Outcomes of Glenoid Labral Repair Using All-Suture Anchors

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Background: In recent years, innovation in arthroscopic glenoid labral repair techniques has included the development of all-suture anchors. There are multiple potential advantages of all-suture anchors, including decreased bone removal, anchor migration, synovitis/chondral injury, and bone reaction. Despite these potential advantages, few studies have examined clinical outcomes of glenoid labral repair with all-suture anchors.

Purpose: To evaluate patient-reported and return-to-sport outcomes of arthroscopic glenoid labral repairs using all-suture anchors.

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

Methods: All patients who underwent arthroscopic glenoid labral repair using all-suture anchors at our institution over a 6-year period were identified. As a part of a longitudinal data repository, we collected baseline (presurgical) and follow-up patient-reported outcome data, with a minimum follow-up time of 2 years, using the American Shoulder and Elbow Surgeons (ASES) score and the Western Ontario Shoulder Instability Index (WOSI) score. For athletes, we also collected data on return to preinjury level of sport and relevant contextual factors. We compared baseline and follow-up ASES and WOSI scores and examined the association between demographic, injury, and surgery variables and ASES/WOSI scores at follow-up.

Results: Of 529 eligible patients, follow-up data were collected for 372 (70%). Of those, 51 underwent any type of subsequent ipsilateral shoulder surgery (14% of those with follow-up data [51/372]). In the remaining 321 patients (mean age at surgery, 23.9 years; 83% male), we collected both presurgical and follow-up outcome data (mean follow-up time, 3.3 years). Across all labral repair types, mean values significantly improved from baseline to follow-up for both the ASES (baseline, 62.1; follow-up, 92.7) and the WOSI (baseline, 47.5; follow-up, 85.4). Younger age, being a competitive athlete, and having a labral tear in the inferior location (vs not) were associated with higher ASES and WOSI scores at follow-up. Those with concomitant biceps tenodesis demonstrated lower ASES and WOSI scores at follow-up compared with those without tenodesis. Within competitive athletes (n = 201), 95% of athletes who attempted to return to preinjury level of sport were able to do so.

Conclusion: Among patients with follow-up data, 14% underwent subsequent ipsilateral shoulder procedures. Those who didn't undergo subsequent procedures demonstrated excellent patient-reported outcomes, including large and meaningful improvements in ASES and WOSI scores and a high level of return-to-sport in athletes, after arthroscopic all-suture anchor glenoid labral repair at a mean follow-up of 3.3 years.

Keywords: glenoid; labrum; arthroscopic labral repair; shoulder instability; all-suture anchor; soft anchor

Arthroscopic glenoid labral repair has advanced in recent years, as advancements in anchor design, arthroscopic instrumentation, and surgical technique have contributed to improvement in outcomes for arthroscopic shoulder stabilization.[2,8,10,31,36] Solid anchors, manufactured from a variety of materials such as metal, biocomposite, and polyetheretherketone (PEEK) previously have been the gold standard for glenoid labral repair.[30] These anchor types

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have been thoroughly studied and have demonstrated acceptable biomechanical properties.[6,15,27] Nevertheless, suture anchor design has advanced recently to include the development of all-suture anchors.[1,27]

There are numerous potential advantages of all-suture anchors over conventional solid anchors in shoulder soft tissue repairs. All-suture anchors are smaller in diameter than comparable solid anchors, resulting in less bone removal when the anchor is drilled and set, preserving critical bone stock around the glenoid.[11,27] This also allows for a greater number of anchors to be incorporated into the repair, resulting in more points of labral fixation to the glenoid and improved repair outcomes.[7] Notably, reactive osteolysis associated with solid anchors has resulted in glenoid bone loss, cyst formation, and glenoid fracture[5,6,11,43,46] All-suture anchors have demonstrated less perianchor reactive osteolysis than solid anchors, suggesting that all-suture anchors may have more reliable biologic fixation.[25,38,47,49] This has particular clinical relevance, as perianchor radiolucency, especially in the inferior aspect of the glenoid, has been correlated with failure of repair, recurrent instability, recurrent dislocation, and anchor arthropathy.[33] Additional complications, such as chondrolysis, synovitis, anchor migration, and chondral damage caused by third-body wear, may be avoided with the use of all-suture anchors.[11,12,18,23]

