

# Return to Sport After Arthroscopic Capsular Repair in Elite Baseball Players

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**Background:** Chronic attritional midsubstance capsular tears arising from repetitive throwing stress are a rare but important source of pain and dysfunction in elite baseball players; however, little is known regarding outcomes after arthroscopic capsular repair.

**Purpose:** To evaluate the patient-reported outcomes and return-to-sport (RTS) rates after arthroscopic capsular repair in elite baseball players.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** We identified 11 elite-level baseball players who were treated with arthroscopic repair for a midsubstance glenohumeral capsular tear by a single surgeon with a uniform approach and a standardized postoperative protocol between 2012 and 2019. All players had at least 2 years of follow-up data. Demographic data and concomitant surgical procedures were recorded. Preoperative and postoperative Kerlan-Jobe Orthopaedic Clinic (KJOC) scores and Single Assessment Numeric Evaluation (SANE) scores were collected in a subset of the cohort, and statistical comparisons were made. A telephone survey was conducted to determine the patients' RTS level and outcome scores. Statistical comparisons between preoperative and postoperative outcomes scores were made using *t* tests.

**Results:** Eight major league players, 1 minor league player, and 2 collegiate players were included. There were 9 pitchers, 1 catcher, and 1 outfielder. All patients had debridement of the posterolateral labrum and rotator cuff. Two pitchers underwent a rotator cuff repair, and 1 outfielder underwent a posterior labral repair. The mean age at the time of surgery was 26.9 years (range, 20-34 years), with a mean follow-up of 3.5 years (range, 2.6-5.9 years). There were significant preoperative versus postoperative improvements in the mean KJOC (20.6 vs 89.8;  $P = .0002$ ) and SANE (28.3 vs 86.7;  $P = .001$ ) scores. All patients reported a high degree of satisfaction. At a mean of 16.3 months (range, 6.5-25.4 months), 10 of 11 (90.1%) players met the Conway-Jobe good or excellent criteria for RTS.

**Conclusion:** Arthroscopic capsular repair provided significant improvements in functional outcomes in elite baseball players, high levels of patient satisfaction, and high levels of RTS.

**Keywords:** arthroscopic capsular repair; baseball; capsule tear; Kerlan-Jobe Orthopaedic Clinic; return to sport; shoulder

Recent literature suggests that, despite injury-prevention efforts, rates of shoulder injuries and subsequent surgeries among professional baseball players are not decreasing. While the bulk of surgical treatment addressed labral and rotator cuff pathology, capsular procedures accounted for nearly 10% of all surgical treatment in a large cohort of professional baseball players.<sup>3</sup> Kvitne and Jobe,<sup>13,16</sup> first highlighted the clinical importance of the anterior capsule in the throwers' shoulder, noting associated symptomatic instability as a direct result of attritional damage and laxity from the chronic and repetitive stress of the overhead throwing motion. Utilizing an open capsulolabral repair,

they reported 68% excellent results. Along this spectrum, chronic attritional tears of the anterior inferior glenohumeral ligament in its midsubstance or from the humeral attachment are a rare but increasingly reported source of pain and dysfunction in overhead athletes.<sup>4,10,12,18</sup> With an improved biomechanical understanding of the throwing motion and the adaptation of modern arthroscopic techniques, there is a robust body of literature cataloguing the expected rates of return to sport (RTS) and patient-reported outcomes after surgical treatment of more common throwing maladies, allowing a clinician to appropriately counsel a high-level thrower in these matters.<sup>2,3,11,14,15</sup> However, few studies to date have reported on rates of RTS and patient-reported outcomes after an arthroscopic repair of capsular lesions in elite baseball players.<sup>12</sup>

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The purpose of this study was to evaluate patient-reported outcome scores and rates of RTS after a novel technique of arthroscopic capsular repair in professional baseball players. We hypothesized that postoperative outcome scores would be significantly improved with high rates of RTS.

