SURGICAL TREATMENT OF TRAUMATIC ANTERIOR SHOULDER INSTABILITY IN AMERICAN FOOTBALL PLAYERS

BY MICHAEL J. PAGNANI, MD, AND DAVID C. DOME, MD

Investigation performed at Tennessee Orthopaedic Alliance, Nashville, Tennessee

Background: American football players have been reported to be at high risk for postoperative instability after arthroscopic stabilization of anterior shoulder instability. While some authors have recommended open methods of stabilization in athletes who play contact sports, there are few data in the literature showing more favorable results with use of an open technique. We reviewed the results of an open technique of anterior shoulder stabilization in fifty-eight American football players after a minimum of two years of follow-up.

Methods: Fifty-eight American football players underwent open stabilization with use of a standardized technique for the treatment of recurrent anterior shoulder instability. Forty-seven patients had recurrent dislocations, and the remaining eleven had recurrent subluxations. The average age of the patients was 18.2 years, and the average duration of follow-up was thirty-seven months. Patients were evaluated according to the shoulder scoring system of the American Shoulder and Elbow Surgeons and with use of the shoulder instability score described by Rowe and Zarins.

Results: There were no postoperative dislocations. Postoperative subluxation occurred in two patients, neither of whom had had a dislocation prior to the operation. Forward flexion and external rotation returned to within 5° of those of the contralateral shoulder in forty-nine patients. The average score according to the system of the American Shoulder and Elbow Surgeons was 97.0 points, and the average Rowe and Zarins score was 93.6 points. Fifty-five patients had a good or excellent result, and fifty-two of the fifty-eight returned to playing football for at least one year. One patient was forced to stop playing because of recurrent instability.

Conclusions: Open stabilization is a predictable method of restoring shoulder stability in American football players while maintaining a range of motion approximating that found after arthroscopic stabilization. Postoperative stability appears to be superior to that reported after arthroscopic techniques in this population of patients.

The risk of recurrent anterior instability of the shoulder tends to increase with the activity level of the patient. In particular, athletes involved in so-called contact and collision sports can be subjected to sizable loads on the shoulder[1]. American football players have been shown to be at high risk for failure after arthroscopic stabilization procedures[2-5]. However, most reported series of patients treated with open anterior stabilization of the shoulder have consisted of a heterogeneous population, and few studies have presented the results of open repair with specific regard to athletic participation. Furthermore, we are not aware of any studies of open stabilization in a large series of American football players. In the study most closely resembling our current investigation, Uhorchak et al.[6] recently reported that, of sixty-six West Point cadets involved in contact and collision sports, 22% had some degree of instability at the time of a minimum two-year follow-up after open stabilization.

We studied a consecutive series of American football players in whom anterior shoulder instability had been treated with an open stabilization procedure by the senior author (M.J.P.) in the period from August 1993 through January 1999. The patients were evaluated at twenty-four to eighty months (average, thirty-seven months) after the operation.

Materials and Methods

Seventy-one consecutive male American football players were treated for recurrent shoulder instability with an open anterior stabilization procedure. Five players who had undergone a prior operation for instability were excluded from the study, as were two who had been operated on for posterior instability. Six patients were lost to follow-up during the study period, leaving fifty-eight available for the final evaluation.

The patients' ages ranged from fifteen to twenty-nine years (average, 18.2 years). Forty-three patients played football

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at the high-school level, eleven played at the collegiate level, and four were professional football players. Although shoulder dysfunction interfered with the activities of daily life of some of the patients, the primary symptom in all patients was recurrent instability, shoulder pain, and apprehension during participation in American football. Forty-seven patients had frank dislocations, whereas the remaining eleven had symptoms and signs consistent with recurrent anterior glenohumeral subluxation. Forty-one of the forty-seven patients with dislocations reported that at least one episode required manipulative reduction by a health-care professional. The number of recurrent episodes of instability ranged from three to twenty-five.

All patients had persistent signs and symptoms of anterior instability on physical examination, and all had a history of trauma that was believed to have initiated the instability. An anterior apprehension test with the arm abducted and externally rotated was performed on all patients. The examiner progressively increased the degree of external rotation while noting the development of apprehension on the part of the patient. The test was considered positive when the maneuver induced anxiety and protective muscular contraction as the shoulder was brought into a position associated with anterior instability[7].