Previous biomechanical studies of all-suture anchors have demonstrated similar results to conventional anchors. Different manufacturers' all-suture anchors display similar biomechanical properties with regard to cyclic displacement, construct stiffness, and load to failure, with some data showing higher ultimate load to failure for all-suture anchors compared with conventional anchors.[14,29,39,50] Recent case series with all-suture anchors have also demonstrated good clinical outcomes,[19,34] with similar failure rates and patient-reported outcomes compared with conventional anchors. In this study, we sought to evaluate clinical outcomes of arthroscopic all-suture soft anchor glenoid labral repairs, evaluating change in patient-reported outcomes before and after surgery and evaluating the effect of relevant clinical and surgical variables on outcomes. We hypothesized that all-suture anchor labral repairs would demonstrate large and clinically relevant improvements in patient-reported outcomes in all patients and high proportions of return to preinjury sport in athletes.

METHODS

Study Design

We followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines in the development, conduct, and reporting presented in this manuscript.[52] We obtained institutional review board approval at our institution before the initiation of this study. To identify potential participants, we conducted a retrospective billing code database search of glenoid labral repair procedures from 2015 through 2021 performed by 5 fellowship-trained orthopaedic surgeons (J.R.D., E.L.C., B.A.E., M.A.R., and M.K.R.) at Andrews Sports Medicine and Orthopaedic Center in Birmingham, Alabama, in the United States. We included potential patients in this study if they (1) underwent primary, arthroscopic glenoid labral repair using only all-suture soft anchors; (2) were enrolled in our ongoing data repository and had presurgery (baseline) patient-reported outcome data previously collected; and (3) were $\geq$2 years postoperative at the time of follow-up patient-reported outcome data collection. Patients were excluded from this study if they (1) underwent open labral repair, (2) underwent arthroscopic labral repair with any solid anchor, or (3) underwent revision labral repair as an index procedure. Patients with concomitant biceps tenodesis were included, and the effect of these procedures was considered in the subgroup analysis reported herein.

Patient Selection, Surgical Technique, and Postoperative Rehabilitation

Patients with symptomatic labral tears were identified and selected for surgery according to pain and/or instability reported via patient history and elicited on the surgeon's physical examination. All labral repair procedures were performed with the patient in the lateral decubitus position, with the arm hung in balanced suspension with approximately 5 to 7 kg of axial traction. Patients received general anesthesia and typically received a preoperative regional interscalene nerve block performed by the anesthesia team. Shoulders with associated biceps symptoms or pathology received concomitant biceps tenodesis, as

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indicated by surgeon discretion. Standard portals were used, with a subscapularis accessory portal or posterior accessory portal as needed for anterior and posterior glenoid access, respectively. In the case of traumatic tears, the labrum was elevated from the glenoid bone using atraumatic elevators for the length of the tear, and a shaver was then used to lightly decorticate the glenoid rim to achieve bleeding bone, preparing the rim for optimal labral healing. For bony Bankart repairs, 2 techniques were utilized, at the discretion of the operating surgeon. For small bony Bankarts with minimal bone loss, the labrum was debrided of bony fragments and repaired with a standard single-row repair. For large bony Bankarts, bone was preserved, and a double-row compressive repair technique was used. In the case of remplissage, 1 or 2 anchors were placed into a prepared Hill-Sachs defect, and the repair sutures passed through the infraspinatus and posterior capsule to fill the defect. Choice of remplissage and the number of anchors used was also at the discretion of the operating surgeon. For multidirectional instability patients, native and intact labral tissue was not detached from the glenoid. Labral repair with generous capsulorrhaphy was performed with standard suture passers, beginning at the anteroinferior aspect of the glenoid, moving superior, and finishing posterior. Knotted and/or knotless 1.8-mm and/or 2.6-mm all-suture anchors (FiberTak; Arthrex, Inc) were drilled and set using a curved or straight drill guide placed just off the articular surface of the glenoid rim and tensioned sequentially. The attending surgeon determined the extent of labral tearing and the number of anchors used in the repair at the time of the procedure. Postoperative rehabilitation included physical therapy beginning on postoperative day 1 for range of motion, with the shoulder placed in an immobilizer for 4 weeks for standard anterior or posterior tears $<180^\circ$ in width, and 6 weeks for tears $>180^\circ$ in width. Athletes were allowed to return to play according to physician discretion after demonstrating symmetric strength with full range of motion, typically beginning around 4 months postoperatively.

