Posterior Labral Repairs of the Shoulder Among Baseball Players

Results and Outcomes With Minimum 2-Year Follow-up

James S. Kercher,*† MD, Robert P. Runner,‡ MD, Timothy P. McCarthy,‡ MD, and Xavier A. Duralde,† MD
Investigation performed at Peachtree Orthopedic Clinic, Piedmont Hospital, Atlanta, Georgia, USA

Background: There is a paucity of information regarding the treatment of posterior labral tears of the shoulder for baseball players. Reports regarding treatment and postoperative outcomes are more limited than its anterior and superior counterparts.

Purpose: To evaluate the clinical presentation, surgical findings, postoperative outcomes, and rate of return to sport after arthroscopic repair of posterior labral injuries of the shoulder among baseball players.

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

Methods: Retrospective review was performed of baseball players who underwent arthroscopic posterior labral repair between 2009 and 2015 by a single surgeon, with a minimum 2-year follow-up. The group was composed of 32 male patients involved in recreational (6.3%), high school (43.8%), college (31.3%), and professional (18.8%) baseball, with a mean age of 20.5 years. Patients were categorized by chief complaint, clinical findings, surgical findings, and concomitant procedures performed. Pre- and postoperative measures included pain scale, range of motion, American Shoulder and Elbow Surgeons shoulder score, return to play, and patient satisfaction.

Results: A variety of tear patterns were identified; 32% involved 90° of the posterior superior labrum; 35% involved the posterior 180°; and 32% involved 90° of the posterior inferior labrum. The dominant mechanism of injury was throwing (34.4%). The most common chief complaint was pain (n = 25, 78%), followed by pain and instability symptoms (n = 6, 18.8%), with only 3% citing isolated sensation of instability. Magnetic resonance imaging clearly identified tear patterns in 75% of cases. American Shoulder and Elbow Surgeons scores significantly improved ($P < .0001$), increasing on average 30.9 points from the preoperative mean of 65.4 to a postoperative mean of 96.3. No significant range of motion deficits were noted. Tear size and number of anchors utilized did not influence outcomes. Ninety-four percent of athletes returned to play, 61% at previous levels, and 6% did not return. Pitchers had a lower return to previous level of play than position players (41% vs 86%, $P = .0113$).

Conclusion: Arthroscopic treatment of posterior labral tears of baseball players was effective in improving pain and function, resulting in 94% patient satisfaction and 94% return to sport, with 61% returning to previous level of play. Patient presentation is variable, with a majority of patients citing pain rather than instability.

Keywords: shoulder; arthroscopy; posterior labral repair; baseball; throwers

Injuries to the glenoid labrum of the shoulder are frequently found among overhead athletes. Although injuries to the superior and anterior labrum have historically received more attention, posterior labral injury and posterior instability have become increasingly recognized as a significant clinical entity.[9,15,17,30] Injuries to the posterior labrum in the baseball population commonly result from throwing, diving on the outstretched arm, or posterior subluxation of the lead shoulder during batting—so-called batter's shoulder.[13,33] Although posterior labral tears can occur from an acute event, onset is commonly more insidious and related to repetitive microtrauma[27] and capsular contracture, which can lead to failure of the posterior capsulolabral structures. These lesions are being increasingly reported, as they are more readily identified arthroscopically and their pathophysiology is better understood by sports medicine physicians.[35] Multiple reports regarding the management of posterior instability exist for football players owing to the high incidence of this lesion secondary to repetitive posteriorly directed loads by interior linemen.[9] Although operative treatment of the posterior labrum has been successful in football, baseball players present a different set of challenges because the throwing

The American Journal of Sports Medicine
2019;47(7):1687–1693
DOI: 10.1177/0363546519843070

motion requires higher degrees of freedom to successfully compete. Systematic reviews revealed inferior results in the management of unidirectional posterior instability of the throwing athlete as compared with contact athletes.[9] Studies are limited that specifically examine results of posterior labral repair isolated to baseball players.[13,17,33]

Advancements in diagnostics, arthroscopic techniques, and an improved understanding of shoulder biomechanics have allowed physicians to better understand, identify, and treat posterior labral pathology. Concerns regarding operative treatment of posterior labral tears among baseball players include the development of postoperative stiffness attributed to overtightening, which would negatively affect the overhead throwing motion. The purpose of this study is to evaluate the clinical presentation, surgical findings, and postoperative outcomes for arthroscopic repair of posterior labral injuries among baseball players. We hypothesized that arthroscopic posterior labral repair utilizing a suture anchor technique among players who have failed a course of nonoperative treatment will result in high patient satisfaction and high rates of return to play.

