

Clinical Outcomes After Anterior Shoulder Stabilization in Overhead Athletes

An Analysis of the MOON Shoulder Instability Consortium

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Background: Traumatic anterior shoulder instability is a common condition affecting sports participation among young athletes. Clinical outcomes after surgical management may vary according to patient activity level and sport involvement. Overhead athletes may experience a higher rate of recurrent instability and difficulty returning to sport postoperatively with limited previous literature to guide treatment.

Purpose: To report the clinical outcomes of patients undergoing primary arthroscopic anterior shoulder stabilization within the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability Consortium and to identify prognostic factors associated with successful return to sport at 2 years postoperatively.

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

Methods: Overhead athletes undergoing primary arthroscopic anterior shoulder stabilization as part of the MOON Shoulder Instability Consortium were identified for analysis. Primary outcomes included the rate of recurrent instability, defined as any patient reporting recurrent dislocation or reoperation attributed to persistent instability, and return to sport at 2 years postoperatively. Secondary outcomes included the Western Ontario Shoulder Instability Index and Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow questionnaire score. Univariate regression analysis was performed to identify patient and surgical factors predictive of return to sport at short-term follow-up.

Results: A total of 49 athletes were identified for inclusion. At 2-year follow-up, 31 (63%) athletes reported returning to sport. Of those returning to sport, 22 athletes (45% of the study population) were able to return to their previous levels of competition (non-refereed, refereed, or professional) in at least 1 overhead sport. Two patients (4.1%) underwent revision stabilization, although 14 (28.6%) reported subjective apprehension or looseness. Age ($P = .87$), sex ($P = .82$), and baseline level of competition ($P = .37$) were not predictive of return to sport. No difference in range of motion in all planes ($P > .05$) and Western Ontario Shoulder Instability Index scores (78.0 vs 80.1, $P = .73$) was noted between those who reported returning to sport and those who did not.

Conclusion: Primary arthroscopic anterior shoulder stabilization in overhead athletes is associated with a low rate of recurrent stabilization surgery. Return to overhead athletics at short-term follow-up is lower than that previously reported for the general athletic population.

Keywords: shoulder; instability; return to sport; overhead athlete

Traumatic anterior shoulder instability is a common condition affecting the sports participation of young athletes.²³ Traditionally, anterior shoulder instability has been treated with closed reduction, followed by a trial of nonoperative management and gradual return to activities. However, the risk of recurrent instability, particularly in a young active population, is upward of 90%.^{27,28,33} Surgical stabilization may be indicated for patients experiencing

recurrent instability or those at risk for recurrence who do not wish to modify their activities.

In the absence of bone loss, surgical treatment typically involves repair or imbrication of the anteroinferior capsulolabral complex to the glenoid. While the goal of surgery is to prevent recurrent instability by tightening the anterior soft tissues, postoperative stiffness or even small deficits in external rotation may adversely affect throwing mechanics and return to overhead sport.^{2,3,5,7,16,18,25,26,30} Furthermore, repetitive overhead activities postoperatively may gradually stretch the anterior capsule despite adequate repair at the time of surgery.¹⁹

The outcomes of shoulder stabilization among overhead athletes have not been well described. Prior small studies

demonstrated that overhead athletes have higher rates of recurrent instability and difficulty returning to sports as compared with patients participating in lower-risk sports.¹⁶ Additionally, many patients who are able to return to sport are unable to do so at their previous levels. Previous studies reported an overall return to sport of 61% to 71% in overhead athletes undergoing anterior stabilization procedures at short- and midterm follow-up.^{2,3,16,18,25} It is currently unknown which patient and surgical factors are associated with a failure to return to sport after anterior shoulder stabilization procedures in this patient population.

The purpose of the current study is to investigate the clinical outcomes of overhead athletes undergoing anterior stabilization procedures within the Multicenter Orthopaedic Outcomes Network (MOON) Shoulder Instability Cohort and to identify prognostic factors associated with successful return to sport at 2 years postoperatively. We hypothesized that overhead athletes would experience a lower return to sport rate than previously reported for the general athletic population.