## METHODS

### Patients

This was a retrospective review of all elite baseball players who underwent arthroscopic capsular repair by the senior author (N.S.E). After receiving institutional review board approval, we conducted a query of billing data using the current procedural terminology code 29806 from 2012 to 2019 and identified 11 patients treated surgically by the senior author. Individual patient charts were examined using the electronic medical record. Reviewing the operative reports, viewing the intraoperative photographs, and conferring with the senior author confirmed the diagnosis of a midsubstance glenohumeral capsular injury treated with an arthroscopic capsular repair. Only elite baseball players (major league, minor league, and collegiate levels) were included. All players had failed a trial of nonoperative treatment and had presented to care with pain and throwing dysfunction. On examination, all patients had pain with apprehension maneuvers that remitted with relocation maneuvers. Basic demographic data and injury characteristics were recorded, including age at the time of surgery, imaging findings, prior conservative treatments, position played, level of play, the location of the capsular lesion, concomitant procedures performed (posterior rotator cuff debridement, rotator cuff repair, posterosuperior labral debridement, and labral repair), and other concomitant upper extremity injuries (eg, elbow pathology).

### Patient-Reported Outcomes

Secondary to the retrospective nature of the study, only 6 of the 11 players had both preoperative and postoperative outcome scores included for analysis. In these patients, baseline Single Assessment Numeric Evaluation (SANE) and Kerlan-Jobe Orthopaedic Clinic (KJOC) scores were collected preoperatively. For those without preoperative scores, only postoperative scores were collected. All patients were contacted via telephone and surveyed to

obtain their final KJOC and SANE scores at the final follow-up. Additionally, satisfaction with their surgical results was assessed at that time using a 1 to 5 Likert scale (lowest to highest satisfaction).

### Return to Sport

RTS was assessed via a telephone survey and/or game logs for all participants. Time to RTS was defined as the time from surgery to the time available for full sport participation and calculated and confirmed using game logs. A successful RTS was defined as meeting either the good or excellent criteria as outlined by Conway and Jobe.<sup>5</sup> In their study of pitchers returning to sport after ulnar collateral ligament repair or reconstruction, an excellent score indicated a return to competition at the same or higher level. A score of good denoted an RTS at a lower level of competition or a return to throwing in daily batting practice. Fair and poor outcomes indicated the ability to return to recreational sport and no return, respectively. The Conway-Jobe criteria have been used by Gulotta et al<sup>12</sup> in their report on anterior capsule repair in Major League Baseball (MLB) players. The reasons for not returning to sport, not returning to competition, or returning at a lower level were noted after discussion with each player.

### Surgical Technique

All patients were placed in the lateral decubitus position and underwent diagnostic arthroscopy utilizing a standard posterior viewing portal and an anterior working portal within the rotator interval. Concomitant pathology was noted and addressed on a case-by-case basis to include debridement or repair of the labrum and rotator cuff.

The location of the capsular tear was carefully assessed, taking note of continuation to either the humeral or glenoid attachment. All tears were found within the axillary pouch between the anteroinferior and posteroinferior glenohumeral ligaments (Figure 1A). Accessory anteroinferior or posteroinferior portals were placed to facilitate suture passage. Medially based tears were repaired from lateral to medial in a “baseball stitch” fashion using a nonabsorbable 1.3-mm tape suture (SutureTape; Arthrex) successively passed between leaflets using an appropriately curved 25-degree suture shuttling device (SutureLasso; Arthrex) (Figure 1B). Suture limbs were tensioned and then secured at the glenoid insertion with a 2.9-mm knotless anchor (PushLock;

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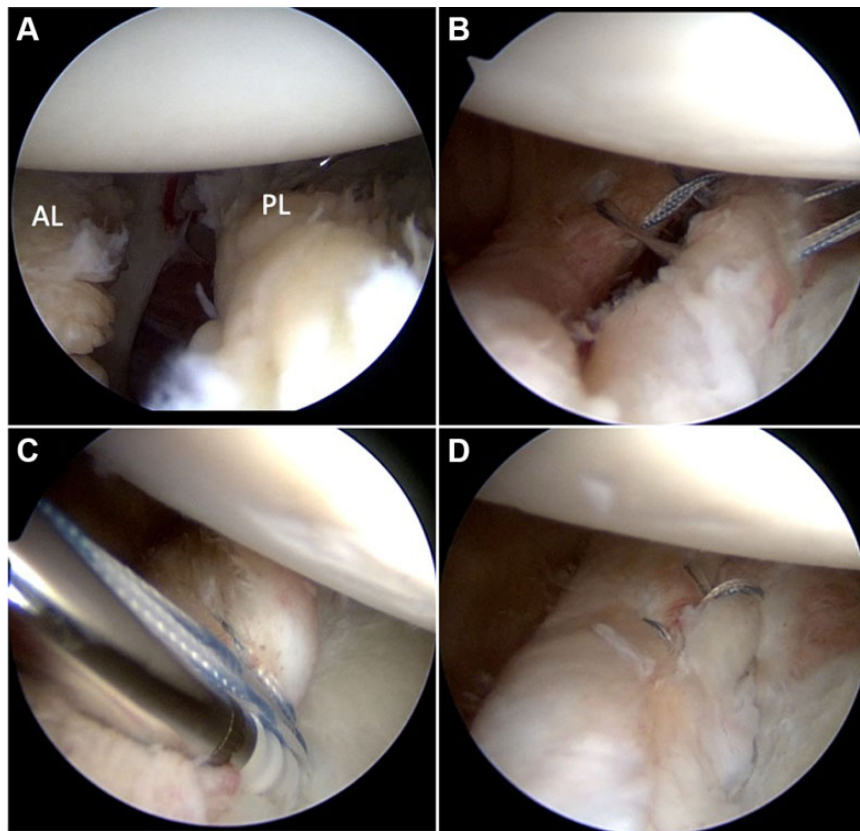
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Ethical approval for this study was obtained from Cedars-Sinai (protocol ID: STUDY00000218).