The signs and symptoms of anterior subluxation were often more subtle than those of dislocation. Eight of the eleven patients remembered a specific injury, which typically occurred with extreme external rotation combined with either abduction or hyperextension. The chief symptom in the athletes with subluxation was more vague, such as a sense of movement, pain, or clicking with certain activities. Several athletes noted repeated transitory episodes of severe pain, particularly when tackling. After an acute episode, the severe pain usually subsided quickly but the shoulder remained sore and weak.

Plain radiographs revealed an osseous Bankart lesion in five patients and a Hill-Sachs lesion in nineteen. Magnetic resonance imaging of the shoulder was not routinely performed in this series.

All patients were treated with the operation after failure of a rehabilitation program that emphasized strengthening of the rotator cuff and scapular rotator muscles. In the later stages of the rehabilitation, proprioceptive neuromuscular feedback exercises were incorporated. The duration of nonoperative treatment ranged from nine weeks to thirty-seven months. All patients had recurrent instability or persistent apprehension despite completion of the rehabilitation program.

Forty-one of the fifty-eight patients underwent arthroscopic examination of the shoulder prior to the open stabilization procedure. In the early part of the study, we did not routinely perform arthroscopy when traumatic anterior instability was to be treated with an open repair. However, we now routinely perform an arthroscopic inspection of the shoulder with the patient in the beach-chair position prior to the open portion of the procedure. We find the arthroscopic examination to be helpful for identifying concomitant lesions in the rotator cuff and labrum. In addition, by identifying the presence or absence of a Bankart lesion, the arthroscopy aids in the planning of our method of stabilization[8]. In particular, we shift the capsule on its lateral margin if no Bankart lesion is present.

Operative Technique

Our general approach to open anterior stabilization has been described previously[7,9]. A slight modification of our previously reported technique is described below.

The patient is positioned supine with the head of the operating table raised 30° and the involved upper extremity abducted 45° on an arm-board. Folded sheets are placed beneath the elbow to maintain the arm in the coronal plane of the thorax and to minimize extension of the shoulder. The skin is incised along the anterior axillary crease in a longitudinal fashion along the Langer lines. The incision is placed lateral to the coracoid process. The deltopectoral interval is identified, the cephalic vein is retracted laterally, and the interval is developed. The clavipectoral fascia is then incised at the lateral border of the conjoined tendon at its coracoid attachment, and the coracoacromial ligament is divided to facilitate exposure of the superior aspect of the capsule and, particularly, the rotator interval area.

The bicipital groove and the lesser tuberosity are identified. A vertical tenotomy of the subscapularis tendon is performed with electrocautery approximately 1 cm medial to its insertion on the lesser tuberosity. The medial portion of the tendon is tagged with heavy, number-1, nonabsorbable braided polyester (Ethibond) sutures (Ethicon, Somerville, New Jersey). The interval between the anterior aspect of the capsule and the subscapularis tendon is then carefully developed with a combination of blunt and sharp dissection.

The laxity and quality of the capsule are then assessed. If there is a lesion in the rotator interval, it is generally closed at this point with number-1 nonabsorbable braided polyester (Ethibond) sutures. A transverse capsulotomy is then performed, and a ring (Fukuda) retractor is placed intra-articularly. The glenohumeral joint is explored for evidence of a Bankart lesion, and the joint is irrigated to remove any loose bodies.

If a Bankart lesion is noted, the capsulolabral separation at the anteroinferior aspect of the glenoid neck is extended medially with use of an elevator or knife to allow placement of a retractor along the glenoid neck. The glenoid neck is then roughened with an osteotome or a motorized burr to provide a bleeding surface. Two or three metallic suture anchors are placed in the anteroinferior aspect of the glenoid neck near, but not on, the articular margin of the glenoid. The capsule and labrum are reattached to the anterior aspect of the glenoid with slight medial and superior mobilization of the capsule. The goal is not to reduce external rotation but to obliterate excess capsular volume and to restore the competency of the inferior glenohumeral ligament at its glenoid insertion.

