tear involved more than 60% of the tendon substance. No bursal-sided tears were noted.

**Glenoid labral lesions**

No patient had a discrete anterior labral tear that required repair. In 1 patient (20%), a type II superior labrum anterior-posterior tear was found and required a single suture anchor for repair. All other patients had fraying of the superior and posterior labrum, and this was debrided in those cases.

**Postoperative outcomes**

Patients were followed up at a mean of 45.2 months (range, 25-72 months). All patients showed ROM that was consistent with the preoperative ROM. In the affected shoulder, the mean external rotation was $106^\circ \pm 6^\circ$ and the mean internal rotation was $26^\circ \pm 12^\circ$, for a total arc of $133^\circ \pm 13^\circ$. In the unaffected shoulder, the mean external rotation was $104^\circ \pm 8^\circ$ and the mean internal rotation was $38^\circ \pm 7^\circ$, for a total arc of $142^\circ \pm 13^\circ$. The difference in total arc was $10^\circ \pm 4^\circ$. There were no significant differences between the arc of motion from preoperatively to postoperatively.

No patient had positive apprehension or signs of instability on examination.

**Return to play**

Of the 5 players, 4 returned to their prior level of competition (80%). One patient was not able to return and is currently retired. The players returned to play at a mean of 13.3 months from the time of surgery, with a range of 8 to 18 months. The player who returned at 8 months was a catcher. Table I outlines the characteristics and results of the patients.

**Discussion**

An isolated anterior capsular tear in the absence of glenohumeral dislocation is a rare injury that we have seen in older professional throwing athletes. Most of the literature on anterior capsular injuries has associated this pathology with frank shoulder dislocations. Mizuno et al8 investigated the prevalence of isolated complete midsubstance capsular tears in their series of patients who underwent surgery to treat recurrent glenohumeral instability. They noted this pathology in 12 of 303 patients (4%) who they treated for anterior instability. Three patients were similar to the patients in our group in that they had capsular tears associated with throwing. However, the main complaint in these patients was recurrent instability, whereas the only complaint in our patients was pain and the inability to throw at a high level. Of the 12 patients with isolated capsular tears in the series of Mizuno et al, 9 returned to competition at their preinjury level. This is consistent with our finding that 80% of our patients returned to their preinjury level of competition.

Rhee et al9 attempted to distinguish the clinical outcomes of isolated capsular midsubstance tears versus tears with Bankart lesions after shoulder dislocations. They noted that of 21 shoulders with a midsubstance capsular tear, 7 were isolated. However, outcomes between the two groups were not significantly different, although the sample sizes were small. Bonnevialle et al10 looked at the midrange follow-up of patients with anterior-inferior shoulder instability due to trauma. In their series of 79 shoulders, 8 (10%) were associated with minor trauma. Although the authors reported that 25 patients had isolated anterior capsular distension without labrum detachment, an analysis specific to this group was not performed.

Gehrmann et al10 were the first authors to describe a case in which a lateral capsular lesion was attributed to repetitive microtrauma without a concomitant history of acute
dislocation. However, their patient, a 17-year-old baseball player, had had a humeral avulsion of the glenohumeral ligament lesion, not a midsubstance capsular tear as described in our series. Similarly, the series by Taljanovic et al.10 involved humeral avulsion of the glenohumeral ligament lesions due to microtrauma. In a review article, Burkhart et al3 mentioned that they have observed anterior capsular tears in older throwing athletes, but they did not provide a description of their presentation or treatment. To our knowledge, our study is the first to report midsubstance capsular tears in older throwing athletes, but they did not provide a description of their presentation or treatment. To our knowledge, our study is the first to report midsubstance capsular tears caused by microtrauma in professional baseball players without an associated history of gross instability.