**Figure 1.** (A) Instrumenting from a posterior portal, a 25-degree curved left suture shuttling device (SutureLasso; Arthrex) pierces the posterior leaflet of an anterior inferior capsular tear in a right shoulder viewing from a high anterior rotator interval portal. (B) An intraoperative photograph of an anterior inferior capsular tear taken mid-repair with alternating “baseball” stitch repair. (C) Fixation of the tape suture at the chondrolabral junction with a knotless anchor (PushLock; Arthrex). (D) The final repair construct when viewed from the high anterior portal demonstrates anatomic capsular repair. AL, anterior leaflet; PL, posterior leaflet.

Arthrex) (Figure 1C). Laterally based tears were repaired in a reverse fashion from medial to lateral with eventual fixation into the humeral insertion.

#### Postoperative Protocol

Patients were immobilized in a shoulder immobilizer for 4 weeks with allowances made for immediate elbow and wrist range of motion. They were instructed to begin passive abduction in the scapular plane 1 week postoperatively. Patients were weaned from the shoulder immobilizer after 4 weeks and began a formal physical therapy program beginning with active-assisted shoulder range of motion with progression toward full shoulder range of motion. Once achieving full range of motion, patients began light rotator cuff and scapular strengthening exercises with full strength progressions beginning at the 8-week mark. Players progressed to a 6-month interval throwing program upon achieving full symmetric painless range of motion and strength. This was initiated no earlier than 4 months postoperatively with allowances made for concomitant procedures (eg, labral or rotator cuff repair).

#### Statistical Analysis

Statistical comparisons were made between preoperative and postoperative KJOC and SANE scores using simple, paired, 2-tailed *t* tests, with a significance threshold of  $P < .05$ .

## RESULTS

#### Patients

Overall, 8 major league, 1 minor league, and 2 collegiate players with a mean age of 26.9 years (range, 20-34 years) were identified and included in the study. There were 9 pitchers, 1 catcher, and 1 outfielder. All injuries occurred in the dominant throwing arm. Three patients underwent concomitant procedures. One patient had several prior elbow surgeries. No patients were lost to final follow-up at a mean time of 3.5 years (range, 2.6-5.9 years) (Table 1).

#### Imaging Findings

All 11 patients had plain-film radiographic evidence of posterior glenoid dysplasia on the axillary lateral view. All