TABLE 1
Patient Data of 32 Athletes Who Met Inclusion Criteria

	n (%)
Patients	32
Age, mean ± SD (range), y	20.5 ± 5.6 (16-41)
Male	32 (100)
Position	
Pitcher	18 (56.3)
Position player	14 (43.7)
Mechanism of injury	
Throwing	11 (34.4)
Batting	8 (25)
Traumatic	4 (12.5)
Insidious	9 (28.1)
Level of sport	
Professional	6 (18.8)
College	10 (31.3)
High school	14 (43.8)
Recreational	2 (6.3)

METHODS

This is a retrospective sequential review of all baseball players who underwent arthroscopic unilateral posterior labral repair between July 1, 2009, and July 31, 2015, by the senior surgeon (X.A.D.), with a minimum 2-year follow-up. A total of 32 male athletes without prior shoulder surgery were identified, including professional, collegiate, high school, and recreational baseball players. All patients had undergone a prolonged course of rehabilitation emphasizing posterior capsular stretching, strengthening of the rotator cuff and periscapular muscles, as well as proprioceptive training, scapular stabilization, and a structured throwing program under the direction of a physical therapist or certified athletic trainer trained in the care of baseball players. Nonoperative treatment was tried in all cases for a mean 15.05 months (range, 2-60 months). The median duration of symptoms was 9.5 months (mean, 15 months; 25th and 75th percentiles, 4.5 and 24 months). For analysis, we utilized the 25th percentile and compared patients with symptoms <5 months (n = 8) and ≥ 5 months (n = 24). Subacromial cortisone injections were used in 6 players. The amount of physical therapy varied and was generally shortest in cases of batter's subluxation when it became obvious that the player could not make ball contact without shoulder pain. The duration of throwing programs varied depending on player progression. All patients underwent arthroscopic labral repair posterior to the midaxis of the glenoid. Patients were excluded if any procedure anterior to the midaxis of the glenoid was performed. Patient data collection was performed for multiple variables: age, sex, hand dominance, batting dominance, baseball position, throwing hand, level of sport, and side of injury (Table 1).

Mechanism of injury was categorized as throwing, batting, insidious, or traumatic. Duration of symptoms before surgery was noted. The chief presenting complaint was categorized into pain, instability, or pain and instability symptoms. Preoperative pain, instability, and American Shoulder and Elbow Surgeons (ASES) shoulder scores were obtained for all patients. Preoperative range of motion was evaluated for all patients in forward elevation, external rotation at the side, and internal rotation to the level of the spine, as well as internal and external rotation in 90° of abduction. Preoperative symmetry to the nonoperative arm, relocation test, load-shift test, and O'Brien active compression test were performed. Magnetic resonance imaging (MRI) scans with intra-articular contrast were reviewed and findings evaluated. Preoperative MRI findings were evaluated by outside radiology services; however, definitive preoperative MRI findings were recorded by the senior surgeon (Figure 1).

Examination under anesthesia and intraoperative diagnostic arthroscopy were performed for all patients. The location of the posterior labral tear was subclassified into 3 groups of tears: 90° of the posterior superior labrum, 90° of the posterior inferior labrum, and 180° of the posterior labrum. All patients underwent suture anchor fixation, and the location and number of suture anchors used

*Address correspondence to James S. Kercher, MD, Peachtree Orthopedics, Piedmont Hospital, 2045 Peachtree Rd, Suite 700, Atlanta, GA 30309, USA (email: jimkercher@gmail.com).
†Peachtree Orthopedics, Piedmont Hospital, Atlanta, Georgia, USA.
‡Department of Orthopaedics, Emory University, Atlanta, Georgia, USA.
One or more of the authors has declared the following potential conflict of interest or source of funding: J.S.K. has received consulting fees from MedShape Inc and RTI Surgical Inc; payments from Arthrex Inc and Vericel Corporation; and speaking fees from Aastrom Biosciences Inc. X.A.D. has received payments from Smith & Nephew and hospitality payments from Wright Medical Technology Inc. AOSSM checks author disclosures against the Open Payments Database (OPD). AOSSM has not conducted an independent investigation on the OPD and disclaims any liability or responsibility relating thereto.

Figure 1. Magnetic resonance image of a patient with a posterior inferior labral tear. Imaging findings did not always clearly demonstrate the extent of the pathology.

were recorded along with additional procedures performed at time of arthroscopy.