Clinical and Outcome Data Collection

For labral repair patients eligible for this study, we obtained demographic and clinical data from chart and operative note reviews of the electronic medical record. These data included age, sex, labral tear location, labral tear size, presence of recurrent instability at time of surgery, presence of bony Bankart lesion present at time of surgery, presence of Hill-Sachs lesion at time of surgery, presence of chondral defect at time of surgery, labral repair type, number and type of anchors utilized, follow-up time, competitive athlete status, and whether the operative shoulder underwent revision surgery at our institution. Careful attention was paid to the operative reports as well as intraoperative photographs to ensure use of all-suture anchors for the index labral repair. Postoperative imaging was not routinely performed as part of clinical follow-up visits, and these data are not included in the current study.

To collect patient-reported function data, we enrolled labral repair patients into an ongoing electronic data repository (Outcomes Based Electronic Research Database [OBERD]; Universal Research Solutions) before their surgery and collected baseline preoperative surveys. The OBERD system then regularly distributed outcome surveys electronically to enrolled patients using automated emails and/or SMS messages at 2 years postoperatively. For patients who did not respond to the electronic survey request, we contacted them via telephone or email and collected patient-reported outcome data. Before enrollment in our data repository, all patients provided either written, electronic informed consent (data repository data collection) or documented oral consent (telephone data collection). All study data were collected, combined, and managed using REDCap electronic data capture tools (Vanderbilt University) hosted at the American Sports Medicine Institute and Ascension St. Vincent's.[20,21] We used the American Shoulder and Elbow Surgeons (ASES) Standardized Shoulder Assessment Form and the Western Ontario Shoulder Instability Index (WOSI) score to evaluate shoulder-related function before and after surgery. The ASES evaluates limitations in shoulder-related function, including subsections on pain, instability, and activities of daily living, and is scored from 0 to 100.[37] The ASES is valid, reliable, and responsive in measuring shoulder function for patients with labral pathology and has a minimal clinically important difference (MCID) value reported to range from 6.4 points to 7.8 points.[28,42] The WOSI is a 21-item scale that evaluates shoulder-related function and quality-of-life specific to individuals with symptomatic shoulder instability.[26] The WOSI is valid, reliable, and responsive to change in those with shoulder instability and undergoing labral procedures,[26,44] with a reported MCID value of 14 points.[51] Last, within athletes only, we collected data on preinjury/surgery sports participation as well as return to preinjury sport and contextual factors associated with successful or unsuccessful return.

Statistical Analysis

We calculated summary statistics for baseline and/or follow-up demographic, clinical, surgical, and outcome data. We compared baseline and follow-up ASES and WOSI scores using paired t tests across the entire cohort, as well as within labral repair type subgroups. We further calculated effect sizes to quantify the magnitude of baseline to follow-up change in ASES and WOSI scores (Cohen d). We also compared follow-up ASES and WOSI scores between those with and without concomitant biceps procedures using independent t tests. Finally, we examined the association between preinjury demographic and injury variables and ASES and WOSI scores at follow-up or successful return to preinjury sport (within athletes) using linear and logistic regression, respectively. For all analyses, we considered P values $<.05$ to be statistically significant.

All statistical analyses were performed using SPSS Statistics, Version 28.0 (SPSS Inc).

RESULTS

Included Cohort Characteristics

A total of 529 patients had all-suture anchor glenoid labral repairs and were enrolled in our ongoing registry with baseline (presurgery) questionnaire data collected. From this group of 529 patients, we collected follow-up data from a total of 372 patients (70%; 372/529; n = 321 with patient-reported outcomes data; n = 51 with subsequent procedure information). Of the 372 patients, 51 underwent subsequent ipsilateral shoulder procedures after their index all-suture anchor glenoid labral repair (14%; 51/372). Additional information regarding subsequent procedures (whether for recurrent instability or other shoulder issues) are described in more detail below. Patient-reported survey data were collected in the remaining 321 patients (those without subsequent revision surgeries), at a mean follow-up time of 3.3 years (Table 1). The group with successful patient-reported outcomes follow-up (N = 321) did not differ from the group with unsuccessful follow-up (ie, those lost to follow-up; n = 157) in age (P = .50), sex distribution (P = .65), presurgical/baseline ASES scores (P = .67), or presurgical/baseline WOSI scores (P = .31). Demographic, injury, and surgical data for the included cohort are shown in Table 1. Among the included cohort with outcome data, 83% were male and 63% were competitive athletes at the time of surgery (Table 1). Preoperative self-reported recurrent instability was noted in approximately half of patients undergoing labral repair, and one-quarter had associated Hill-Sachs lesions at the time of surgery (Table 1). Anterior labral (Bankart) repairs were the most common type of labral repair performed in the included cohort (61%), and 10% underwent concomitant biceps tenodesis during labral repair due to tear extension into the biceps anchor (Table 1).

