Isolated electrothermal capsulorrhaphy in overhand athletes

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The purpose of this study was to determine the efficacy of arthroscopic electrothermal capsulorrhaphy for the treatment of instability in overhand athletes. Electrothermal capsulorrhaphy without labral repair was used to treat 20 symptomatic overhand athletes (15 baseball, 3 softball, and 2 volleyball). Nineteen patients were evaluated at a mean of 23 months. Overall Rowe results were 10 excellent, 4 good, 2 fair, and 3 poor, with a mean score of 82. The overall mean American Shoulder and Elbow Surgeons score was 85.7 (mean pain score, 42.2; mean score for activities of daily living, 43.5). Two failures (ten percent) required open shoulder stabilization. Ten athletes returned to their prior level of sport, three returned to a lower level, and six were unable to return to their sport. These preliminary results indicate that treatment of the overhand athlete with isolated electrothermal capsulorrhaphy is favorable but does not reproduce the success of open surgery. Overall recurrence and failure rates were high. Instability in overhand athletes may require something other than isolated electrothermal capsulorrhaphy to address laxity. (J Shoulder Elbow Surg 2004;13:133-7.)

Glenohumeral laxity is common in the overhand athlete. The forceful overhand action places extreme demands on the shoulder. Chronic stress from repetitive overhand throwing, serving, or swimming activities may lead to attenuation of the anterior static restraints. Over time, this may allow mild anterior glenohumeral translation.11 Initially, increased activity of the dynamic stabilizers compensates for mild instability. With continued overhand use, however, fatigue of these muscles can lead to further anterior subluxation of the humeral head with resultant microtrauma and abrasion to the rotator cuff and labrum.12,28 The most common symptom is pain at the posterior glenohumeral joint line in the horizontally abducted and externally rotated (ie, cocking) position.9,28

If a conservative rehabilitative program fails to return the athlete to competition in 3 to 6 months, surgery may be an option. The capsular laxity can be reduced by open anterior reconstruction. Labral detachments (eg, Bankart or superior labral anterior-posterior [SLAP]) are uncommon findings.21 Open surgery has had good success in returning properly selected patients to competition.1,3,8,19 Current studies on arthroscopic capsular shift to treat shoulder instability have included few overhand athletes.17,27

The past several years have seen an increase in treating shoulder instability with arthroscopic electrothermal capsulorrhaphy (ETC).4-6,14,15,18,25,26 However, the few reports involving overhand athletes have also included concomitant labral repairs.5,13,25 The purpose of this study is to review the results of an isolated ETC performed for the treatment of glenohumeral instability in the overhand athlete without labral detachment with a minimum follow-up of 16 months.

MATERIALS AND METHODS

From October 1997 and December 1999, a total of 23 overhand athletes who exhibited symptoms of pain or instability during sport were treated with ETC. Indications for operative intervention were shoulder pain, instability, or both while in the position of horizontal abduction and external rotation during throwing or serving. Symptoms were unresponsive to activity modifications, antiinflammatory medications, and a minimum of 3 months of a comprehensive rehabilitative program emphasizing strengthening of the dynamic stabilizers of the shoulder.9 Plain radiographs showed no signs of arthrosis or outlet impingement that may have contributed to the pain. Typically, such a patient would undergo an open anterior capsulolabral reconstruction.8,19,24 ETC was attempted in a small sample of patients presenting to a single group practice in order to avoid an open procedure. This decision was based solely on surgeon preference. Excluded from the study were patients with prior shoulder surgery, concomitant bony procedures, or complete Bankart tear or labral detachment requiring stabilization and repair. These exclusionary criteria permitted review of the results of an isolated ETC procedure only and left a sample of 20 patients.
Operative technique

All patients underwent the diagnostic arthroscopy and ETC procedure under general anesthesia in the lateral decubitus position. The shoulder was placed in 30° to 45° of abduction and 15° to 30° of forward flexion with 5 to 15 lb of traction on the affected arm. Diagnostic arthroscopy of the glenohumeral joint was performed through a standard posterior portal and an anterior portal made at the rotator interval. Laxity of the glenohumeral ligaments, most commonly the anteroinferior band, and a positive drive-through sign were noted in each patient. Partial tears or fraying of the labrum, biceps anchor, or rotator cuff was debrided with a motorized shaver.

Thermal capsulorrhaphy was performed with a monopolar Oratec thermal probe (Oratec, Inc, Menlo Park, CA), with power set at 40 W and temperature at 65°C to 67°C. The probe was introduced through the anterior portal and used to shrink the glenohumeral ligaments thermally, beginning along the inferior aspect of the inferior glenohumeral ligament, passing medially to laterally, and advancing superiorly to include shrinkage of the middle glenohumeral ligament. Because symptoms were attributed predominantly to anterior instability, the rotator interval and posterior capsule were not treated. Capsular shrinkage was performed by use of a striping pattern (mean, 3-5 stripes) with areas of normal untreated tissue between each stripe; painting or a grid pattern of thermally treated tissue was not done. There was visible darkening and contraction of the capsule with the shrinkage. The drive-through sign was eliminated in each case, and subluxation of the humeral head was decreased. The affected arm was then placed into a sling with the shoulder in slight abduction and internal rotation.