Surgical Technique for Arthroscopic Posterior Labral Repair

Surgery was performed with the patient in the beach-chair position under interscalene block and general anesthesia. An examination under anesthesia was performed to verify laxity degree and direction. Diagnostic arthroscopy was then performed. Care was taken to visualize the posterior labrum to identify pathology initially from the posterior portal (Figure 2A). The arthroscope was then transferred to the anterior portal. A 5-mm working cannula was placed over a switching stick through the posterior portal. A second 5-mm working cannula was placed posterolateral through the rotator cuff into the joint with observation from the anterior portal (Figure 2B). Localization of this portal was determined by use of a spinal needle passed percutaneously with observation via the anterior portal.

The nonviable labrum was debrided with a 4.5-mm shaver via the posterolateral portal. The glenoid neck was prepared to bleeding bone. Suture anchors were placed in the glenoid rim in the area of labral damage. A tissue penetrator was passed via the posterior portal through the labrum and one suture limb from the anchor was grasped and pulled through the labrum. The suture was then retrieved via the posterolateral portal utilizing a crab claw. Sliding knots were utilized, with care taken to keep the knot posterior and directed away from the

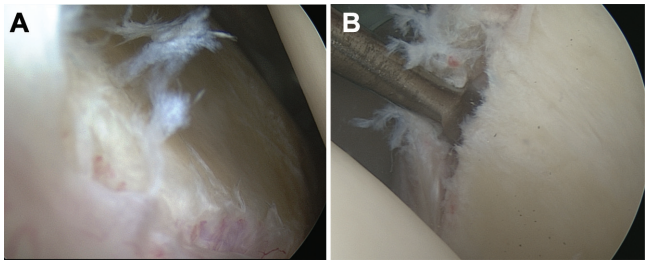

Figure 2. Posterior labral tear as viewed from (A) the posterior portal and (B) the anterior portal at the time of arthroscopy.

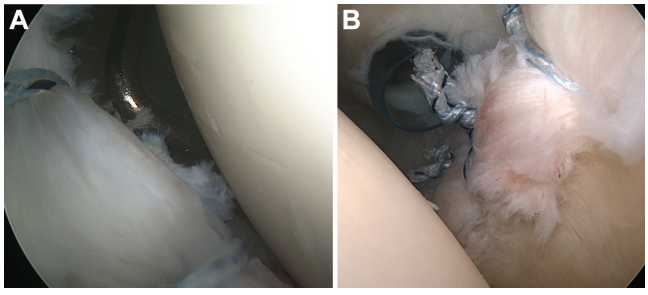

Figure 3. (A) Posterior labral repair technique and (B) final result viewed via the anterior portal.

articular surface to avoid potential articular damage. The steps were repeated until the labrum was repaired (Figure 3). Posterosuperiorly, knotless anchors are preferentially utilized to avoid potential impingement of overhead athletes. Associated pathology is then treated appropriately.

Postoperative Rehabilitation

All patients wore a sling in neutral rotation for the first 3 weeks but were allowed to remove the arm from it when in a safe environment for light activities of daily living. Low-impact cardiovascular exercises were started at 2 weeks. Postoperatively, range of motion exercises were started at 3 weeks. Resistive exercises were allowed at 6 weeks. Batting off a tee and throwing were initiated at 4 months if strength and range of motion allowed, and unrestricted activities were allowed at 6 months.

The time frame for initial return to play and return to previous level of play was recorded. Athletes who were able to successfully return to baseball were asked to subjectively rate whether their abilities were equal to their abilities before injury (return to previous level of play) or less than that (return to play). Success in this series was based on the athlete's ability to return to sport. Postoperative satisfaction was evaluated as not satisfied, satisfied, or very satisfied with the final results. Final postoperative pain and instability scores with formal ASES shoulder scores and range of motion were obtained and compared with preoperative levels for analysis. Instability was evaluated pre- and postoperatively with the ASES questionnaire, in which instability was self-rated on a scale between 0 (very stable) and 10

TABLE 2
Hand Dominance As Related to Injury Pattern[a]

	All Players		Pitchers		Position Players	
	Dominant Hand	Nondominant Hand	Dominant Hand	Nondominant Hand	Dominant Hand	Nondominant Hand
Shoulders	23	9	16	2	7	7
Mechanism of injury						
Throwing	10 (43.5)	1 (11.1)	9 (56.2)	1 (50.0)	1 (14.3)	0 (0.0)
Batting	1 (4.3)[b]	7 (77.8)	0 (0.0)	1 (50.0)	1 (14.3)[b]	6 (85.7)
Traumatic	3 (13.0)	1 (11.1)	1 (6.3)	0 (0.0)	2 (28.6)	1 (14.3)
Insidious	9 (39.1)	0 (0.0)	6 (37.5)	0 (0.0)	3 (42.9)	0 (0.0)

[a]Values are presented as n (%).
[b]Patient throws right, bats left.