METHODS

The MOON Shoulder Instability Consortium was formed to investigate outcomes of shoulder instability surgery. Following institutional review board approval, patients undergoing surgical treatment of shoulder instability were prospectively enrolled across 10 academic and private groups throughout the United States. For the purposes of this study, overhead athletes undergoing primary arthroscopic shoulder stabilization for traumatic anterior instability involving the throwing arm were included for analysis. Overhead athletes were defined as patients reporting participation in overhead athletics at the time of enrollment (baseball, cricket, tennis, volleyball, or the quarterback of a football team). Patients undergoing revision stabilization procedures or patients with posterior or multidirectional instability were excluded from this study.

Patients completed a detailed enrollment questionnaire that included demographics, sports played, level of sports participation, and shoulder instability history. Level of sport participation was defined as recreational (without officiating), competitive (with officiating), or professional. Patient-reported outcome scores were also collected, including but not limited to the Western Ontario Shoulder Instability Index (WOSI),²⁹ Shoulder Activity Scale,⁴ and Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow questionnaire (KJOC) score.¹¹ Patients underwent a standardized

examination under anesthesia by a member of the MOON Shoulder Instability Consortium. Intraoperative findings were documented, and a clinical evaluation was performed by the operating surgeon between 4 and 6 months postoperatively to document range of motion and strength in the operative shoulder. Surgical management was not standardized across the patient population, and each patient's treatment plan was individualized according to clinical history and intraoperative findings. Range of motion was estimated to the nearest 10° by the operating surgeon who performed the clinical examination and was not blinded to the performed procedure. Strength was graded with the Oxford Muscle Strength Grading Scale. A questionnaire was administered to calculate the previously mentioned clinical outcome measurements at this visit and yearly thereafter. Clinical failure was defined as any patient-reported recurrent dislocation or reoperation on the operative extremity owing to persistent instability. Study data were collected and managed with REDCap (Research Electronic Data Capture)¹⁵: a secure web-based application designed to support data capture for research studies, providing (1) an intuitive interface for validated data entry, (2) audit trails for tracking data manipulation and export procedures, (3) automated export procedures for seamless data downloads to common statistical packages, and (4) procedures for importing data from external sources.

Statistical analysis was performed with SPSS (v 22.0; IBM). Continuous and categorical pre- and postoperative outcomes were compared with a 2-tailed Student *t* test, Mann-Whitney *U* test if appropriate, and chi-square/Fisher exact test. To determine independent predictors of return to sport, logistic regression analysis was performed. Predictors of return to sport were identified a priori and included patient sex, age, and baseline level of athletic competition (recreational, competitive, and professional). Statistical significance was set at $P = .05$.

RESULTS

A total of 137 overhead athletes completing their 2-year clinical follow-up at the time of the current study were identified for potential inclusion (83.2% of all overhead athletes in the instability consortium). After application of exclusion criteria, 49 patients were included for analysis as part of the current study (Figure 1). All patients reported acute traumatic anterior shoulder instability as the index injury. The mean age at the time of the surgical stabilization was 21.7 years (range, 14-52 years) (Table 1).

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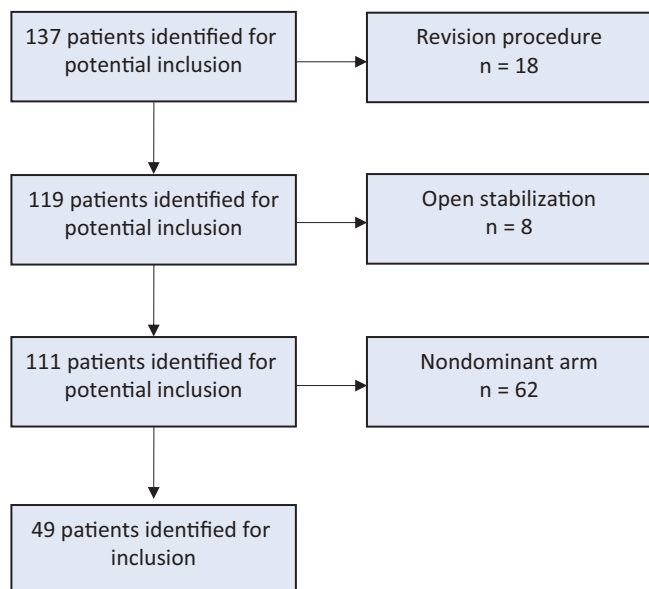


Figure 1. Application of inclusion and exclusion criteria.