Patient-Reported Outcomes

ASES and WOSI scores at baseline (presurgery) and follow-up for the entire cohort, stratified by labral repair subgroup, are shown in Table 2. Within the overall cohort (N = 321), both ASES and WOSI scores significantly improved from baseline to follow-up (Table 2). Additionally, within each labral repair subgroup, ASES and WOSI scores also significantly improved from baseline to follow-up (Table 2). Compared with those without concomitant biceps tenodesis (n = 288), patients who underwent concomitant biceps tenodesis alongside their labral repair (n = 33) reported statistically lower ASES scores and WOSI scores at baseline/preoperative (respectively, 54.2 ± 20.8 vs 63.0 ± 21.0, P = .02; 39.0 ± 19.2 vs 48.4 ± 20.4, P = .02) and at follow-up (respectively, 86.3 ± 14.9 vs 93.5 ± 11.5, P < .01; 79.7 ± 23.6 vs 86.1 ± 17.1, P = .03). The amount of change in ASES and WOSI scores from preoperatively to follow-up did not differ between those with and without concomitant biceps tenodesis (respectively, P = .67 and P = .43).

Subsequent, Ipsilateral/Revision Shoulder Procedures

After their primary, index all-suture anchor labral repair, a total of 51 patients underwent any type of subsequent ipsilateral shoulder procedure (14% of total patients with follow-up data collected [51/372]). The most common subsequent ipsilateral shoulder procedures performed to address recurrent instability were isolated revision labral repair (n = 17), isolated Latarjet (n = 6), revision labral repair plus Latarjet (n = 2), capsular plication (n = 2), and capsular shift (n = 1), for a total of 8% of eligible patients with follow-up data collected (28/372). Additional most common subsequent ipsilateral shoulder procedures included biceps tenodesis, subacromial decompression, subcoracoid decompression, distal clavicular excision, and manipulation under anesthesia. There was a higher proportion of female versus male patients that underwent subsequent shoulder procedures (31% female/69% male) than those who did not undergo subsequent shoulder procedures (17% female/83% male; P = .02). Those that did and did not undergo subsequent ipsilateral shoulder procedures after their primary labral repair did not differ in age at time of surgery (P = .64).

Predictors of Outcomes

For ASES scores, younger age (P < .01), being a competitive athlete (P < .01), the presence of a Hill-Sachs lesion (vs not; P < .01), having a labral tear in the anterior location (vs not; P < .01), and having a labral tear in the inferior location (vs not; P < .01) were predictive of higher ASES scores at follow-up. Sex (P = .21), follow-up time (P = .44), the presence of a bony Bankart lesion (P = .54), the presence of a chondral defect (P = .24), having a labral tear in the superior location (vs not; P = .33), and having a labral tear in the posterior location (vs not; P = .12) were not predictive of higher/lower ASES scores at follow-up. For WOSI scores, younger age (P < .01), being a competitive athlete (P < .01), and having a labral tear in the inferior location (vs not; P = .01) were predictive of higher WOSI scores at follow-up. Sex (P = .28), follow-up time (P = .65), the presence of a bony Bankart lesion (P = .78), the presence of a chondral defect (P = .10), the presence of a Hill-Sachs lesion (P = .52), having a labral tear in the superior location (vs not; P = .33), having a labral tear in the anterior location (vs not; P = .32), and having a labral tear in the posterior location (P = .81) were not predictive of higher/lower WOSI scores at follow-up.

