Arthroscopic Stabilization of Posterior Shoulder Instability Is Successful in American Football Players

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Purpose: To evaluate subjective and objective clinical outcomes of arthroscopic posterior capsulolabral repair for the treatment of symptomatic unidirectional posterior shoulder instability in American football players. **Methods:** Fifty-six consecutive American football players with unidirectional posterior shoulder instability underwent an arthroscopic posterior capsulolabral repair with or without suture anchors. Patients were evaluated, with return to play as the primary outcome measure supplemented with the American Shoulder and Elbow Surgeons (ASES) scoring system. Stability, range of motion, strength, pain, and function were also assessed with subjective scales. **Results:** At a mean follow-up of 44.7 months postoperatively, 93% returned to sport and 79% returned to sport at the same level. Significant improvements ($P < .01$) were seen between preoperative and postoperative evaluations in ASES score and subjective scores of stability, range of motion, strength, pain, and function. Excellent or good results (ASES score > 60; stability < 6) were achieved in 96.5% of athletes, and 96% were satisfied with their operations. **Conclusions:** Arthroscopic capsulolabral repair for unidirectional posterior shoulder instability is effective in American football players because it improves stability, pain, and joint function, which optimizes the likelihood of successful return to play. **Level of Evidence:** Case series; Level of evidence, IV.

Posterior shoulder instability is relatively uncommon, with an incidence between 2% and 12% in all cases of shoulder instability.[1] Although anterior instability is much more common in athletes, posterior shoulder instability is becoming more recognized as an important pathologic condition, particularly in American football players.[2] Posterior shoulder instability ranges from the more common recurrent posterior subluxation to the rare chronic locked posterior dislocation.[1,3-10] Posterior shoulder instability often results from attenuation and tears from microtraumatic stresses to the posterior capsulolabral complex from repetitive sport-specific motions, but it can also be generated through traumatic insult to the posterior capsulolabral complex.[4,11]

Recent literature has supported the advancement from open nonanatomic surgery to arthroscopic anatomic repair.[3,6,8-10,12,13] Arthroscopic treatment allows improved visualization of posterior capsular laxity, posterior capsular tears, and detachment of the posterior capsulolabral complex in posterior instability.[8,13-15] These recent large prospective studies have evaluated posterior shoulder instability and treatment across a generalized athletic population. These include, most notably, studies by Bradley et al.[6,10] and Savoie et al.[12] in patients who underwent arthroscopic posterior capsulolabral repair for posterior glenohumeral instability. Bradley et al.[6] reported a 90% return to sport and a 94% success rate based on American Shoulder and Elbow Surgeons (ASES) scores in 200 athletes at 36.7 months. Savoie et al.[12] reported a 97% success rate based on the Neer-Foster rating scale in 92 patients.

American football presents a unique challenge in the management of posterior instability because of the varied nature of required sport-specific motions. Overhead motions, such as throwing and receiving, have been shown to stress the posterior glenolabral complex.[16] Activities such as blocking and tackling frequently involve posteriorly directed forces along the humerus and glenohumeral joint, again stressing the posterior structures. Football is also somewhat unique in the constancy of high-energy collisions that occur in

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every play and during all sport-specific activities. Because of the increased demands on football players with regard to glenohumeral stability, it is unclear whether the favorable results of arthroscopic capsulolabral reconstruction found in the general athletic population will be truly applicable to this group of athletes.

Unlike anterior shoulder instability, there is a paucity of literature evaluating arthroscopic treatment of posterior shoulder instability in American football players.[2] The purpose of this study was to evaluate subjective and objective clinical outcomes of arthroscopic posterior capsulolabral repair for the treatment of symptomatic unidirectional posterior shoulder instability in American football players. We hypothesized that American football players would have low return-to-sport rates and poor clinical outcomes because of the higher forces and strains on the shoulder in this sport.

Methods

A group of 56 consecutive American football players who underwent arthroscopic capsulolabral reconstruction for isolated posterior shoulder instability between January 1998 and December 2009 were included in this retrospective study. Inclusion criteria were as follows: American football players who played at any level, the presence of unidirectional posterior instability, and a minimum 2-year follow-up. Patients who displayed multidirectional instability or patients with habitual or psychogenic voluntary shoulder subluxation were excluded. All patients had failed a course of preoperative physical therapy for motion and strengthening with avoidance of aggravating activities. The timing for surgery was based on the football season schedule, level of competition, desire to return to competitive athletics, and patient preference. Informed consent as well as institutional review board approval (2012) was obtained before the initiation of this study.