A padded sling was maintained for 4 weeks after the operation. During the period of immobilization, only active range-of-motion exercises of the wrist and elbow were permitted. Gentle Codman exercises of the shoulder were allowed. After the period of immobilization, range of motion of the shoulder was allowed to 20° of external rotation, 90° of forward flexion and abduction, and 10° of extension until 6 to 8 weeks postoperatively. After 6 to 8 weeks, aggressive range-of-motion and strengthening exercises were initiated. Passive stretching was limited to 10° to 20° less than that in the opposite shoulder in forward flexion, abduction, and external rotation. The patient was allowed to achieve the final end range of motion actively over time with activity to minimize the risk of stretching the repair. Overhand throwing and serving were not allowed until a minimum of 12 weeks postoperatively. Maximal effort and velocity were allowed when full motion and strength were regained.

Patients were evaluated at follow-up with a physical examination and functional questionnaire based on the modified American Shoulder and Elbow Society assessment. Postoperative function was also evaluated and graded by use of the system of Rowe et al. Failures were defined as recurrent symptoms requiring further surgery for instability or a fair or poor result based on the criteria of Rowe et al.

All data were acquired on a Microsoft Excel spreadsheet (Microsoft, Redmond, WA). Mean values and SD are presented for ranges of motion. Mean values and ranges are presented for all other continuous data. The small sample size precluded meaningful statistical analysis between descriptive parameters.

RESULTS

Of 20 patients, 19 (95%) were available for evaluation at a mean of 23 months (range, 16-39 months). The preoperative demographic data are summarized in Table I. The mean age at treatment was 21.8 years (range, 15-36 years). There were 15 male and 4 female subjects. The dominant extremity was involved in all cases (11 right and 8 left). Three patients could recall a distinctive throwing episode when symptoms began, whereas sixteen were associated with repetitive microtrauma during overhand activities. Each patient participated in an overhand sport at a competitive level, including baseball (15), softball (3), and volleyball (1). Preoperative symptoms were pain alone in 14 patients (74%), pain and instability in 4 (21%), and instability alone in 1 (5%). No patient had a history of frank dislocation requiring reduction by a clinician. Symptoms had been present for a mean of 9.6 months (range, 3-46 months).

On physical examination, 9 patients had a positive anterior apprehension test. Fifteen had relief of either their apprehension or pain with the relocation test. Each patient demonstrated translational laxity of the involved shoulder of at least one grade higher than the uninvolved shoulder in one or more directions. Physical examination demonstrated predominantly anterior instability in 14 patients and anteroinferior instability in 5.

Examination with patients under anesthesia confirmed the preoperative diagnosis in each case. None of the shoulders demonstrated more than grade 1 or

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2 instability compared with the contralateral side. Associated findings at arthroscopy are summarized in Table II. Two patients had chondromalacia of the humeral head articular surface. Fraying of the labrum at the biceps anchor indicative of a SLAP tear, type I, was noted in 11 patients. Fraying or partial-thickness tearing of the rotator cuff crescent overlying the posterior-superior labrum in the abducted–externally rotated position, corresponding to the lesion of internal impingement, was noted in 8 patients.

On follow-up physical examination, forward flexion averaged 175° ± 9.3° compared with 180° on the contralateral side. External rotation with the arm at the side averaged 61° ± 8.8° versus 65° on the contralateral side. External rotation with the arm elevated averaged 96° ± 16.4° versus 95° on the contralateral. Internal rotation averaged as follows: thumb reaching eighth thoracic vertebral level ± 1.7 levels (vs T8 on the contralateral side).

The mean postoperative American Shoulder and Elbow Surgeons score was 85.7 (range, 39.2-100), with a mean pain score of 42.2 (range, 15-50) and a mean activities of daily living score of 43.5 (range, 16.7-50). There were no significant differences seen in American Shoulder and Elbow Surgeons scores with regard to age, duration of symptoms, trauma, presence of apprehension or relocation signs, diagnosis, or sport.

The mean postoperative Rowe score was 82 (range, 40-100), yielding 10 excellent, 4 good, 2 fair, and 3 poor overall results. Seventy-four percent of the patients had a good or excellent result (Table III). There were no significant differences seen in Rowe scores with regard to age, duration of symptoms, trauma, presence of apprehension or relocation signs, diagnosis, or sport.

At latest follow-up, 10 patients had returned to their prior level of sport, 3 returned to a lower level, and 6 were unable to return to their sport (Table IV). Five patients were unable to return to sport because of recurrence of their preoperative symptoms of pain, and one patient could not return because of recurrence of instability symptoms. All volleyball and softball players returned to their same level of sport. Only 2 of 3 high school baseball players and 4 of 10 professional baseball players returned to their prior level. Of the 10 professional baseball players, 4 were unable to return to any level of their sport. Neither of the 2 college baseball players returned to any level of their sport.