The study population included 42 (89%) males and 7 (11%) females. The majority of patients reported involvement in competitive (30 of 49, 61%) or recreational (18 of 49, 37%) sports. One professional athlete was included for analysis. The mean number of overhead sports per athlete at baseline was 1.85. All patients indicated at least 1 dislocation at baseline (mean, 2.4 dislocations per patient). Forty-five patients (91.8%) said that the initial injury occurred during sport. No difference in range of motion in all planes was noted at baseline between the operative and nonoperative extremities ($P > .05$). Table 2 presents a list of performed procedures.

At 2 years' follow-up, 31 patients (63%) reported returning to sport. Of those returning to sport, 22 patients (45% of the study population) were able to return to the same or higher of level of competition. The mean number of overhead sports at 2 years postoperatively among those patients reporting return to overhead athletics was 1.26 sports per athlete. Thirty patients (61%) indicated participating in multiple overhead sports at baseline. Of these patients, 11 (37%) continued to participate in multiple overhead sports at final follow-up, while 8 (26%) participated in only 1 overhead sport. The remaining 11 patients (37%) did not return to overhead athletics. Of the 19 patients (39%) reporting participation in 1 overhead sport at baseline, 7 (37%) cited continued involvement in only 1 overhead sport at final follow-up. Two patients (11%) indicated participation in multiple overhead sports, while 10 (53%) patients did not return to sport. There was no difference in the rate of return to at least 1 overhead sport between multi- and single-sport athletes at final follow-up ($P = .37$).

Table 3 summarizes select postoperative outcomes for all patients. With the exception of internal rotation at the side ($P = .01$), there was no difference in pre- and postoperative range of motion in the operative extremity.

TABLE 1
Baseline Patient Characteristics

| | n (%) |
|---|------------|
| Age, ^a y | 21.7 ± 7.7 |
| Sex | |
| Male | 42 (89.1) |
| Female | 7 (10.9) |
| Surgical extremity | |
| Right | 46 (47.9) |
| Left | 3 (52.1) |
| Beighton score >5 | 2 (4.1) |
| Baseline sport participation ^b | |
| Baseball | 23 (46.9) |
| Football | 22 (44.9) |
| Softball | 15 (30.6) |
| Tennis | 12 (24.5) |
| Volleyball | 12 (24.5) |
| Other racquet sport | 19 (38.8) |
| Injury occurring during sport | 45 (91.8) |

^aMean ± SD.

^bPercentages reflect the number of patients within the study population reporting participation in each sport at baseline, including single- and multisport athletes.

TABLE 2
Reported Procedures Performed
at the Time of the Index Procedure^a

| | n (%) |
|--|-----------|
| Primary procedure: arthroscopic Bankart (anterior) | 49 (100) |
| Concomitant procedure | |
| Posterior capsulorrhaphy | 12 (24.5) |
| SLAP repair | 2 (4.1) |
| Arthroscopic suture plication | 3 (6.1) |
| Arthroscopic debridement | 3 (6.1) |
| Surgical factors | |
| Surgical positioning | |
| Beach chair | 24 (49) |
| Lateral decubitus | 25 (51) |
| Mean number of anchors utilized per patient | 3.6 |

^aSLAP, superior labrum anterior to posterior.

Significant improvements in WOSI and KJOC outcome scores were noted at final follow-up. The total WOSI score increased from 44.9% to 78.7% ($P < .001$) postoperatively. Similarly, the mean KJOC score increased from 39.3 to 64.7 ($P < .001$) postoperatively. When differences were examined between those patients who reported return to sport and those who did not, no difference in range of motion and WOSI scores was noted at baseline or final follow-up (Table 4). Patients failing to return to sport had lower preoperative KJOC scores (29.6 vs 44.7, $P = .01$) than those who successfully returned to sport. No baseline differences in age or sex distribution were observed at baseline between patients who reported return to overhead athletics and those who did not.