Return-to-Sport Outcomes Within Athletes

In competitive athletes only (n = 201), sport-related data and return-to-sport outcomes are shown in Table 3. In the included cohort of athletes, the majority participated

TABLE 1
Demographic, Clinical, and Surgical Data for the Cohort With Outcome Data (N = 321)[a]

Variable	Value
Age at surgery, y	23.9 ± 9.6
Follow-up time, y	3.3 ± 1.1
Sex	Male: 266 (83)
	Female: 54 (17)
	Other/prefer not to answer: 1 (<1)
Competitive athlete at time of surgery	201 (63)
Recurrent instability self-reported before surgery	162 (50)
Bony Bankart (anterior) lesion noted intraoperatively	21 (7)
Hill-Sachs lesion noted intraoperatively	79 (25)
Chondral defect noted intraoperatively	18 (6)
Tear location[b]	
Superior	104 (32)
Anterior	207 (64)
Posterior	184 (57)
Inferior	161 (50)
Labral repair type[b]	
Anterior (Bankart)	196 (61)
Posterior	136 (42)
SLAP	43 (13)
270°	20 (6)
360°	17 (5)
All-suture anchor types	
Knotless	191 (60)
Knotted	50 (16)
Combined	34 (11)
Not reported/specified	46 (14)
Underwent concomitant remplissage during surgery	30 (9)
Underwent concomitant biceps tenodesis during surgery	33 (10)

[a]Data are presented as mean ± SD or n (%). SLAP, superior labrum anterior to posterior.
[b]Tear location or repair type could occur in combination.

at the high school (59%) or collegiate level (19%) (Table 3). American football was the most common primary sport of included athletes (39%), followed by baseball (21%) and basketball (7%) (Table 3). Overall and for all reasons, 70% of athletes successfully returned to preinjury participation in sport. However, only 149 of the 201 competitive athletes attempted to return to participation in sport. Of those who attempted to return, 141 (95%) were able to return to preinjury level of participation. Thus, only 8 athletes were unable to return specifically due to limitations from their glenoid labral repair procedure or due to fear of reinjury. Other reasons for unsuccessful return to sport included graduation and/or lack of sufficient talent to move to the next level or personal reasons (Table 3). For athletes (n = 201), age at surgery (P = .21), sex (P = .07), follow-up time (P = .53), the presence of a bony Bankart lesion (P = .38), the presence of a chondral defect (P = .99), the presence of a Hill-Sachs lesion (P = .94), having a labral tear in the superior location (vs not; P = .62), having a labral tear in the anterior location (vs not; P = .73), having a labral tear in the inferior location (vs not; P = .77), having a labral tear in the posterior location (vs not; P = .64), or undergoing biceps tenodesis during labral repair (P = .89) all were not predictive of successful return to sport.

DISCUSSION

The results of this retrospective study using all-suture anchors in glenoid labral repair demonstrated excellent clinical outcomes. Specifically, we found statistically significant and clinically relevant improvements in shoulder patient-reported outcomes in those not requiring subsequent revision/shoulder procedures. However, our subsequent revision/ipsilateral shoulder surgery rate was 14%. Despite a variety of tear patterns and a high proportion of contact athletes in our cohort, we found high rates of return to preinjury level of sport within the competitive athletes in our cohort (for those who attempted to return).

Previous clinical outcome data from studies on labral repairs using conventional solid anchors have demonstrated recurrent instability and need for revision procedures ranging from 6% to 24%.[3,9,13,45,48] In our study, we found that 14% of patients with follow-up data collected had any type of subsequent, ipsilateral shoulder procedure after their all-suture labral repair, but that only 8% had subsequent procedures to address recurrent instability. Patient-reported outcome scores, when collected and reported in previous studies of conventional solid anchor glenoid labral repairs, demonstrate a wide range of

TABLE 2
Baseline and Follow-up Patient-Reported Outcome Data (N = 321)[a]