No operative complications, nerve deficits, or wound infections occurred in any patient. At latest follow-up, 1 patient lacked more than 10° of external rotation and another patient lacked more than 10° of forward flexion when compared to their unoperated sides. Two patients required a second open anterior procedure to address recurrent symptoms of instability.

Of the 3 poor results, 2 required an open surgical stabilization for recurrence. One patient was a high school baseball player who returned to competition 12 months postoperatively but had the same painful symptoms recur. He underwent an open capsular shift 24 months after the index procedure and was able to participate in junior college baseball the following year. Another patient was a professional baseball player who exhibited similar symptoms of pain when he resumed throwing 6 months postoperatively. He underwent an anterior capsulolabral reconstruction 8 months after the index procedure and returned to professional baseball the following year. The third patient was a professional baseball player who had recurrent symptoms of pain when he resumed throwing 6 months postoperatively. He chose to have no further treatment and, 2 years after surgery, was still unable to participate in baseball because of continued symptoms in his shoulder.
DISCUSSION

In 1991 Jobe et al\(^8\) described the use of anterior capsulolabral reconstruction to treat shoulder instability in overhand athletes. By using their original open surgical technique or a modification thereof, these authors reported that over 92% of patients returned to competition.\(^8,19,24\) Using a humeral-based inferior capsular shift procedure, Bigliani et al\(^3\) reported on a subset of 31 overhand athletes treated for instability. All 31 patients returned to their sport, and 22 (71%) returned to the same level.

There have been few reports on the treatment of overhand athletes with ETC. In a retrospective, matched controlled study, Savoie and Field\(^25\) compared the results of arthroscopic capsular shift, laser-assisted capsulorrhaphy, and ETC for the treatment of multidirectional instability (MDI) and noted recurrence rates of 10%, 3%, and 6.7%, respectively. In that study 80% of athletes in each group returned to their previous level of sport. In another matched controlled study, Levitz et al\(^13\) noted that when ETC was added to the arthroscopic treatment of microinstability in baseball players, 93% of patients returned to competitive play versus 80% who had arthroscopy without ETC. Of note, subjects who had concomitant labral repairs (including SLAP and Bankart tears) were included in these reports.

The current study describes the short-term results of an isolated ETC for the treatment of symptomatic shoulder instability in overhand athletes. Only 13 of 19 patients (68%) returned to their previous sport, and only 10 returned to their previous level. There are a few possible causes for the high failure rate. First, it is possible that some of the patients with bidirectional instability may have had true MDI, and therefore, these shoulders would have also required closure of the rotator interval to address the instability.\(^15,25\) Fanton\(^5\) has noted that patients with MDI treated with ETC have less consistent results than those with unidirectional anterior instability. A second possible factor may have been unrecognized—unstable SLAP tears in some of the labra that were debrided. Morgan et al\(^120\) noted that the relocation maneuver was highly sensitive for unstable posterior SLAP lesions in symptomatic overhead athletes with subtle instability. The combination of labral repair and ETC seems to improve the overall results in overhand athletes.\(^5,13,18,25\) A third possible contribution to surgical failure might involve the undefined effects on the collagen ultrastructure after thermal treatment.\(^16\) Finally, postoperative rehabilitation may have contributed to the mixed results. In a follow-up report, Fanton\(^5\) noted that postoperative immobilization may be needed for at least 4 weeks to treat capsular laxity, whereas our patients discontinued the use of slings after 4 weeks. Furthermore, our patients were allowed to participate in overhand activities at 12 weeks postoperatively, whereas other authors have waited longer before initiating overhand exercises.\(^5,13\)

A number of weaknesses exist in this study. Data were collected retrospectively and did not allow for a comparison group. The strict inclusion criteria (eg, no prior shoulder surgeries, no labral detachment) resulted in a more specific but small sample size, which limited the benefit of meaningful statistical analysis across parameters without introducing a type II error.\(^16\) Moreover, our data suggest that the etiology of instability in the overhand athlete is multifactorial and variable. No attempt was made to compare our sample with a cohort of open reconstruction or arthroscopic suture capsulorrhaphy. Lastly, the follow-up period was short, and continued evaluation of these patients will determine whether the results deteriorate over time.

In summary, an isolated ETC procedure was safely performed in 19 overhand patients with symptomatic glenohumeral instability. At 16-month minimum follow-up, the preliminary results are favorable but do not reproduce the success of open surgery. With 2 reoperations, 5 fair or poor results, and 6 patients unable to return to sport, failure rates for this unique population are unacceptably high. This study suggests that overhand athletes may require treatment other than an isolated ETC procedure (eg, labral repair, rotator interval closure) to address the instability. Therefore, current indications for ETC should be better defined, and further long-term results are needed before its isolated use can be recommended in the overhand athlete.

REFERENCES

9. Jobe FW, Kvitrn RS, Giangarra CE. Shoulder pain in the over-