Sex ($P = .82$), age ($P = .87$), and baseline level of competition ($P = .37$) had no observed effect on the rate of return

TABLE 3
Selected Postoperative Outcomes at Final Follow-up^a

| | Baseline | Follow-up ^b | Δ, % | P Value |
|------------------------|----------------|------------------------|-------|--------------------|
| Range of motion, deg | | | | |
| FF | 170.2 ± 16.8 | 172.7 ± 9.3 | +1.5 | .36 |
| ERS | 68.2 ± 18.8 | 66.2 ± 17.6 | -2.9 | .59 |
| IRS | 54.5 ± 11.3 | 59.2 ± 2.7 | +8.6 | .01 ^c |
| ER at 90° of abduction | 87.1 ± 12.1 | 84.3 ± 17.0 | -3.3 | .35 |
| IR at 90° of abduction | 54.8 ± 19.9 | 58.9 ± 16.5 | +7.5 | .28 |
| Abduction | 167.3 ± 15.2 | 167.4 ± 17.7 | 0 | .98 |
| WOSI | | | | |
| Aggregate | 1156.9 ± 432.7 | 446.3 ± 430.4 | -61.4 | <.001 ^c |
| % | 44.9 ± 9.3 | 78.7 ± 20.5 | +75.3 | <.001 ^c |
| KJOC | 39.3 ± 19.1 | 64.7 ± 25.9 | +64.6 | <.001 ^c |

^aValues are presented as mean ± SD. Δ, change; ER, external rotation; ERS, external rotation at the side; FF, forward flexion; IR, internal rotation; IRS, internal rotation at the side; KJOC, Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow questionnaire score; WOSI, Western Ontario Shoulder Instability Index.

^bRange of motion was collected at the final clinical examination (4-6 months postoperatively), while WOSI and KJOC data were collected at 2 years postoperatively.

^cP < .05.

TABLE 4
Comparison of Baseline Demographics, ROM, and Patient-Reported Outcomes Among Patients Who Did and Did Not RTS^a

| | Baseline | | | Final Follow-up ^b | | |
|-----------|----------------|----------------|------------------|------------------------------|---------------|---------|
| | RTS | No RTS | P Value | RTS | No RTS | P Value |
| Age | 21.1 ± 6.3 | 22.7 ± 9.8 | .50 | | | |
| Sex | | | | | | |
| Male | 27 | 15 | .70 | | | |
| Female | 4 | 3 | | | | |
| ROM, deg | | | | | | |
| FF | 170.0 ± 15.5 | 170.6 ± 19.2 | .91 | 171.9 ± 9.1 | 170.6 ± 19.2 | .78 |
| ERS | 65.0 ± 19.3 | 72.8 ± 17.4 | .16 | 66.5 ± 17.8 | 66.7 ± 17.5 | .96 |
| IR | 54.0 ± 11.9 | 55.3 ± 10.6 | .07 | 54.0 ± 11.9 | 58.7 ± 3.5 | .15 |
| ER Abd | 87.3 ± 14.3 | 86.1 ± 7.0 | .74 | 86.8 ± 16.4 | 80.0 ± 17.5 | .18 |
| IR Abd | 50.7 ± 21.9 | 61.1 ± 14.5 | .08 | 56.4 ± 17.0 | 62.8 ± 15.3 | .19 |
| Abduction | 167.0 ± 17.2 | 167.8 ± 11.7 | .86 | 167.1 ± 17.2 | 167.8 ± 11.7 | .88 |
| WOSI | | | | | | |
| Aggregate | 1160.9 ± 412.8 | 1150.0 ± 404.6 | .93 | 462.8 ± 405.6 | 417.7 ± 480.9 | .73 |
| % | 44.7 ± 19.7 | 45.2 ± 19.3 | .93 | 78.0 ± 19.3 | 80.1 ± 22.9 | .73 |
| KJOC | 44.7 ± 18.5 | 29.6 ± 16.8 | .01 ^c | 67.4 ± 23.3 | | |

^aValues are presented as mean ± SD unless noted otherwise. Abd, abduction; ER, external rotation; ERS, external rotation at the side; FF, forward flexion; IR, internal rotation; KJOC, Kerlan-Jobe Orthopaedic Clinic Shoulder and Elbow questionnaire score; ROM, range of motion; RTS, return to sport; WOSI, Western Ontario Shoulder Instability Index.

^bROM was collected at the final clinical examination (4-6 months postoperatively), while WOSI and KJOC data were collected at 2 years postoperatively.