(very unstable). Final follow-up was made with in-person evaluation by the treating physician in 21 cases, by telephone in 5 cases, and by the current team physician in 6 cases. Statistical analysis was performed with SAS (v 9.3; SAS Institute Inc). Descriptive statistics were presented as means and SDs for quantitative variables or proportions for categorical variables. Proportions were compared with chi-square or Fisher exact tests (when expected values were <5). Quantitative variables were compared by a pooled independent 2-sample t test for independent comparisons or a paired t test for dependent comparisons. All reported P values are 2-sided with a type I error of .05.

TABLE 3
Concomitant Procedures Performed During the Time of Repair

	n	%
Subacromial decompression by bursectomy	18	56.25
Extensive debridement	10	31.25
Rotator cuff debridement	3	9.38
Rotator interval closure	3	9.38
Distal clavicle resection	2	6.25
Capsular imbrication	2	6.25
Acromioplasty	2	6.25
Rotator cuff repair	1	3.13

RESULTS

All 32 athletes were male with a mean age of 20.5 years at time of surgery. No patients were lost to follow-up, and all were available for reevaluation at a mean follow-up of 41.58 months (range, 24-92 months). There were a variety of levels of play: recreational (6.3%), high school (43.8%), college (31.3%), and professional (18.8%). There were 25 (78.1%) right-handed throwers, and 9 of 32 (28.1%) injured the nonthrowing arm. A majority of the athletes (56.3%) were pitchers. The mechanism of injury was variable, with 11 (34.4%) from throwing, 8 (25%) from batting, 9 (28.1%) with insidious onset, and 4 (12.5%) from trauma. All batting injuries occurred in the lead shoulder, and 10 of 11 throwing injuries occurred in the dominant arm. Dominant shoulder injuries primarily occurred among pitchers, and position players more commonly injured the nondominant arm during batting (Table 2).

Only 1 patient (3.1%) reported isolated instability symptoms preoperatively, with 25 (78%) having a chief symptom of pain and 6 (18.8%) indicating pain and instability symptoms. No patient could demonstrate posterior subluxation actively in the office. The mean preoperative visual analog scale pain score was 4.34 out of 10, and the mean instability score was 3.43 out of 10. Preoperative physical examination revealed the following: 23 (71.9%) with positive O'Brien test result, 16 (50%) with positive relocation test result, and 8 (25%) with positive load-shift test results. All patients demonstrated positive findings on at least 1 instability test. Nonoperative treatment was attempted in all cases for a mean 15.05 months (range, 2-60 months).

At time of arthroscopy, a variety of tear patterns involving the posterior labrum were identified: 32% involved 90° of the posterior superior labrum; 35% involved the posterior 180°; and 32% involved 90° of the posterior inferior labrum. MRI clearly identified a tear pattern in 75%. A mean 2.78 suture anchors were used in the posterior repair (range, 2-4 anchors). There was no difference in results according to tear size or number of anchors utilized ($P = .935$). Concomitant procedures performed are presented in Table 3.

ASES scores significantly improved ($P < .0001$), increasing 30.9 points from the preoperative mean of 65.4 to a postoperative mean of 96.3. The mean pain score (0-10) preoperatively was 4.34, which improved to 0.33 postoperatively ($P < .00001$). The mean instability score (0-10) preoperatively was 3.44, which improved to 0.60 postoperatively ($P < .0001$). No significant postoperative range of motion deficits were found, with the exception of a notable difference in the isolated concomitant rotator cuff repair. The patient with a rotator cuff repair achieved lower abduction/internal rotation when compared with the group mean of those without; however, no statistical significance was obtained given the lack of power. There was no significant association between final range of motion in abduction/external rotation or abduction/internal rotation and return to play ($P = .3378$ and $P = .9032$, respectively).