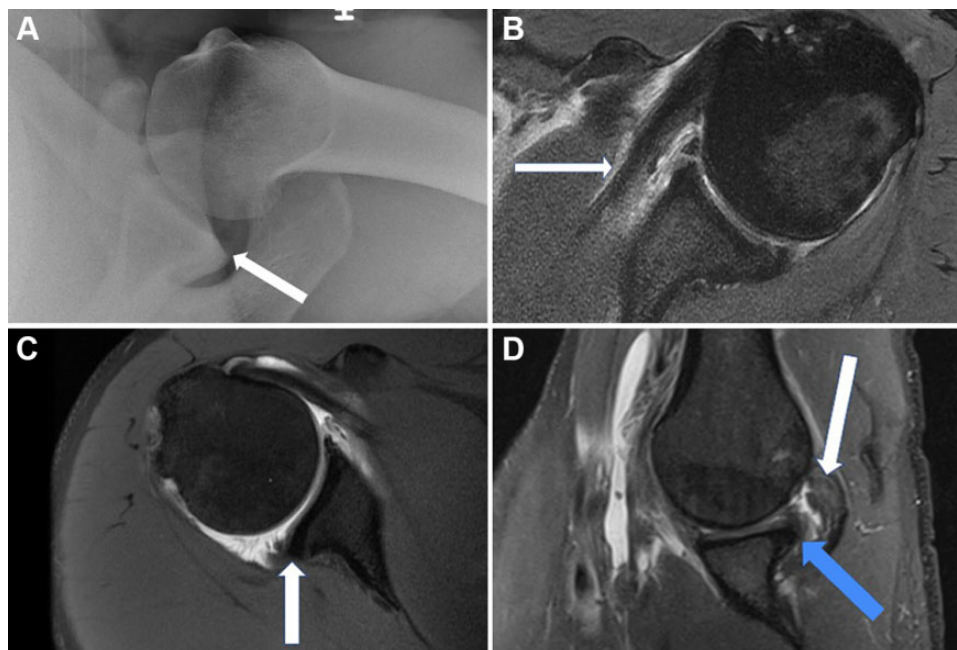
TABLE 1  
Player Demographics (N = 11)<sup>a</sup>

Player	Age, y	Position	Level	Site of Capsular Injury	Concomitant Procedures	RTS	RTS Level	RTS Time, mo	Follow-up, mo
1	32	Pitcher	MLB	Anteroinferior	Debridement	Y <sup>b</sup>	MLB	19.3	45.6
2	28	Pitcher	MLB	Posteroinferior	Debridement, RCR	Y	MLB	17.7	55.7
3	33	Catcher	MLB	Anteroinferior	Debridement	Y	MLB	9.5	47.8
4	24	Outfield	MLB	Posteroinferior	Debridement, PLR	Y	MLB	6.5	56.1
5	27	Pitcher	MiLB	Anteroinferior	Debridement, RCR	Y <sup>b</sup>	MiLB	17.4	43.7
6	21	Pitcher	NCAA	Anteroinferior	Debridement	Y	NCAA	22.5	36.6
7	20	Pitcher	NCAA	Anteroinferior	Debridement	Y <sup>c</sup>	NCAA	19.2	33.9
8	20	Pitcher	MLB	Anteroinferior	Debridement	Y	MLB	14.6	58.5
9	27	Pitcher	MLB	Anteroinferior	Debridement	Y	MLB	18.8	32.1
10	31	Pitcher	MLB	Anteroinferior	Debridement	Y	LBPRC/ML	25.4	31.5
11	34	Pitcher	MLB	Anteroinferior	Debridement	N	Retired	NA	33.2

<sup>a</sup>LBPRC/ML, Liga de Beisbol Profesional Roberto Clemente/Mexican League; MLB, Major League Baseball; MiLB, Minor League Baseball; N, has not returned to sport (Conway-Jobe score, poor); NA, not applicable; NCAA, National Collegiate Athletic Association; PLR, posterior labrum repair; RCR, rotator cuff repair; RTS, return to sport; Y, return to same level sport (Conway-Jobe score, excellent).

<sup>b</sup>Returned to spring training without competition with later retirement (Conway-Jobe score, good).

<sup>c</sup>Returned to NCAA and is currently a redshirt (Conway-Jobe score, good).



**Figure 2.** (A) An axillary lateral radiograph demonstrating posterior glenoid dysplasia (white arrow). (B) A short-tau inversion recovery (STIR) sequence axial MRI demonstrating perimuscular and peritendinous edema of the subscapularis (white arrow). (C) A T1-weighted fat-saturated axial MRI noting posterior glenoid dysplasia and posterior-superior labral tearing (white arrow). (D) A T1-weighted fat-saturated abduction–external rotation axial oblique MRI showing partial-thickness articular-sided posterior superior rotator cuff tearing (solid white arrow) and posterior superior labral pathology (blue arrow). MRI, magnetic resonance imaging; STIR, subscapularis muscle on short-tau inversion-recovery.

capsular tears were visible with magnetic resonance (MR) arthrography when available. Two patients without MR arthrography had evidence of perimuscular and peritendinous edema of the subscapularis muscle on short-tau inversion-recovery sequences. All patients had varying degrees of imaging findings consistent with internal impingement (ie, posterior superior labral pathology, partial thickness undersurface rotator cuff tearing, cystic

change within the tuberosity, glenoid dysplasia, and Bennett lesions) (Figure 2).

