Arthroscopic Capsular Plication in Throwing Athletes

ABSTRACT:

Introduction: Arthroscopic capsular plication has recently been advocated as an alternative to thermal capsulorraphy and open capsular shift in patients with symptomatic capsular laxity of the shoulder. Arthroscopic methods are particularly attractive in throwing athletes because they minimize trauma to the subscapularis. We report on a consecutive series of arthroscopic capsular plication procedures in throwing athletes.

Study Design: Case series.

Materials & Methods: Sixteen throwing athletes were treated with arthroscopic capsular plication for symptoms of recurrent anterior instability after failing an extended course of non-surgical treatment. Patients with labral lesions were excluded from the study. Minimum follow-up was 2 years (range, 24-50 months). No patient was lost to follow-up. The patients' mean age was 20.6 years (range, 16-36). There were 10 males and 6 females.

Results: 15/16 (94%) patients were satisfied with the outcome of their operation. However, only 11/16 (69%) patients returned to their pre-morbid levels of throwing for at

least one year after surgery. Two patients (12.5%) were unable to return to throwing at their pre-morbid levels. Three patients stopped participation in throwing sports for reasons unrelated to their shoulders.

Two patients developed postoperative instability and both underwent revision surgery. One patient had a traumatic dislocation while playing basketball and underwent open capsulolabral reconstruction. The second developed recurrent subluxation after throwing for 2 full seasons and underwent arthroscopic revision at another institution.

Two of the three patients who underwent concomitant rotator interval closure lost more than 10 degrees of external rotation. One of these patients was unable to throw at his pre-morbid level and the other gave up throwing sports for reasons unrelated to the shoulder. No other patient lost more than 5 degrees of external rotation.

Discussion: Arthroscopic capsular plication yielded a high degree of patient satisfaction in throwing athletes. However, the percentage of patients who returned to their pre-morbid levels of throwing was less than optimal. The performance of rotator interval closure in combination with capsular plication appears to increase the risk of motion loss in throwers and is not recommended.

INTRODUCTION:

Arthroscopic capsular plication of the shoulder has recently been introduced [31, 32] as an alternative to open capsular repair and thermal capsulorraphy in patients with symptomatic capsular laxity of the shoulder. Biomechanical studies have shown that capsular plication techniques reduce glenohumeral translation[1], diminish capsular volume[9,27], and restrict range of motion.[11, 28]

The majority of patients with symptomatic capsular laxity will improve clinically with rehabilitative exercise[6,19], and the surgical treatment of patients with capsular laxity without discrete labral lesions can be challenging. When non-operative treatment fails, reports have shown less satisfactory results with both open[16,34] and arthroscopic[21,24,29] stabilization procedures in patients with excess capsular laxity.

Throwing athletes with instability represent another challenge. The act of throwing subjects the shoulder to extremely high loads.[10] While relatively high success rates were reported with open capsulolabral reconstruction in the early 1990s, open techniques tend to traumatize the subscapularis tendon. Such trauma is minimized with an arthroscopic method, and many surgeons would recommend an arthroscopic technique in throwing athletes. Arthroscopic thermal capsulorraphy has been largely discredited because of the risks of heat-induced capsular necrosis and chondrolysis and because of high failure rates.[7,13,17,20,25,33] Therefore, arthroscopic capsular plication might be particularly applicable to symptomatic throwing athletes.

We undertook a retrospective review of a consecutive series of throwing athletes treated with arthroscopic capsular plication at our institution.

MATERIALS & METHODS:

Sixteen consecutive throwing athletes were treated with arthroscopic capsular plication for symptoms of recurrent anterior instability over a five-year period. All patients had classic pre-operative findings of recurrent anterior instability including positive anterior apprehension, relief with the relocation maneuver, and pain or a sense of instability with throwing. Eleven patients had positive sulcus signs and were felt to have a component of multidirectional instability.

All patients failed an extended course (minimum, six months) of non-surgical treatment including cessation of throwing, rotator cuff and scapular rotator strengthening, posterior capsular stretching, correction of lower extremity strength and balance deficits, and analysis of throwing mechanics. All patients also failed at least two progressions of a stardardized interval throwing program. During the same period, a larger group of throwing athletes with similar presentations improved with rehabilitation and did not go on to surgical treatment.

In all cases, the primary indication for surgical treatment was to restore or improve the ability to throw.

The patients' mean age was 20.6 years (range, 16-36). There were 10 males and 6 females. Six patients competed at the high school level, six at the collegiate level, and two at the professional level. The other two patients were elite amateur softball players.

Surgical Technique:

The procedure was performed in the modified beach-chair position with the arm draped freely and the forearm held in a mechanical arm holder. Standard anterior, posterior and anterolateral arthroscopic portals were created. In cases were posterior capsular plication was performed, an additional posterolateral portal was created.

With the arthroscope in the posterior portal, a 90 degree curved suture lasso (Arthrex, Naples, FL) was introduced through the anterior portal. The suture lasso was introduced into the lateral capsule and penetrated medially for a distance of approximate 1.5 centimeters (Figure 1). When the labrum was judged to be healthy and robust, the lasso exited through the anteroinferior labrum. If the labrum was attenuated or atrophic, the lasso was simply passed through the medial capsule.