After repair of the Bankart lesion (or in the absence of a Bankart lesion), an anterior capsulorrhaphy is performed to eliminate excess capsular laxity. The arm is placed in 45° of ab-

TABLE I Standardized Postoperative Rehabilitation Protocol

Weeks Postop.	
0-4	Sling immobilization with shoulder in internal rotation, pendulum exercises, elbow range of motion
4-8	Passive and active-assisted shoulder range of motion. Limit external rotation to 45°. When 140° of active forward flexion is obtained, begin rotator cuff strengthening (internal-external rotation strengthening with arm at low abduction angles)
8-12	Deltoid isometric exercises with arm at low abduction angles, body blade exercises. Limit external rotation to 45°. If no impingement or rotator cuff symptoms are noted, slowly increase abduction during rotator cuff and deltoid strengthening. Scapular rotator strengthening: press-ups (seated dips), shrugs, horizontal abduction exercises, open-can exercises
12-18	Restore terminal external rotation. Proprioceptive neuromuscular feedback patterns; plyometric exercises; sport-specific motion using pulley, wand, or manual resistance
>18	Conventional weight-training. Orient for return to sport (progress from field drills to contact drills). Obtain abduction harness for selected football positions (linemen). Return to full contact when abduction and external rotation strength are symmetrical on manual muscle-testing

duction and 45° of external rotation, and the superior and inferior capsular flaps are reapproximated with forceps. The shoulder is held in a reduced position. If the capsular flaps can be overlapped, the capsule is shifted to eliminate excess capsular volume with the arm maintained in position. If ≤5 mm of overlap is present when the inferior flap is pulled superiorly in relation to the superior flap, the capsule is simply imbricated. With >5 mm of capsular overlap, the capsulotomy is extended in a vertical direction near its lateral insertion on the humeral neck, and a T-plasty capsular shift is performed. The inferior capsular flap is shifted superolaterally, and the superior flap is moved over the inferior flap in an inferolateral direction. The transverse portion of the capsulotomy is then closed.

After the capsule has been addressed satisfactorily, the subscapularis is reapproximated, but not shortened, with nonabsorbable suture. The deltopectoral interval is loosely closed with absorbable suture. Routine wound closure is then performed.

Postoperative Rehabilitation Protocol

A standard rehabilitation program was prescribed throughout the course of the study (Table I).

Data Collection and Follow-up

All patients were examined after a minimum of two years of follow-up. The patient self-evaluation form developed by the Research Committee of the American Shoulder and Elbow Surgeons was administered[10]. Patients were specifically questioned regarding the occurrence of any episodes of instability.

The physician assessment was performed by one or both of the authors. Again, this portion of the examination was guided by the recommendations of the Research Committee of the American Shoulder and Elbow Surgeons[10]. A shoulder score index was then tabulated on the basis of the patient self-assessment and physician assessment portions of the evaluation. In addition, a second score was derived with the shoulder instability scoring system of Rowe and Zarins[11].

Results

Arthroscopic and Operative Findings

A Bankart lesion was noted in forty-six of the fifty-eight patients. Forty-three of the forty-seven patients with a history of recurrent dislocation and three of the eleven patients with a history of recurrent subluxation had a Bankart lesion. Three patients had an osseous Bankart lesion that was of sufficient size to require excision and repair of the remaining capsule and labrum to the underlying osseous defect. No lateral capsular lesions were noted in this series.

One patient (a professional athlete) had an associated bucket-handle tear of the superior aspect of the labrum; it was treated with excision of the fragment during the arthroscopy. This labral tear included approximately 15% of the supraglenoid insertion of the biceps brachii. The biceps tendon in this patient was noted to be frayed and degenerated proximally. Seven other patients had fraying of the superior part of the labrum.

Capsular laxity was corrected by a T-plasty capsular shift in sixteen patients. All twelve patients who did not have a Bankart lesion underwent a T-plasty capsular shift.

A Hill-Sachs lesion was noted in thirty-seven of the forty-one patients who underwent arthroscopy. Two patients had a small partial-thickness tear on the articular surface of the supraspinatus tendon. Each tear was thought to represent <10% of the tendon attachment. The small partial tears were treated with débridement during arthroscopy.

Loose bodies were found and removed from four shoulders. Three patients had small, displaced osseous fragments of the anterior aspect of the glenoid, which were adherent to the anterior aspect of the capsule and labrum. These fragments were sharply dissected from the soft tissue and excised. The capsule was then repaired to the underlying osseous bed.

Postoperative Instability

None of the patients had dislocation of the shoulder postoperatively. Two patients reported postoperative episodes of

subluxation, and each continued to have a positive anterior apprehension test on their follow-up examinations. Both of these individuals had had subluxation preoperatively, and neither had had dislocations. One of the two patients had a Bankart lesion; the other did not. Neither had a Hill-Sachs lesion. Both patients experienced the initial postoperative episode of instability while they were playing football.

The patients with preoperative subluxation had a higher rate of postoperative instability than did those with preoperative dislocation (Fisher exact test, $p = 0.044$).