Overall, 94% of athletes returned to play, 61% at the previous level, and 6% did not return. Analysis of predictors of

return to previous level of play was performed. No statistical significance was found between preoperative length of symptoms and return to play. Mechanism of injury did not predict return to previous level of play (P = .303). Pitchers had a significantly lower rate of return to previous level of play at 41% when compared with position players at 86% (P = .0113). Correspondingly, nonpitcher position players were significantly more likely to be satisfied with their final results (P = .031). Lower rates of return to previous level of play were found for high school athletes (40%) as compared with college athletes (80%) and professional athletes (83.3%, P = .0617). However, age (16-19 vs $\geq$20 years) was not associated with return to previous level of play (55.6% vs 69.2%, P = .441). The pattern of tear was not predictive of return to previous level of play (P = .2421). The presence of a positive test result for the O'Brien, relocation, or load-shift test was not associated with return to play (P = .6750, P = .1826, and P = .3554, respectively).

DISCUSSION

Arthroscopic posterior labral repair is an effective option for baseball players who have not responded to a course of nonoperative treatment. In this study, arthroscopic posterior labral repair allowed 61% of players to return to their previous levels of play, while 94% were able to return to baseball. Among our patients, 73% were very satisfied with the results of surgery, and 21% were satisfied. These findings support our hypothesis that this procedure is a good option in the treatment of baseball players with a posterior labral tear who have failed a nonoperative regimen. Our results are comparable with those of Sayde et al[32] of a 63% return to previous level of play in a review of 14 studies evaluating the success of SLAP (superior labrum anterior and posterior) tear repairs in a mixed group of 198 overhead athletes. Comparison of studies across the literature regarding labral repair of overhead athletes is somewhat difficult because tear location, extent, and anchor placement are not clearly described in the majority of series reported. Return to play varies from approximately 30% to 80% in series involving SLAP repair among baseball players.[4,6,22,25] In 2 series addressing repair of posterior labral tears, Wanich et al[33] reported a 92% return to play among batters after repair for batter's subluxation, and Radkowski et al[28] reported a 55% return to play for a group of 15 throwers after similar repairs. In our series, position players were more successful than pitchers at returning to previous levels of play (86% vs 41%). These findings are in agreement with the previous 2 studies, as well as with the return-to-play results from Fedoriw et al[10] in a similarly sized series. However, results in the literature are mixed, with multiple other series demonstrating equivalent or higher return to play for pitchers over position players after SLAP repair.[4,6,20,22,25,29,32]

The literature regarding posterior instability of the shoulder includes a variety of sports and mechanisms of injury. These series also include patients with multi- and bidirectional instability, making results of surgical repair difficult to compare. The degree of instability is also variable, with some patients demonstrating frank posterior dislocation and relocation on examination and others demonstrating only painful subluxation. Because of this variability, comparison with this current series is somewhat difficult. One of the largest studies on posterior labral tears of athletes limited the series to patients with posteroinferior tears and included only 4 (14%) baseball players.[26] In the series from Savoie et al[31] that included 32 (36%) throwers, >40% of the athletes sustained a traumatic posterior dislocation and cited recurrent instability as their primary symptom. Our patients in contrast had a greater variety of posterior labral tears but could be characterized as having more subtle instability. Excessive posterior capsular laxity, which has been demonstrated to be a significant cause of failure after surgical repair of posterior instability,[9] was not present in this series of patients.

Literature regarding treatment of posterior stability involving football linemen has revealed excellent results with arthroscopic repair.[1,3] Many series regarding athletes with posterior instability have relatively small numbers of throwers,[2,14,18,23,34,35] and several do not separate throwers from other athletes for individual evaluation. The difference between overhead throwers and contact athletes is critical in terms of mechanism of injury and demands of the sport. The fact that football linemen can reliably return to sport after posterior labral repair does not suggest that throwers will have the same results. Results in those series that did examine throwers individually after posterior labral repair revealed a rate of return to play for elite throwers of approximately 30% to 60%.[8] Radkowski et al[28] compared the results of posterior capsular labral repair for posterior instability between throwing and nonthrowing athletes and showed similar results in terms of patient satisfaction. The authors used a variety of surgical techniques and found that throwing athletes were less likely to return to preinjury level sports (55%) as compared with nonthrowing athletes (71%).