#### Return to Sport

In all, 10 of 11 (90.1%) players met the good or excellent criteria for RTS. Of those players who returned to sport, 6 of 10 met the excellent criteria for return to the same

TABLE 2  
Preoperative and Postoperative Functional Outcome Scores<sup>a</sup>

Outcome Measure	Preoperative	Postoperative	<i>P</i>
KJOC	20.6 ± 16.7	89.8 ± 9.5	<b>.0002</b>
SANE	28.3 ± 21.4	86.6 ± 11.7	<b>.001</b>

<sup>a</sup>Data are reported as mean ± SD. Bold *P* values indicate statistically significant differences between groups ( $P < .05$ ). There were no significant differences between preoperative and postoperative scores in player position, return to sport level, or concomitant procedures. KJOC, Kerlan-Jobe Orthopaedic Clinic; SANE, Single Assessment Numeric Evaluation.

preinjury level competition. Four players met the good criteria. One MLB pitcher returned to pitching in international competition. One MLB pitcher and 1 Minor League Baseball (MiLB) pitcher returned to spring training with pain-free throwing at their respective levels within their organizations without returning to pitching in competition. Both have since retired. One National Collegiate Athletic Association (NCAA) pitcher returned to pain-free throwing and, at the time of this writing, is in redshirt status. Finally, 1 MLB pitcher did not attempt to return to baseball (see Table 1).

#### Time to RTS

Ten of 11 players returned to sport at a mean of 16.9 months (range, 6.5-25.5 months). Position players returned earlier than pitchers (7.9 vs 19.2 months).

#### Functional Outcomes

Baseline preoperative function was poor in the subset of players with preoperative functional outcome scores. When comparing preoperative and postoperative functional outcomes in this cohort, all players demonstrated statistically significant improvements in both their KJOC and SANE scores (Table 2). There were no significant differences in either preoperative or postoperative outcome scores when accounting for player position, RTS level, or concomitant procedures.

#### Patient Satisfaction

Surveyed players were unanimously pleased with their outcome, reporting a high degree of satisfaction with the surgery (5 of 5 on a Likert scale). They would readily recommend the procedure to a colleague and would have the procedure again if needed in the future.

#### DISCUSSION

Capsular injury is an important source of throwing dysfunction in elite-level baseball players of varying ages and competition levels that is refractory to conservative management. As hypothesized, the results of this study demonstrate that arthroscopic capsular repair provides clinically

and statistically significant functional improvements in both KJOC (20.6 preoperatively vs 89.8 postoperatively;  $P = .0002$ ) and SANE (28.3 preoperatively vs 86.8 postoperatively;  $P = .001$ ) scores in elite-level baseball players. Similarly, arthroscopic repair afforded athletes high rates of RTS (90%). All patients were very satisfied with their surgical outcomes.

A strength of the present work is the evaluation of functional outcome scores in the setting of capsular tears. Gulotta et al<sup>12</sup> evaluated only range of motion and did not assess patient function using validated outcome tools developed for elite baseball players. The KJOC score is specifically designed to assess upper extremity function in overhead athletes and has been shown to be the most sensitive test to discern between differing levels of function, injury, and performance in elite-level throwers.<sup>1,7</sup> In the present work, a selection of the cohort had preoperative and postoperative KJOC and SANE scores. All surveyed patients had poor preoperative function, as evidenced by their low KJOC and SANE scores. All surveyed patients had statistically meaningful improvements after repair. Very little is known regarding the baseline functional scores in an injured population of elite baseball players with capsular tears, let alone injured players in general. This study helps to shed light on this area. Fronek et al<sup>9</sup> examined KJOC scores in a series of MiLB players and found mean KJOC scores of 75.8 in those not currently playing secondary to an arm injury. In a similar study by Franz et al,<sup>8</sup> asymptomatic professional baseball players with a history of a surgically treated injury in their throwing arm had a mean KJOC score of 75.6, and those asymptomatic players with a history of a nonoperatively treated injury in their throwing arm had a mean KJOC score of 86.7. The mean preoperative KJOC score in our study was substantially lower than these reports (20.6), which perhaps speaks to the severity of the dysfunction caused by a capsular injury. When comparing the results of repair, our study found that arthroscopic capsular repair significantly improved the mean postoperative KJOC score to 89.8, which, while somewhat higher, is commensurate with other literature outlining postoperative superior labrum anterior to posterior (SLAP) repair in professional athletes.<sup>11,16</sup>