Variable	Baseline	Follow-up	*P*	Effect Size
Overall cohort				
ASES	62.1 ± 21.2	92.7 ± 12.1	<.001	1.5
WOSI	47.5 ± 20.6	85.4 ± 18.1	<.001	1.6
Anterior (Bankart) repairs (n = 196)				
ASES	64.3 ± 20.9	93.9 ± 11.2	<.001	1.4
WOSI	48.2 ± 20.3	85.5 ± 17.3	<.001	1.7
Posterior labral repairs (n = 136)				
ASES	61.0 ± 21.0	91.3 ± 14.2	<.001	1.4
WOSI	46.8 ± 20.6	84.7 ± 19.3	<.001	1.6
SLAP repairs (n = 43)				
ASES	60.4 ± 19.5	88.5 ± 16.1	<.001	1.4
WOSI	49.3 ± 20.2	82.5 ± 22.1	<.001	1.4
270° repairs (n = 20)				
ASES	68.0 ± 22.1	94.5 ± 9.1	<.001	1.3
WOSI	53.6 ± 22.7	85.9 ± 11.8	<.001	1.3
360° repairs (n = 17)				
ASES	69.3 ± 17.3	94.7 ± 9.7	<.001	1.4
WOSI	49.7 ± 19.0	90.2 ± 8.3	<.001	2.2

[a]All baseline and follow-up data are reported as mean ± SD. ASES and WOSI scores are scaled 0-100, with 100 representing best shoulder function; all *P* values are calculated using paired-samples *t* test; all effect sizes are Cohen *d*; and values >0.8 are considered large effects. ASES, American Shoulder and Elbow Surgeons score; SLAP, superior labrum anterior to posterior; WOSI, Western Ontario Shoulder Instability index.

shoulder-related functional recovery, from Constant-Murley scores as low as 39.6 (out of 100) in early experience to as high as approximately 89 to 91 in the data from a recent meta-analysis.[16,17,45] A previous study examining outcomes between those with standard and accelerated rehabilitation after arthroscopic Bankart repair with conventional anchors reported that, at a mean follow-up of approximately 3.5 years, ASES scores for both groups were approximately 88 points (out of 100).[24] In another study examining outcomes after labral repair with a knotless solid anchor, at mean follow-up of 34 months, mean WOSI scores were approximately 86 (out of 100), and 81% of patients were able to return to normal performance in recreation and sports.[32] Also related to return to participation in sports, Tan and colleagues[48] reported return-to-sport participation rates of 85%. Importantly, however, these cohorts were notably older than the patients in our current study, and most were participating in sports at a recreational level.[32,48]

Given that previous biomechanical studies have shown similar or better mechanical performance comparing all-suture anchors with conventional solid anchors,[39] we expected at least similar clinical outcomes when comparing our findings with conventional solid anchor labral repair. Specifically, in previous biomechanics studies, there was no significant difference in elongation during cyclic loading or ultimate load to failure when comparing knotless and knotted soft-body anchors and knotless solid PEEK anchors.[53] Recently, clinical outcome data using newly developed all-suture soft anchors have been reported in smaller case series studies.[19,34,41] A recently published series by Pearce and colleagues[34] of 31 patients at a mean of 2.6 years after Bankart repair with all-suture knotless anchors demonstrated a mean postoperative ASES scores of 93.3. That study also reported for athletes that the median participant's sports participation was similar to his or her preinjury level and that the postsurgical participation intensity was the same or better than their presurgical intensity.[34] However, the specific rates of return to preinjury sport and level were not reported, and the athlete cohort included primarily outdoor/mountain athletes (bikers, skiers, snowboarders, rock climbers), as compared with primarily football and baseball players in our study. Another 2 recent studies using all-suture

TABLE 3
Return-to-Sport Outcomes in Athletes[a]

Variable	n (%)
Primary sport at time of injury/surgery (n = 201)	Football: 78 (39) Baseball: 43 (21) Basketball: 13 (7) Softball: 10 (5) Powerlifting/CrossFit: 9 (4) Soccer: 6 (3) Volleyball: 5 (2) Wrestling: 5 (2) Cheerleading/dance: 5 (2) Other sports[b]: 27 (13)
Level of competition at time of injury/surgery (n = 201)	Professional: 1 (<1) Collegiate: 39 (19) High school: 118 (59) Club/travel: 7 (3) Adult recreational: 35 (17) Youth recreational: 1 (1)
Proportion of athletes able to return to preinjury level of sport who attempted to return after surgery (n = 149)[c]	141 (95)
Reasons for not returning to preinjury sport (n = 60)[d]	
Graduated and not talented enough for next level	32 (53)
Limited by this labral repair surgery	7 (12)
Personal reasons or decreased interest	17 (28)
Other injuries prevented return	3 (5)
Fear of reinjury	1/60