Posterior instability may be a greater challenge to diagnose because it classically presents with a more vague clinical picture than anterior instability with regard to mechanism, symptoms, signs, and radiographic findings. In our group, pain was the principal symptom rather than isolated instability (75% vs 3% in this series). Physical examination revealed some type of instability in the shoulder in the majority of patients, although it was not always specific to posterior instability. This is consistent with findings in other studies on posterior instability[26] and with the circle concept of instability proposed by Curl and Warren,[7] in which labral disruption can result in multidirectional laxity. MRI successfully demonstrated the posterior labral tear in 77% of patients in this series. Pennington et al[26] reported that 61% of posterior labral tears were identified by the radiologist but 96% were identified by the treating surgeon when review of the MRI was coupled with physical examination of the patient. Asymptomatic labral pathology is present in a large percentage of baseball pitchers,[12,16,19] and care must be taken to avoid treating lesions that are not contributing to the player's pain complex, as this may result in stiffness. However,

baseball players with symptomatic posterior labral tears present with a clinical picture including mechanism, symptoms, signs of instability on physical examination, and labral pathology during arthroscopic evaluation. Surgery was offered in this series in the face of the negative MRI findings for patients who failed nonoperative treatment if the rest of the clinical picture was consistent with a posterior labral tear.

The pattern of labral tear in this group was variable despite inclusion being limited to players with labral tears posterior to the midline of the glenoid. Our findings are similar to those of Savoie et al,[31] who were unable to identify an "essential lesion" for posterior instability. In contrast to their study, labral tears were identified in all patients in this series, but the exact location varied from antero- to posterosuperior, with some involving the entire posterior labrum. There appears to be a spectrum of location and configuration of labral tears in baseball players, making the comparison of results among series difficult. Even in modern-day series involving SLAP repairs, the exact location of the labral tear and anchor placement is not clearly defined. A type II SLAP tear was originally defined as a tear from 11 to 1 o'clock on the superior glenoid neck that destabilized the biceps anchor, but significant variability exists regarding the extent of these tears. Brockmeier et al[4] noted 15% of patients with more extensive tears requiring additional anchors in his report on SLAP repairs. Park et al[24] and Neri et al[21] also stated that some patients in their series had extension of the labral tear posteriorly beyond the traditional 11- to 1-o'clock area and required additional anchors. In a series of SLAP repairs for overhead athletes, Neuman et al[22] stated that the number and location of anchors (range, 1-4 anchors) depended on the extent of the tear, suggesting a variability in the pathology identified in that series of athletes. Friel et al[11] included patients with concomitant Bankart lesion if the primary symptoms appeared to be coming from the superior labrum. It is somewhat arbitrary where a SLAP tear ends and a posterior labral tear begins. Although our study included differential tear patterns, it contained a subgroup of posterior superior tears reaching the biceps anchor. For that reason, we compared our results with both SLAP repair and posterior labral repair studies, as these tears appear to represent a variable continuum in the pattern of labral tears among athletes. Most important, all of these patients share the fact that the shoulder is destabilized enough to cause pain and limited function but not necessarily a sensation of instability.

No anchors were placed anterior to the midline in this series, with the results comparable with those reported in type II superior labral tears that did utilize anterior anchors. There is concern that anchors placed anterior to the biceps anchor tether the biceps, thus limiting external rotation in abduction.[11] It was our impression during surgery that adequately repairing the posterior labrum adequately stabilized the biceps and fixation anterior to the midline is unnecessary in this patient population. Suture anchors were utilized in the repair of all labral tears in this series, as superior results have been reported in the literature with this technique.[3,11,17,28,32] Knotless anchors were utilized if the tear was posterosuperior to avoid impingement with the rotator cuff in the abducted externally rotated position. Otherwise, sutures were tied without concerns of impingement against suture knots. Attempts were made to keep knots posterior to the labrum to avoid contact with articular surfaces.

Regarding anchor placement, it was our opinion that placing anchors anterior to the biceps root could limit excursion of the arm in external rotation and should be avoided in overhead athletes. Our results, however, were similar to those reported in the literature for SLAP repair in which anchors were placed anterior to the biceps anchor. As noted by Neuman et al,[22] anchor placement and number of anchors in our series were dictated by tear pattern alone and may explain why there is no correlation between the number of anchors and the results in the series. A recent study regarding pitching motion analysis comparing biceps tenodesis and repair of a type II SLAP tear demonstrated equivalent neuromuscular stabilization of the scapula with both techniques, but SLAP repair led to alterations in normal scapulothoracic motion whereas biceps tenodesis did not.[5] In our study, labral tears were primarily present posteriorly, and it is difficult to determine how biceps tenodesis would have any effect on a posterior inferior labral tear or associated subluxation.