Patient Evaluation

Clinical examinations, radiographs, return to play, and subjective grading scales were recorded for all patients. Patients also were asked if they were satisfied with their results and if they would elect to undergo the procedure again based on their outcomes. Age, sex, level of competition, dominant versus nondominant arm, and length of follow-up were recorded as well.

Clinical examination, performed preoperatively and at latest follow-up (minimum 2 years), included measurement of active and passive range of motion (ROM), palpation for tenderness, evaluation for impingement, and evaluation of strength and instability. A thorough examination for instability was performed and included anterior and posterior translation, inferior translation, anterior apprehension, and generalized ligamentous laxity. Posterior shoulder stability and symptomatic translation were assessed with the jerk test, posterior load and shift test, and posterior stress test.[17-19] The sulcus test was used to assess inferior instability.[20] Specifically, patients who had a positive sulcus sign with their humerus in a neutral position that did not correct with humeral external rotation were diagnosed with inferior instability and subsequently excluded from this study. Standard radiographs and magnetic resonance arthrograms were obtained in all patients and were correlated with the clinical examination for evaluation of capsulolabral pathologic characteristics.

Patient outcome was evaluated using the ASES shoulder score (0 to 100) preoperatively and at latest follow-up. The ASES score combines a subjective functional scale measuring activities of daily living (ADL) (0 to 3 for each of 10 tasks; total score of 0 to 30) and a subjective pain scale (0 to 10, 10 being the worst). The cumulative ADL score and the amount of pain experienced by the patient were weighed equally in determining the overall ASES score. This measure was performed by the following formula as published by Richards et al.[21]: $[(10 - \text{pain score}) \times 5) + (5/3) \times \text{ADL score}] = \text{the overall ASES score}$. A subjective stability scale was added preoperatively and at latest follow-up because the ASES scale does not account for stability (0 to 10: 0 = completely stable and 10 = completely unstable). Patients were also asked to rank their perceived instability on a scale of 0 to 10 (10 being significantly unstable). Patient-described strength (0 to 3: 0 = none, 1 = markedly decreased, 2 = slightly decreased, and 3 = normal) and ROM (0 to 3: 0 = poor, 1 = limited, 2 = satisfactory, and 3 = full) scales were evaluated at latest follow-up as well. As with previous studies by us, failures were defined as either ASES score less than 60 and a stability score less than 5, because the ASES system does not account for this parameter.[6,10] Of note, validated scoring systems that incorporate strength, ROM, and other factors, including the Disabilities of the Arm, Shoulder, and Hand questionnaire and Single Assessment Numeric Evaluation scores, were not used in this study because data collection was started before these systems were validated. Intraoperative findings and specific surgical procedures performed were correlated with these subjective and objective outcomes.

Operative Treatment

Patients who met the inclusion criteria and failed nonoperative management were selected for surgery. All surgical procedures were performed by the senior author (J.P.B.). A thorough bilateral examination under anesthesia (EUA) was performed for comparison. Shoulders were examined for anterior and posterior laxity with the load and shift test, and inferior laxity was evaluated with the sulcus test. All patients had 2+ or greater posterior laxity on EUA. A systematic

diagnostic arthroscopy was performed to evaluate the labrum, capsule, biceps tendon, subscapularis tendon, rotator interval, rotator cuff, and articular surfaces. The posterior shoulder was assessed through the anterior portal for a patulous posterior capsule, capsular tear, labral fraying, and posterior labral tear.

Based on the preoperative clinical examination, magnetic resonance arthrography, EUA, pathologic findings at diagnostic arthroscopy, and surgeon experience, one of 3 procedures was performed. They included capsulolabral plication without suture anchors, capsulolabral plication with suture anchors, or capsulolabral plication with suture anchors and additional plication sutures. In general, shoulders found to have a patulous capsule without a labral tear underwent a capsulolabral plication with or without suture anchors. Those with labral tears typically received a capsulolabral plication with suture anchors. After fixation, the capsule was evaluated for residual laxity, and additional plication sutures were placed as indicated. The rotator interval was not closed in these patients with unidirectional posterior shoulder instability. These procedures have been previously described in the literature.[6,10]

Postoperative Rehabilitation

Immobilization for 4 to 6 weeks immediately postoperatively in 30° of abduction with prevention of internal rotation was carried out using a DonJoy UltraSling (DJO Global, Vista, CA). Cryotherapy was used for inflammation control. Active wrist and elbow motion as well as gentle passive scaption exercises were started on postoperative day 1. No active arm elevation was done until the fourth postoperative week.