[a]Data are presented as n (%), unless otherwise indicated.
[b]Other sports included those with n < 5 participants (track and field, tennis, swimming, golf, gymnastics, hockey, cross-country, rugby, martial arts, boxing, and ultimate frisbee).
[c]Those that attempted return to play excluded those that did not return due to graduation/insufficient talent, for personal reasons, or for injuries unrelated to their glenoid labral repair (n = 52).
[d]Did not return to preinjury sport for all reasons shown in the table.

anchors for labral repair in 54 and 62 patients showed improvements in Constant-Murley scores to approximately 92 and 94 (out of 100) postoperatively, respectively.[19,41] Similar to the Pearce study,[34] patients in our study were younger and included a preponderance of competitive athletes, as compared with these studies.[19,41] In the present study, across all all-suture labral repair types, we found mean ASES and WOSI scores at follow-up of 92.7 and 85.4, respectively, and a revision/subsequent ipsilateral surgery rate of 14% (8% for recurrent instability). Additionally, within competitive athletes that attempted to return to sport, 95% were able to do so at their preinjury level. Altogether, our data demonstrate excellent patient-reported outcome scores, satisfactory rates of revision surgery, and high rates of successful return-to-sport in competitive athletes after labral repair with all-suture anchors as compared with the current, early literature for this novel approach. The data presented in this report also suggests that using all-suture anchors for glenoid labral repair with our technique and rehabilitation approach leads to at least similar outcomes to those reported in traditional solid anchors, without the potential complications of solid anchors.

There are several potential advantages related to the use of all-suture anchors during glenoid labral repair. Most notable is the smaller drill hole and bone loss footprint inherent to an all-suture anchor. The majority of anchors used in this study were knotless and had a drill diameter of 1.8 mm, which is considerably smaller than the typical 2.4-mm to 3.5-mm solid anchors, including those offered by the same manufacturer.[4] Additionally, second-generation all-suture anchors have been shown to have similar or less bone reaction and perianchor cyst formation when compared with PEEK or bioabsorbable implants.[22,38,40] Most all-suture anchors demonstrate minimal or zero cystic fluid around the anchor with magnetic resonance imaging (MRI) follow-up; however, it is important to note that cysts can still occur if there is the presence of micromotion.[27,35,40,41,49] Micromotion may be present due to implant design or to inadequate bunching of the anchor while tightening during anchor deployment. We recommend that for knotted all-suture anchors, specifically, the anchor is pulled firmly by the surgeon to set it securely in bone and to confirm adequate pull-out strength intraoperatively and minimize chance of intraoperative or postoperative failure of the anchor. This may prevent later subfailure cyclic displacement, anchor settling, anchor micromotion, anchor pull-out, perianchor bone cyst formation, and, importantly, recurrent instability.

Limitations

There are a number of limitations to this study. Our single-institution database is vulnerable to bias and errors at the time of data entry. Similarly, retrospective, single-arm survey-/outcomes-based research such as this study has inherent bias, including a lack of comparison group, either not undergoing labral repair or undergoing labral repair with solid anchors. We may consider comparing all-suture anchor outcomes to solid anchor outcomes as a future study. We understand that some improvement in patient-reported outcome scores may have been attributable to concomitant procedures performed at the time of labral repair. Additionally, outcomes of surgeries performed by experienced, high-volume surgeons may not be generalizable to all patients undergoing labral repair. It is important to note that we did not record clinical failures of patients who did not undergo revision surgery, nor did we fully track or capture revision surgeries performed at other institutions in those that did not complete patient-reported outcome follow-up (30% of the eligible cohort). Additionally, our center does not routinely collect follow-up imaging (in the short term or midterm/follow-up) unless clinically indicated. Thus, we were unable to evaluate our cohort for measures such as perianchor cyst formation/presence, anchor stability, and labral healing. Future studies should include the collection of follow-up imaging (particularly MRI) data, including direct comparisons with other anchor types, as well as the collection of longer-term data to ensure that patients maintain their shoulder-related function and high levels of return to play through a longer duration of follow-up.

CONCLUSION

Arthroscopic glenoid labral repair with all-suture soft anchors can be an effective, safe treatment for patients with labral tears. After labral repair with all-suture anchors, our results demonstrate meaningful improvement in clinical patient-reported outcomes as well as excellent return-to-play outcomes in competitive athletes. Among patients with follow-up data, 14% underwent subsequent ipsilateral shoulder procedures, including 8% for recurrent instability.

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