A nitinol loop was advanced through the lasso and retrieved from the anterolateral portal with a suture grasper. Suture was loaded into the nitonol loop. The lasso was then removed and the lateral end of the suture was brought from the anterior portal to the

anterolateral portal with a suture loop. Sliding and alternate-post half-hitch knots were then tied arthroscopically. (Figures 2 and 3)

The procedure was then repeated for additional sutures. (Figure 4) In each case, three or four anterior plication sutures were placed. In the first five patients, absorbable monofilament polydioxanone (PDS) sutures were placed. In the remaining eleven patients, composite polyethylene and PDS sutures with both absorbable and non-absorbable components ("OrthoCord", DePuy Mitek, Norwood, MA) were utilized.

In the first three patients, a comcomitant rotator interval closure was performed. All of these patients had positive sulcus signs. A spinal needle was passed through the capsule just above the subscapularis and a PDS suture was introduced into the joint via the spinal needle. A suture penetrator (Arthrex, Naples, FL) was passed into the capsule just anterior to the biceps tendon. The intra-articular end of the suture was then removed with the penetrator. From the anterior portal, the sutures were then tied as above.

Five of the remaining eight patients with positive sulcus signs in the latter part of the series had one or two posterior plication sutures placed in a fashion identical to that described for the anterior sutures except that the posterolateral portal was used to introduce the suture lasso and the anterior portal was used to retrieve and tie the sutures. It was elected to use posterior plication sutures rather close the rotator interval in these

patients because early follow-up reveal range-of-motion deficits in patients who had undergone rotator interval closure.

Three patients had concomitant partial, articular-sided tears of the anterior portion of the supraspinatus. The tears were debrided in all three cases. No infraspinatus tears were encountered in this series.

Post-Operative Rehabilitation Protocol

All patients were immobilized in a sling in a position of internal rotation for four weeks after the operation. During the initial four weeks, the sling was removed for pendulum exercises, elbow range-of-motion, and shoulder shrugs.

Passive and active-assisted shoulder range-of-motion were at instituted four weeks post-operatively with external rotation limited to forty-five degrees. When 140 degrees of active forward flexion were obtained, rotator cuff strengthening was initiated with the arm at low abduction angles.

From weeks eight to twelve, external rotation was restricted to sixty degrees. At this time, deltoid isometrics with the arm at low abduction levels and body blade exercises were started. If no impingement or rotator cuff symptoms were noted, the patient slowly increased abduction during rotator cuff and deltoid strengthening.

Scapular rotator strengthening including press-ups (seated dips), horizontal abduction exercises, and open-can exercises were progressed.

Beginning at week twelve, an effort was made to restore terminal external rotation. Proprioceptive neuromuscular feedback patterns, plyometric exercises, and sport-specific motion using a pulley, wand, or manual resistance were added to the program.

Most conventional weight training exercises were allowed after week twenty. A throwing interval program was allowed at week twenty-two. The throwing program gradually increased distance, velocity and the number of throws. Full velocity throwing was generally allowed only after at least six month had elapsed since surgery.

Exclusions and Follow-Up

To avoiding confounding variables, patients with concomitant repairs of superior labral lesions or Bankart lesions were excluded from the study.

Minimum follow-up was 2 years (range, 24-50 months). No patient was lost to follow-up. All patients underwent a physical examination that evaluated signs of instability and apprehension and measured range-of-motion. All patients completed a questionnaire regarding their satisfaction with the procedure, their ability to throw, and any complaints of instability after surgery.

RESULTS:

Patient Satisfaction:

Fifteen of sixteen (94%) patients reported they were satisfied with the outcome of their operation and that they would have the operation again if they we able to reassess their decision for surgery.

Return to Throwing:

Only eleven of the sixteen (69%) athletes returned to their pre-morbid levels of throwing for at least one year after surgery. Two patients (12.5%) were unable to return to throwing at their pre-morbid levels because of persistent pain, stiffness or instability in the post-operative shoulder.

The other three patients stopped participation in throwing sports for reasons unrelated to their shoulders. One patient was involved in a motor vehicle accident nine months after his plication procedure and suffered a closed head injury and knee and contralateral shoulder injuries that prevented a return to throwing. Prior to his accident, he had returned to high velocity throwing and was pleased with his outcome.

Another patient discontinued throwing when he ceased to be recruited by college baseball teams after his shoulder operation. He had no symptoms referable to the shoulder and felt that he could have thrown given the opportunity.

A third patients stated that she “just never tried to throw again” despite having the operation primarily to restore her ability to throw. She stated that her shoulder felt much better with activities of daily life than it had prior to surgery and that she was satisfied with her outcome.

***Post-Operative Instability*:**

Two patients (12.5%) developed postoperative instability. Both underwent revision surgery. None of the other patients reported instability complaints and none had apprehension on their final post-operative examination.

One patient had a traumatic dislocation while playing basketball ten months after his operation. This patient underwent an open capsulolabral reconstruction and was found to have an osseous Bankart lesion. No Bankart lesion had been noted at the time of his index procedure.