After 4 to 6 weeks of sling immobilization, advancement of passive ROM exercises, pain-free internal rotation, active-assisted ROM exercises, and isometric internal and external rotation exercises were begun. Passive and active ROM, capsular strengthening, and strengthening of the rotator cuff and posterior deltoid were carried out at 2 to 3 months. Isokinetic testing was performed at 6 months postoperatively, and a sport-specific rehabilitation protocol was initiated when the patient reached 80% strength and endurance compared with the contralateral side. Return to sport was allowed only after full ROM without pain, full strength, and endurance were achieved. Most patients were permitted to return to competition by 6 months after surgery.

Statistical Analysis

The preoperative and latest follow-up ASES scores, stability scores, functional scores, and pain level findings were compared using a paired sample Student *t* test. Comparisons between separate groups, such as follow-up duration, were made by using the Student *t* test. Analysis of variance was performed for continuous variables, and χ-square modeling was used for nonparametric data when comparing multiple groups, including ROM, strength, intraoperative findings, and surgical fixation methods. Analyses were performed with $P < .05$.

Results

Patient Characteristics

There were a total of 56 shoulders, and all players were male individuals: 2 were professional National Football League American football players (4%), 14 were collegiate players (25%), and 40 were high school athletes (71%). The mean follow-up was 44.7 months (range, 24 to 98 months). The mean patient age was 17.9 years (range, 14.8 to 25.5 years).

Return to Sport

At latest follow-up, of the 56 patients, 4 patients (7%) did not return to American football, 8 (14%) returned at a limited level, and 44 (79%) returned at the same level. Therefore, overall 52 athletes (93%) returned to American football postoperatively. Patients who graduated, decided to no longer play football, or decided to play a different sport were all counted as not returning. In general, patients were permitted to return to competition by 6 months postoperatively.

ASES Scores

Mean preoperative ASES scores for the 56 shoulders were 47.4 ± 21 (range, 2 to 92). At latest follow-up, the ASES scores increased to a mean of 87.9 ± 13 (range, 36 to 100) ($P < .001$). According to the ASES scale, 47 shoulders (84%) had scores of excellent (> 80), 7 (12.5%) had scores of good (61 to 80), 1 (1.75%) had a score of satisfactory (40 to 60), and 1 (1.75%) had a score of poor (< 40). Thus, 54 shoulders (96.5%) had excellent or good results on the ASES scale at latest follow-up.

Stability

Using a patient-described subjective stability scale (0 to 10: 0 = stable; 10 = completely unstable), the mean preoperative stability score for the 56 shoulders was 7.5 ± 1.9 (range, 2 to 10). At latest follow-up, the mean stability score was 1.6 ± 1.7 (range, 0 to 6). This improvement was significant ($P < .001$). At latest follow-up using this subjective stability scale, 39 (70%) shoulders had scores of excellent (0 to 2), 14 (25%) had scores of good (3 to 4), 3 (5%) had scores of satisfactory (5 to 6), and 0 (0%) had a score of poor (7 to 10). Thus, 53 shoulders (95%) had excellent or good stability results at latest follow-up. No patient had a redislocated shoulder postoperatively.

Pain

Using a standardized subjective pain scale (0 to 10: 0 = no pain; 10 = severe pain), the mean preoperative

pain score for the 56 shoulders was 6.2 ± 2.7 (range, 0 to 10). At latest follow-up, the mean pain score was 1.4 ± 1.8 (range, 0 to 7). This improvement was significant ($P < .001$).

Function

Analyzing the functional scale portion of the ASES scoring system (0 to 30; 0 being worst), the mean preoperative functional score for the 56 shoulders was 17.0 ± 6.8 (range, 1 to 28). At latest follow-up, the mean functional score was 26.7 ± 3.7 (range, 13 to 30). This improvement was significant ($P < .05$).

Range of Motion

Using a patient-described subjective ROM scale (0 to 3: 0 = poor, 1 = limited, 2 = satisfactory, and 3 = full), at latest follow-up the mean ROM scores for the 56 shoulders was 2.5 (range, 1 to 3), whereas 29 shoulders (52%) had full ROM and 24 shoulders (43%) had satisfactory ROM. Thus, 53 shoulders (95%) had satisfactory or full ROM, whereas 3 shoulders had limited ROM at latest follow-up.

Strength

Using a patient-described subjective strength scale (0 to 3: 0 = none, 1 = markedly decreased, 2 = slightly decreased, and 3 = normal), the mean strength score for the 70 shoulders at latest follow-up was 2.5 (range, 1 to 3). Thirty-one (55%) shoulders had normal strength, 23 (41%) shoulders had slightly decreased strength, and 2 shoulders (4%) had markedly decreased strength.