Although the mechanism of the described pathology is largely unknown, we believe that this may be an end-stage manifestation of internal impingement.5 Whether the pathologic process starts with anterior microinstability as proposed by Walch et al11 and Jobe7 or whether it is caused by posterior capsular contracture as proposed by Burkhart et al,3 it is generally agreed that the anterior capsule undergoes abnormally high forces in throwing athletes. In young throwers, the capsule is most likely pliable enough to withstand these forces without tearing. With age, the capsule becomes less compliant and is more apt to tear as opposed to stretching with repetitive microtrauma. This corresponds with our findings that all patients were aged in their 30s. It is interesting that this cohort of patients had loss of internal rotation in the affected shoulder when compared with the uninvolved shoulder. This deficit may add further credence to the idea that this is the late manifestation of internal impingement because posterior capsular contractures are part of the pathoanatomy.7

Diagnosis with MRI alone can be difficult; therefore, it is important to have a high level of suspicion in these athletes. We believe that a greater awareness of this condition will likely increase the clinician’s and the radiologist’s ability to detect these lesions. The best opportunity for an MRI diagnosis comes during the acute phase of the injury when the extracapsular edema is evident on T2-weighted coronal images.

None of the patients in our series were able to return to play with an nonoperative regimen of rest and rehabilitation. Therefore, we have now recommended surgical intervention as soon as the diagnosis is made provided that the athletes would like to continue their careers. Repair can be performed arthroscopically if the lesion is accessible, or it can be performed in an open manner through a subscapularis split. We found that medially based lesions could be repaired arthroscopically with suture anchors in the glenoid and that midsubstance tears could be repaired side to side arthroscopically. However, laterally based tears were difficult to access arthroscopically, and we found that conversion to an open approach provided better visualization and repair. Although our series is small, it is important to note that both patients who underwent an open procedure were able to return to play whereas 2 of the 3 patients treated arthroscopically were able to return. Therefore, we believe that the surgeon should not hesitate to proceed with an open procedure if there is any question of whether an adequate repair can be performed arthroscopically, although care should be taken to take down as little subscapularis as possible.

Because this is a retrospective small case series, the implications of our findings are somewhat limited by the sample size. In addition, without prospective evaluation, one may only speculate as to the mechanism that leads to isolated capsular tears in this subset of athletes. Finally, follow-up was limited to 1-year minimum—it remains to be seen how these athletes’ shoulders will respond over time. Nevertheless, we believe that it is important to call attention to this unusual condition and that this diagnosis should be kept in mind when treating patients who are similar to the patients presented in this case series (ie, overhead athletes, especially pitchers with signs of internal impingement). Although we were able to treat this condition both arthroscopically and open, the conceptual approach to treatment was the same for all our patients and we believe that recognition and accurate diagnosis are the most important aspects of treatment.

### Conclusion

Midsubstance tears of the anterior capsule in the absence of instability episodes are rare but may occur in the setting of chronic overhead activity. Accurate diagnosis is critical, and a high clinical suspicion is necessary because lesions may elude even advanced imaging.

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**Table 1** Patient data

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age (y)</th>
<th>Position</th>
<th>Open/arthroscopic approach</th>
<th>Concomitant procedures</th>
<th>Return to play</th>
<th>Time to return (mo)</th>
<th>Last follow-up (mo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>32</td>
<td>Pitcher</td>
<td>Arthroscopic</td>
<td></td>
<td>Excellent</td>
<td>13</td>
<td>72</td>
</tr>
<tr>
<td>2</td>
<td>31</td>
<td>Pitcher</td>
<td>Open</td>
<td></td>
<td>Excellent</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>34</td>
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<td>Arthroscopic</td>
<td></td>
<td>Poor</td>
<td>NA</td>
<td>48</td>
</tr>
<tr>
<td>4</td>
<td>32</td>
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<td>Open</td>
<td>RC repair</td>
<td>Excellent</td>
<td>14</td>
<td>21</td>
</tr>
<tr>
<td>5</td>
<td>37</td>
<td>Catcher</td>
<td>Arthroscopic</td>
<td>SLAP repair</td>
<td>Excellent</td>
<td>8</td>
<td>60</td>
</tr>
</tbody>
</table>

NA, not applicable; RC, rotator cuff; SLAP, superior labrum anterior-posterior tear.
modalities. Repairs may be performed either arthroscopically or open with successful results and return to previous performance levels. Further investigation is needed to better understand this uncommon clinical phenomenon.

Disclaimer

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References