Although we believe that the information in this study provides value for discussion of expectations after surgical outcomes for athletes with posterior labral pathology, there were many limitations. There was significant heterogeneity in terms of tear location, duration of symptoms, and associated procedures, and there was no control or comparison group. We recognize that although this study broadly identified a group of baseball players with posterior labral pathology, subgrouping imparts a variety of permutations with respect to position, mechanism of injury, and tear pattern. The stress on the shoulder is highly variable in this series according to hand dominance with throwing and direction of batting as well as quantity of throwing, which is different between pitchers and position players. Analysis of the aforementioned specifics reduces the power of our work, subjects this study to beta error, and should be considered when interpreting the information. A further weakness of this study is that this was a retrospectively reviewed series of players. The same treatment algorithm, however, was used on all players with a course of extensive supervised physical therapy via a baseball trainer or therapist before the recommendation of surgery. Location of anchor placement varied according to the tear type, and the principle of complete repair of the labral tear was followed in each case. The strengths of this current series are that the population included baseball players treated by a single surgeon with an identical surgical technique. It should be noted that these athletes were treated by a high-volume shoulder specialist and the results may not be generalizable to those within a community-based practice. Success of surgery was graded on return to play, as this was thought to be the best indicator.

In conclusion, arthroscopic treatment of posterior labral tears of baseball players was effective in improving pain and function, resulting in 94% patient satisfaction and

94% return to sport with 61% returning to previous level of play. Patient presentation is variable, with a majority of patients citing pain rather than instability.