^cP < .05.

to overhead athletics at final follow-up. A significant decrease was observed in the number of patients reporting continued participation in each sport at baseline (Table 5). Concomitant posterior capsulorrhaphy ($P \geq .999$) did not have an observed effect on return to sport. Only 2 patients (4%) underwent concomitant superior labrum anterior to posterior (SLAP) repair, and both indicated returning to overhead athletics at final follow-up. No difference in

KJOC ($P = .8$), WOSI aggregate ($P = .1$), and total WOSI ($P = .1$) scores was noted between those with and without concomitant posterior capsulorrhaphy. Similarly, there was no difference in range of motion in all planes ($P > .05$).

One patient reported severe stiffness at clinical follow-up. The patient was noted to have limited range of motion primarily with forward flexion (140°) and abduction (90°).

TABLE 5
Change in Sport Participation Between Patients at Baseline and Final Follow-up^a

| Sport | Baseline, n | Follow-up, n | Δ , % | χ^2 (<i>df</i> = 1) | <i>P</i> Value ^b |
|------------|-------------|--------------|--------------|---------------------------|-----------------------------|
| Baseball | 23 | 12 | -48 | 8.9 | .003 |
| Football | 22 | 9 | -59 | 7.7 | .005 |
| Softball | 15 | 7 | -53 | 8.8 | .003 |
| Tennis | 12 | 6 | -50 | 7.6 | .006 |
| Volleyball | 12 | 3 | -75 | 4.0 | .046 |

^a Δ , change.

^b*P* < .05 for each row.

The patient did not return to overhead athletics at final follow-up and had a WOSI score of 19% relative to the non-operative shoulder. Two patients (4.1%) experienced recurrent dislocation after the index procedure. Both these patients underwent revision stabilization surgery. Despite the low rate of recurrent instability, 28.6% (14 patients) indicated experiencing apprehension or looseness in the operative extremity at 2 years. Of these 14 patients, 11 (78.6%) indicated returning to overhead athletics at final follow-up, with 7 (63.6%) citing involvement at the same or higher level of competition compared with preoperatively. There was no difference in the mean number of overhead sports between those patients who reported apprehension/looseness (1.28 ± 1.1) and those who did not (1.0 ± 0.2) at 2 years (*P* = .38).

DISCUSSION

Surgical treatment of traumatic anterior shoulder instability among overhead athletes has historically been associated with higher rates of recurrent instability as compared with patients involved in lower-risk sports.¹⁶ The current study is the largest known prospective study reporting outcomes of overhead athletes undergoing shoulder stabilization procedures for the diagnosis of anterior shoulder instability. In a prospective case series by Ide et al,¹⁶ complete return to sport after arthroscopic anterior Bankart repair was significantly lower among overhead athletes (68%, 17 of 25) as compared with contact/nonoverhead athletes (90%, 27 of 30). No difference in the rate of recurrent instability was observed at midterm follow-up.¹⁷ Similar results were reported by Resch et al,²⁵ who noted 61% of overhead athletes undergoing arthroscopic Bankart repair at a mean clinical follow-up of 35 months. This is consistent with the overall rate of return to play for overhead athletes in the current study (63%), although the cause of the lower return is not defined or necessarily due to a poor surgical outcome, pain, stiffness, or recurrent instability. It is not clear why athletes without a poor surgical outcome or recurrent instability failed to return to overhead athletics in the current study. The mean age of the analyzed population was approximately 21 years old at the time of surgery. It is possible that a large number of these patients may have experienced a change in sporting interest after graduation from high school or college. This may also explain the large number of patients who reported switching from one sport to another. It is also

plausible that the current measurement tools to assess outcomes in this population are insufficient to assess for small differences in outcomes that prevent patients from returning to one overhead sport over another.

A commonly cited concern for shoulder stabilization of the overhead athlete is the risk of diminished range of motion, which may limit the athlete's performance. This is certainly a concern for the throwing athlete. With the exception of internal rotation at the side, no differences were noted between post- and preoperative range of motion at final follow-up. The clinical significance of the observed gain (+4.7°) in internal rotation at the side is likely of minimal clinical significance for the overhead athlete. Furthermore, range of motion did not affect the ability to return to overhead athletics. The only difference observed at baseline between those patients who returned to sport and those who did not was the KJOC score (29.6 vs 44.7, *P* = .01). Previous studies have validated the KJOC score as a sensitive tool for assessing disability in the upper extremity of throwing athletes.^{1,8,20,22} It is possible that, in addition to using the KJOC score as a postoperative measure of function, low preoperative KJOC scores may be predictive of difficulty returning to overhead athletics after anterior shoulder stabilization procedures.