Surgical Findings

Of the 56 shoulders, 9 (16%) had a patulous posterior capsule with no evidence of posterior labral detachment, 10 (18%) had an incomplete posterior labral tear, and 37 (66%) had a full-thickness detachment of the posterior labrum. Of the 47 (84%) shoulders with labral tears, 32 (68%) also had excessive capsular laxity. Thus, 41 (73%) of all shoulders studied had a patulous posterior capsule regardless of the presence of a posterior labral tear. In those with a patulous posterior capsule, there were significantly lower preoperative ASES and pain scores in athletes with a partial or full-thickness labral tear compared with athletes with intact labra (44.4 *v* 63.3; $P = .01$; 3.8 *v* 6.6; $P = .002$ respectively). This same trend was not found postoperatively. Stability was equivocal based on labral pathoanatomy both preoperatively and postoperatively. Preoperative ASES scores in patients with a patulous capsule were identical to those of patients with an intact capsule. A significantly higher ASES score at latest follow-op was observed in athletes with a patulous capsule when compared with patients with normal capsules (90.7 *v* 80.4; $P = .007$). Similarly, stability between patulous capsules and normal capsules was equivocal preoperatively but improved in athletes with patulous capsules at latest follow-up (preoperatively, 7.5 *v* 7.3; $P = .44$; follow-up, 1.2 *v* 2.6; $P = .002$).

Surgical Procedures

After an EUA and diagnostic arthroscopy, a specific posterior shoulder stabilization procedure was performed based on the criteria described previously. Of the 56 shoulders, 12 (21%) underwent capsulolabral plication without suture anchors, 31 (55%) had capsulolabral plication with suture anchors, and 13 (23%) had capsulolabral plication with suture anchors and additional plication sutures. Therefore, 79% (44) of patients were treated with anchored fixation. No statistically significant differences in ASES or stability scores were found between patients with suture anchor fixation and those with capsulorrhaphy alone. Updated fixation hardware was used as the technology improved during this study.[6,10]

Failures

According to the ASES scoring system, at latest follow-up there were 2 (3.5%) failures (ASES score < 60) when considering function and pain in all 56 shoulders. One athlete's (2%) failure resulted from lack of stability (stability score > 5) at latest follow-up. One patient (2%) had failure by both ASES score and stability scale. All failures had suture anchor repair constructs. Patients determined the operation to be worthwhile in 54 (96%) cases, whereas 2 (4%) patients would not have the procedure again. One hundred percent (56 of 56) of the patients returned to ADL without difficulty. There were no infections, stiffness was dealt with at physical therapy, and no manipulations or lysis of adhesions was required.

Discussion

Our results show that 93% of American football players return to sport, and 79% return to their previous level of play, making the American football player the most likely to return to sport of any group of athletes with posterior shoulder instability of which we are aware. Significant improvements ($P < .01$) between preoperative and postoperative evaluations in ASES score and subjective scores of stability, range of motion, strength, pain, and function were seen, and no revision surgery was required. Excellent or good results (ASES score > 60; stability score < 6) were achieved in 96.5% of athletes, and 96% were satisfied with their operations.

Outcomes of operations for posterior shoulder instability are less well established when compared with anterior instability. Recently, arthroscopic fixation of the posterior capsulolabral complex has gained popularity and shown promising results. In population

studies of 100 and 200 athletes, a success rate of 89% and 90% was found, respectively.[6,10] Similarly, Savoie et al.[12] reported a 97% success rate in 92 patients. These large studies have established arthroscopic capsulolabral reconstruction as an effective and reliable treatment for symptomatic unidirectional posterior instability. However, we are not aware of any studies in the literature evaluating surgical intervention for posterior instability in American football athletes.

Seventy-nine percent of these athletes returned to their previous level of performance, which is slightly better than a 2006 study (n = 100) in which 67% returned to the same level of play, as well as a 2013 study (n = 200) in which 69% returned to the same level of play.[6,10] However, return to the same level of American football play was difficult to quantify because many athletes in this study were injured during their final year of sport at a given level (i.e., seniors in high school or college). Also, some participants returned at a different level or not at all because of unrelated injuries or because they chose to participate in a sport other than football. These patients were classified as not returning to the same level as their preinjury status. Regardless, these results support arthroscopic capsulolabral repair as an effective means to address unidirectional posterior shoulder instability in American football players.