REFERENCES

1. Arner JW, McClincy MP, Bradley JP. Arthroscopic stabilization of posterior shoulder instability is successful in American football players. *Arthroscopy*. 2015;31:1466-1471.
2. Bigliani LU, Pollock RG, McIlveen SJ, Endrizzi DP, Flatow EL. Shift of the posteroinferior aspect of the capsule for recurrent posterior glenohumeral instability. *J Bone Joint Surg Am*. 1995;77:1011-1020.
3. Bradley JP, McClincy MP, Arner JW, Tejwani SG. Arthroscopic capsulolabral reconstruction for posterior instability of the shoulder: a prospective study of 200 shoulders. *Am J Sports Med*. 2013;41:2005-2014.
4. Brockmeier SF, Voos JE, Williams RJ 3rd, et al. Outcomes after arthroscopic repair of type-II SLAP lesions. *J Bone Joint Surg Am*. 2009;91:1595-1603.
5. Chalmers PN, Trombley R, Cip J, et al. Postoperative restoration of upper extremity motion and neuromuscular control during the overhand pitch: evaluation of tenodesis and repair for superior labral anterior-posterior tears. *Am J Sports Med*. 2014;42:2825-2836.
6. Cohen DB, Coleman S, Drakos MC, et al. Outcomes of isolated type II SLAP lesions treated with arthroscopic fixation using a bioabsorbable tack. *Arthroscopy*. 2006;22:136-142.
7. Curl LA, Warren RF. Glenohumeral joint stability: selective cutting studies on the static capsular restraints. *Clin Orthop Relat Res*. 1996;330:54-65.
8. DeLong JM, Bradley JP. Posterior shoulder instability in the athletic population: variations in assessment, clinical outcomes, and return to sport. *World J Orthop*. 2015;6:927-934.
9. DeLong JM, Jiang K, Bradley JP. Posterior instability of the shoulder: a systematic review and meta-analysis of clinical outcomes. *Am J Sports Med*. 2015;43:1805-1817.
10. Fedoriw WW, Ramkumar P, McCulloch PC, Lintner DM. Return to play after treatment of superior labral tears in professional baseball players. *Am J Sports Med*. 2014;42:1155-1160.
11. Friel NA, Karas V, Slabaugh MA, Cole BJ. Outcomes of type II superior labrum, anterior to posterior (SLAP) repair: prospective evaluation at a minimum two-year follow-up. *J Shoulder Elbow Surg*. 2010;19:859-867.
12. Halbrecht JL, Tirman P, Atkin D. Internal impingement of the shoulder: comparison of findings between the throwing and nonthrowing shoulders of college baseball players. *Arthroscopy*. 1999;15:253-258.
13. Kang RW, Mahony GT, Harris TC, Dines JS. Posterior instability caused by batter's shoulder. *Clin Sports Med*. 2013;32:797-802.
14. Kim SH, Ha KI, Yoo JC, Noh KC. Kim's lesion: an incomplete and concealed avulsion of the posteroinferior labrum in posterior or multidirectional posteroinferior instability of the shoulder. *Arthroscopy*. 2004;20:712-720.
15. Leivadiotou D, Ahrens P. Arthroscopic treatment of posterior shoulder instability: a systematic review. *Arthroscopy*. 2015;31:555-560.
16. Lesniak BP, Baraga MG, Jose J, Smith MK, Cunningham S, Kaplan LD. Glenohumeral findings on magnetic resonance imaging correlate with innings pitched in asymptomatic pitchers. *Am J Sports Med*. 2013;41:2022-2027.
17. McClincy MP, Arner JW, Bradley JP. Posterior shoulder instability in throwing athletes: a case-matched comparison of throwers and nonthrowers. *Arthroscopy*. 2015;31:1041-1051.
18. McIntyre LF, Caspari RB, Savoie FH 3rd. The arthroscopic treatment of posterior shoulder instability: two-year results of a multiple suture technique. *Arthroscopy*. 1997;13:426-432.
19. Miniaci A, Mascia AT, Salonen DC, Becker EJ. Magnetic resonance imaging of the shoulder in asymptomatic professional baseball pitchers. *Am J Sports Med*. 2002;30:66-73.
20. Neri BR, ElAttrache NS, Owsley KC, Mohr K, Yocum LA. Outcome of type II superior labral anterior posterior repairs in elite overhead athletes: effect of concomitant partial-thickness rotator cuff tears. *Am J Sports Med*. 2011;39:114-120.
21. Neri BR, Vollmer EA, Kvitne RS. Isolated type II superior labral anterior posterior lesions: age-related outcome of arthroscopic fixation. *Am J Sports Med*. 2009;37:937-942.
22. Neuman BJ, Boisvert CB, Reiter B, Lawson K, Ciccotti MG, Cohen SB. Results of arthroscopic repair of type II superior labral anterior posterior lesions in overhead athletes: assessment of return to preinjury playing level and satisfaction. *Am J Sports Med*. 2011;39:1883-1888.
23. Papendick LW, Savoie FH 3rd. Anatomy-specific repair techniques for posterior shoulder instability. *J Southern Orthop Assoc*. 1995;4:169-176.
24. Park JH, Lee YS, Wang JH, Noh HK, Kim JG. Outcome of the isolated SLAP lesions and analysis of the results according to the injury mechanisms. *Knee Surg Sports Traumatol Arthrosc*. 2008;16:511-515.
25. Park JY, Chung SW, Jeon SH, Lee JG, Oh KS. Clinical and radiological outcomes of type 2 superior labral anterior posterior repairs in elite overhead athletes. *Am J Sports Med*. 2013;41:1372-1379.
26. Pennington WT, Sytsma MA, Gibbons DJ, et al. Arthroscopic posterior labral repair in athletes: outcome analysis at 2-year follow-up. *Arthroscopy*. 2010;26:1162-1171.
27. Provencher MT, LeClere LE, King S, et al. Posterior instability of the shoulder: diagnosis and management. *Am J Sports Med*. 2011;39:874-886.
28. Radkowski CA, Chhabra A, Baker CL 3rd, Tejwani SG, Bradley JP. Arthroscopic capsulolabral repair for posterior shoulder instability in throwing athletes compared with nonthrowing athletes. *Am J Sports Med*. 2008;36:693-699.
29. Ricchetti ET, Weidner Z, Lawrence JT, Sennett BJ, Huffman GR. Glenoid labral repair in Major League Baseball pitchers. *Int J Sports Med*. 2010;31:265-270.
30. Robinson CM, Aderinto J. Recurrent posterior shoulder instability. *J Bone Joint Surg Am*. 2005;87:883-892.
31. Savoie FH 3rd, Holt MS, Field LD, Ramsey JR. Arthroscopic management of posterior instability: evolution of technique and results. *Arthroscopy*. 2008;24:389-396.
32. Sayde WM, Cohen SB, Ciccotti MG, Dodson CC. Return to play after type II superior labral anterior-posterior lesion repairs in athletes: a systematic review. *Clin Orthop Relat Res*. 2012;470:1595-1600.
33. Wanich T, Dines J, Dines D, Gambardella RA, Yocum LA. ''Batter's shoulder'': can athletes return to play at the same level after operative treatment? *Clin Orthop Relat Res*. 2012;470:1565-1570.
34. Williams RJ 3rd, Strickland S, Cohen M, Altchek DW, Warren RF. Arthroscopic repair for traumatic posterior shoulder instability. *Am J Sports Med*. 2003;31:203-209.
35. Wolf EM, Eakin CL. Arthroscopic capsular plication for posterior shoulder instability. *Arthroscopy*. 1998;14:153-163.