The current study did not identify any patient or surgical factors predictive of returning to sport after primary arthroscopic anterior stabilization procedures. Concomitant SLAP lesions were previously reported in 20% to 57% of patients experiencing chronic anterior instability.^{12,14,21,31} The outcomes after isolated SLAP repair among overhead athletes have generally shown a low rate of return to sport.^{10,13,24} It is currently unknown if overhead athletes undergoing treatment for combined injuries to the inferior and superior labrum possess outcomes similar to those of patients treated with isolated superior labral injuries alone. Previous work citing outcomes in the general athletic population after anterior stabilization and concomitant SLAP repair demonstrated no difference in range of motion or rate of recurrent instability.^{9,14} In a prospective cohort study, Hantes et al¹⁴ indicated that the return-to-sport rate of patients with and without concomitant SLAP repair was 76% and 89%, respectively. In the current study, only 2 patients (4%) underwent concomitant SLAP repair. Despite both patients successfully returning to overhead athletics at final follow-up, the limited number of patients precluded the ability to perform a statistical analysis examining the

relationship between concomitant SLAP repair and return to overhead athletics. Although the outcomes after treatment of combined lesions in the general athletic population are likely safe with no noted difference in return to sport at follow-up, the outcomes of overhead athletes remain unknown.

The effect of concomitant posterior capsulorrhaphy at the time of anterior shoulder stabilization in this population is also currently unknown. In the present study, 12 (24.5%) patients underwent concomitant posterior labral repair or posterior capsulorrhaphy despite a diagnosis of primary anterior instability. Reasons for posterior capsular management in the current study included posterior extension of the superior or inferior labral tear. Although posterior capsulorrhaphy at the time of Bankart repair has the potential to further reduce capsular volume, no difference in range of motion, recurrent instability, or patient-reported outcomes was observed. On the basis of these findings, it appears that patients undergoing arthroscopic anterior stabilization who require additional surgery to the posterior labrum/capsule can expect outcomes and rate of return to sport similar to those patients requiring Bankart repair alone.

The current study has several limitations. Although favorable clinical outcomes and a low rate of recurrent instability were observed at 2 years postoperatively, longer clinical follow-up may demonstrate worsening outcomes and higher rates of recurrent instability.^{6,32} A clinical examination was performed by the operating surgeon at approximately 6 months postoperatively to document range of motion and strength. As range of motion was documented without the use of a goniometer, performance bias may have been introduced by the unblinded examiner. The small number of included athletes may also have resulted in insufficient statistical power to detect small differences in range of motion or strength at this time point. Additionally, the study design did not include obtaining objective data on shoulder range of motion, stability, or strength at 2-year follow-up. The current patient population underwent surgery by multiple surgeons at 1 of the 10 centers constituting the MOON Shoulder Instability Consortium. This potentially introduces selection bias among patients undergoing operative management, including the use of open versus arthroscopic capsulolabral repair, the decision to perform concomitant SLAP repair, and the management of identified posterior capsular laxity at the time of surgery. Although all these factors have the potential to affect recurrent instability, the recurrence rate in the current study at 2 years was reported to be 4.1%. This low rate of recurrent instability reflects to some degree the familiarity of the treating surgeons with treating this at-risk population. In an attempt to identify independent predictors associated with return to sport, it is possible that factors not included in our regression model may have influenced our results. Many patients indicated participating in multiple overhead sports at the time of the index procedure. Postoperatively, their participation in at least 1 overhead sport categorized the patient as successfully returning to sport. This may have introduced reporting bias and an overestimation of the number of

patients returning to sport, as some patients may have not returned to all of their overhead sports at 2 years. Similarly, patients noted their overall pre- and postoperative levels of competition as opposed to their level of competition in each sport. It is likely that patients returned to different sports at varying levels of competition postoperatively, which may have therefore overestimated the number of people returning to their preoperative levels of competition. It is also unknown why the included athletes may have stopped or changed their participation in a specific overhead sport.

CONCLUSION

Anterior shoulder stabilization in overhead athletes is associated with a low rate (4.1%) of recurrent stabilization surgery at 2-year follow-up. Sixty-three percent of patients reported returning to at least 1 overhead sport at final follow-up, with 36% returning to the previous level of competition. Age, sex, and baseline level of competition were not predictive of return to sport at final follow-up.

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