Overall, 96% of patients were satisfied with their postoperative outcomes and would have the surgery again. This percentage is comparable or superior when compared with previous studies evaluating arthroscopic unidirectional posterior stabilization in all athletes: 2006 and 2013 studies found that 92% (n = 100) and 94% (n = 200) would elect to have the surgery again.[6,10] Stability, pain, ASES score, and function were all significantly improved postoperatively in these American football players.

Intra-articular injury pattern, the presence of isolated capsular laxity or labral tears, or cases of mixed pathologic features were not found to have significant effects on ASES or stability scores at preoperative or postoperative evaluations. Athletes with each form of pathologic condition were found to have significant improvements in shoulder function after operative repair. Intraoperative findings, including status of the labrum and degree of capsular laxity, guided the decision to perform a capsulolabral repair or plication with or without anchors. Stability and ASES scores were not statistically different between anchored and anchorless repairs. Although limited by statistical power analysis, return to play was no different when comparing those who underwent anchored and those who had anchorless fixations. These results indicate that arthroscopic capsulolabral reconstructions performed with or without anchors can provide adequate outcomes if the construct is customized to the pathoanatomy.

Failure rates in American football athletes were 3.6% by the ASES scoring system and 1.8% by patient-described subjective stability scoring. This was lower than failure rates found in a 2013 study of all athletes (n = 200), in which there was treatment failure in 6% according to the ASES scoring system and in 7% by stability scoring.[6] No patient had a redislocation postoperatively, and one patient reported subluxation, although this is difficult to quantify. No revision surgery was required. As reported previously, unrecognized multidirectional instability or posterior-inferior instability and underestimation of posterior capsulolabral laxity at the time of repair are the likely sources of these failures. Despite concerns surrounding surgical repairs of American football injuries, such as the consistent trauma and wide range of upper extremity activities the sport demands, the athletes actually showed a decreased tendency toward postoperative failures as defined by patient-described subjective scores. Although not specifically recorded, the majority of patients in this study were injured from repetitive microtrauma. We tend to provide slightly more stability and marginally sacrifice ROM in these athletes when performing capsulolabral plication because we believe overall stability in American football players is the primary goal, whereas throwers or overhead athletes are treated differently. This may be one reason for the high success with stability in American football players. Although all failures were treated with anchored fixation, no conclusions can be drawn based on surgery performed because of insufficient sample size. We note that careful tissue handling is vital, particularly in athletes with degenerative tissues, because tenuous repair may lead to an inadequate repair in these players. Further, strict adherence to rehabilitation protocol is important for stability and return to play. In general, these patients were permitted to return to competition by 6 months postoperatively.

This study shows that arthroscopic capsulolabral repair for unidirectional posterior shoulder instability is effective in American football players because it improves stability, pain, and joint function, which optimizes the likelihood of a successful return to play. Contrary to our hypothesis, these athletes tend to have equivocal or better outcomes when compared with athletes participating in less violent sports. Accurate diagnosis is critical and is based on mechanism of injury, physical examination, and imaging. Contrary to the findings of other recent reports, suture anchor fixation may not be as crucial to the repair constructs in American football players. Irrespective of the chosen repair construct, it is imperative to accurately gauge the degree of capsulolabral laxity present at the time of surgery and provide a capsulolabral plication that restores shoulder stability. In American football players, it is essential to provide a construct that can withstand the

demands of the athlete's sport, and consideration of the athlete's pathoanatomy and position-specific demands are key to that decision.

Limitations

One study limitation includes comparisons of athletes participating at various levels of American football. High school football players may not have the degree or duration of shoulder stresses that NFL players have, so grouping them may provide less accurate outcome data. Also, this study combines all positions of American football, which may skew the data because linemen and quarterbacks likely experience different shoulder stresses. The scoring systems used in this study are now dated and subjective. The use of the ASES score for professional or elite college athletes is also not ideal because it addresses only pain and ADL. However, this data collection began before current modern scoring systems were validated, and therefore consistency was maintained to allow for comparison. The use of these scoring systems is also consistent with other literature for posterior shoulder instability.

Further, no direct comparison group was used in this study; only comparisons with the previous literature was carried out. Subgroup analysis was also limited because of the lack of statistical power. A greater sample size may also improve our ability to judge the success of different procedures. During the course of this study, fixation technology improved as did its use. Specific measurements of clinical ROM were not recorded.

Conclusions

Arthroscopic capsulolabral repair for unidirectional posterior shoulder instability is effective in American football players because it improves stability, pain, and joint function, which optimizes the likelihood of a successful return to play.

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