The second patient developed symptoms and signs of recurrent subluxation after throwing for two full seasons and progressing from high school to collegiate softball. This patient underwent arthroscopic revision at another institution. At the time of the revision, it was noted that the capsule had “stretched out again.” It might be noted that the index procedure in this patient had been performed with non-absorbable suture.

Post-Operative Range of Motion:

Two of the three patients who underwent concomitant rotator interval closure lost more than 10 degrees of external rotation with the arm in the abducted position. No other patient lost more than 5 degrees of external rotation.

DISCUSSION:

Arthroscopic capsular plication yielded a high degree of patient satisfaction in throwing athletes. However, the percentage of patients who returned to their pre-morbid levels of throwing was less than optimal.

Sixty-nine percent of the patients in this study were able to return to their pre-morbid level of throwing for at least one year after the procedure. Although only two of the five patients who did not return to throwing attributed their failure to return to their shoulder function, our results are inferior to those reported for open capsulolabral reconstruction in a similar population. Montgomery and Jobe[23] reported that 81% of overhead athletes treated with an open technique were able to return to their pre-morbid levels of athletic participation for at least one year. In the series of Montgomery and Jobe, all patients had Bankart lesions.

In a subsequent report from the Kerlan-Jobe clinic, Enad et al[8] reported that only 53% of overhead athletes returned to their pre-morbid level of sports participation after isolated electrothermal capsulorraphy. Enad et al studied a similar population to ours in that all patients with labral detachments were excluded from their series. Poor functional outcomes after thermal capsulorraphy have also been reported in other series.[7,13,20] In contrast, Levitz et al[18] reported that baseball players who underwent concomitant thermal capsulorraphy for internal impingement fared better (87% competing at same level) than players who did not (61% competing at same level). All of the patients in the series of Levitz et al underwent debridement of the labrum and/or rotator cuff or underwent labral repair. There was a higher percentage of patients undergoing labral repair in the thermal capsulorraphy group (13/31) compared to the group that did not undergo thermal capsulorraphy (13/48) and this factor could have influenced their results.

We excluded all patients with labral tears in our study in order to assess the effect of isolated capsular plication in throwers. As mentioned above, all of the patients treated with open capulolabral reconstruction in the series of Montgomery and Jobe[23] had Bankart lesions. Had patients with labral pathology (SLAP lesions and/or Bankart lesions) been included in this series, it is possible that our results would have been more similar to those of Montgomery and Jobe. In our experience, most throwers who are found to have Bankart lesions have had a specific traumatic injury—usually in another sport. The fact that the mean age of our population was approximately five years younger (20.6 vs. 25 years) than the patients in the series of Montgomery and Jobe may explain, at least partially, this difference in our populations.

Thermal capsulorraphy has been largely discredited because of concerns about heat-induced capsular necrosis, chondrolysis, and high failure rates.[7,13,20,25,33] Based on our results, capsular plication appears to yield similar or better functional outcomes than thermal capsulorraphy without the risks associated with heat energy.

Capsular plication has been shown, in cadaveric studies, to reduce glenohumeral translation[1] and to diminish capsular volume.[9,27] Capsular plication alone decreases simulated passive range-of-motion in cadaveric models.[11, 28] Rotator interval closure also restricts motion in similar models.[22, 26] The performance of rotator interval closure in combination with capsular plication appears to increase the risk of motion loss in throwers and is not recommended.

Burkhart et al[2,3, 4,5] have intimated that true instability never occurs in the elite thrower and some controversy exists in the orthopaedic community on this subject. Some authors attribute instability-like symptoms to internal impingement of the posterior rotator cuff on the glenoid[15,30] and others implicate glenohumeral internal rotation deficits and scapular dyskinesis[2,3,4,5] as causative factors in the development of the "dead-arm" symptoms classically associated with instability in throwers.

Biomechanical studies[12,14] have indicated that posterior capsular tightness tends to be associated with increased anterior translation of the humeral head. The patients in this series were rehabilitated for an extended period to treat associated internal rotation deficits. They were carefully selected for inclusion in the study on the basis of the lack of associated arthroscopic evidence of

labral pathology or posterior impingement findings. Other than instability (and shallow partial tearing of the supraspinatus in three cases), no explanation for their persistent disability could be discovered. The population in this series is a relatively young one and our thought remains that, in many cases, instability can be the primary cause of disability in the throwing athlete with labral pathology and internal rotation deficits developing later as the patient ages.

In summary, arthroscopic capsular plication is an attractive alternative to open capsulolabral reconstruction and to arthroscopic thermal capsulorraphy in throwers with instability symptoms who do not respond to rehabilitation. However, this population remains a challenge to operative treatment and patients treated with this method should be advised that a return to pre-morbid levels of throwing cannot be assured.

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Legends for Figures:

FIGURE 1: A suture lasso was introduced into the lateral capsule and penetrated through the medial capsule. A nitinol loop was advanced through the lasso and retrieved from the anterolateral portal with a suture grasper.

FIGURE 2: Sliding knot.

FIGURE 3: Addition of alternate-post half-hitch knots.

FIGURE 4: Placement of a second suture.