In addition to validated outcome tools, RTS is an important research end point when assessing the efficacy of surgical interventions in any athlete. Gulotta et al<sup>12</sup> were the first to report on RTS after surgical treatment for anterior midsubstance capsular tears in 5 professional baseball players treated in either an arthroscopic or open fashion. In their work, they reference the Conway-Jobe RTS definitions. They had 4 excellent results with 4 of 5 athletes (80%) returning to major league play. Both patients treated with an open repair returned to sport, while 2 of 3 in the arthroscopic group were able to RTS (66%). In the present study, conducted with a larger sample size and long-term follow-up in patients who underwent all-arthroscopic repair, we saw similar findings, with 90% of players returning to any level of sport and 60% returning to competition at the same level. The time required to RTS in our study was also similar, with position players returning earlier (7.9 months)

than pitchers (19.2 months) compared with 8 months and 15 months, respectively, in the Gulotta study. In addition, there were similar rates of concomitant procedures performed in both studies. There is conflicting data on whether concomitant pathology affects return-to-play outcomes.<sup>11,17</sup> While research may be conflicting, the presence and severity of concomitant pathology in the posterior superior labrum, posterior superior cuff insertion, and subscapularis likely play an important role in successful outcomes. In the present study, 2 patients underwent concomitant rotator cuff repair, and 1 patient underwent posterior labral repair. In the Gulotta et al<sup>12</sup> study, there was 1 SLAP repair and 1 rotator cuff repair.

When comparing RTS rates among studies, it is important to compare definitions of RTS. A recent meta-analysis found a high degree of variance in what may constitute returning to play or sport.<sup>6</sup> Definitions ranging from returning to a preinjury level of statistical performance, participation in a specified number of games, or simply return to pain-free participation in sporting activity have all been suggested as the criteria for a successful RTS. Ultimately, in defining RTS, one defines what most may presume to be a successful outcome. Nuances in definition aside, when considering the degree of preoperative dysfunction in this cohort, their ability to return to baseball in any elite capacity should be deemed a success.

When comparing the patients included in the study by Gulotta et al<sup>12</sup> with the present study, there are important differences. The patients in the present study are substantially younger than the Gulotta cohort at 26.8 years (range, 20-33 years) versus 33.5 years (range, 31-37 years). This is an important difference, as Gulotta et al<sup>12</sup> initially described this as an injury seen more commonly in older throwers. In the present study, there are 2 NCAA pitchers with midsubstance anterior capsular tears. There are case reports of humeral avulsions of the glenohumeral ligaments in a 17-year-old baseball player<sup>10</sup> as well as in female collegiate volleyball players.<sup>18</sup> It is entirely possible that age plays some role in the tear location, as these younger players all had laterally based tears. Gulotta et al<sup>12</sup> reported on only mid-substance tears, with 2 medially based tears, 1 central tear, and 2 laterally based tears all oriented obliquely such that they bisect the antero-inferior glenohumeral ligament (AIGHL). In the present study, there were 11 total tears located within the axillary pouch. Two were posteriorly based, extending obliquely and laterally through the posteroinferior glenohumeral ligament to the humeral insertion. All other tears were oblique antero-inferior tears near the AIGHL with or without extension to the glenoid. It is not precisely known what leads to the capsular injury or what, if any, role age plays in the presence or location of the tear. Further study is required in this regard. It is important, however, to maintain a high index of suspicion for this injury and consider this diagnosis in younger athletes as well as older athletes.

### Limitations

The broad clinical application of the findings of this study was significantly limited by its retrospective design,

incomplete data set, small sample size, and narrow scope. This is a selection of elite-level baseball athletes treated by a single surgeon at a single center, and the conclusions herein are applicable to those who practice in a similar setting. Furthermore, while the present study has a relatively long follow-up period, the small sample size precludes the ability to detect important confounding variables. Given the rarity of the injury, the inclusion of athletes with other rotator cuff and labral pathology within this study is an important source of confounding. Future, long-term, multicenter collaborative studies are required to attain a sufficient cohort without confounding concomitant pathology to ascertain these effects. Finally, as previously discussed, rates of RTS are incredibly influenced by the a priori definition and ultimately hinge upon what physicians and players deem to be a successful outcome. Future studies are needed to better characterize and standardize this definition.

### CONCLUSION

Attritional midsubstance capsular injuries are a rare but important source of shoulder dysfunction in elite-level baseball players of all ages and levels of play. Arthroscopic capsular repair provided all patients with significant functional improvement and led to high rates of RTS in those players refractory to conservative management.

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