Return to Sports

Fifty-two of the fifty-eight patients returned to full participation in American football for at least one year. Forty-one participated for at least two years, and twenty-four of them participated for three or more years. Eleven high-school athletes went on to play at least one year of collegiate football. All eleven collegiate players returned to their college teams, and one of the eleven became a professional player. All four professional players returned to their sport.

One of the two patients (a high-school player) with postoperative subluxation could not continue playing football after one year because of persistent instability. He did not have instability with activities of daily life and did not wish to undergo another surgical procedure. The other patient with postoperative subluxation (a collegiate player) continued to participate, despite occasional episodes of subluxation, for two years.

Two patients decided to give up the sport because of instability of the contralateral shoulder. Three other patients decided not to continue their participation in American football for reasons unrelated to the shoulder.

Range of Motion

Forward flexion on the involved side averaged 174° (range, 146° to 180°) compared with 180° on the contralateral side. External rotation with the arm at the side averaged 67° (range, 30° to 95°) compared with 76° on the contralateral side ($p < 0.05$). External rotation with the arm in 90° of abduction averaged 96° (range, 60° to 120°), representing a loss of 8° compared with the value on the contralateral side ($p < 0.05$). No patient lost more than 15° of external rotation compared with the value on the contralateral side. Forty-nine (84%) of the fifty-eight involved shoulders had a range of flexion and external rotation within 5° of those of the contralateral shoulder.

Postoperative Radiographs

Anteroposterior and axillary lateral radiographs were available for forty-five of the patients during the postoperative period. The metallic suture anchors were in satisfactory position; none appeared to have migrated or become misplaced. Radiographs of one patient (a professional player) demonstrated mild degenerative changes of the glenohumeral joint. No other major radiographic anomalies were noted.

Functional Testing

The average postoperative shoulder score according to the scale of the American Shoulder and Elbow Surgeons[10] was 97.0 points (range, 70 to 100 points). Only one patient received a score of <80 points.

The Rowe and Zarins shoulder instability score[11] ranged from 49 to 100 points, with an average of 93.6 points. According to this scoring system, there were fifty-three excellent results, two good results, two fair results, and one failure. Ninety-five percent of the patients had a good or excellent result.

Complications

A subcutaneous hematoma that required surgical evacuation and drainage developed in one patient. He had an uncomplicated recovery.

Discussion

We and many others have previously described high recurrence rates after arthroscopic stabilization procedures in athletes who participate in so-called contact sports[2-5,12]. As a result, we stopped recommending arthroscopic stabilization as a treatment option to American football players in 1993. We believed that the recurrence rates associated with arthroscopic procedures outweighed any perceived advantages in terms of appearance or less perioperative pain.

O'Neill[3] recently reported excellent results after arthroscopic stabilization in a carefully selected group of athletes. However, two of the seventeen American football players in his series had postoperative subluxation and a score of <80 points according to the scale of the American Shoulder and Elbow Surgeons. As a result, O'Neill advised, "football players must be warned about the greater probability of instability on returning to their sport after an arthroscopic procedure." In comparing the results of arthroscopic and open anterior stabilization procedures, Cole et al.[2] noted that all episodes of instability after an arthroscopic Bankart repair resulted from a fall or participation in a contact sport. Bacilla et al.[13] reported a 10% failure rate after arthroscopic Bankart repair in a high-demand population that included twenty-one American football players. The patients were studied for a minimum of eighteen months, and the specific results in football players were not reported.

Gill et al.[14] showed excellent objective long-term results after the Bankart procedure, which confirmed findings in earlier reports by Rowe et al.[15] and Zarins et al.[16]. Our technique is basically a modification of these methods. Wirth et al.[17] reported that 97% of patients treated for traumatic anterior instability, with a somewhat different open method devised by Rockwood, had normal stability and a negative apprehension test after surgery. While athletes were included in each of these studies, the results in football players were not specifically analyzed.

It was our belief that the open technique offers certain advantages that are difficult to duplicate with current arthroscopic technology. First, the ability to restore tension to the capsule in a precise manner is facilitated by freeing the capsule from the adherent subscapularis tendon. Second, the shoulder can be maintained in an optimal position during the cap-

sular repair with less concern about visualization. Third, the capsular structures can be overlapped with ease with use of the open technique. (The ability to reinforce and thicken a damaged capsule may be especially important in an athletic population.) Fourth, the rotator interval, which is difficult to visualize properly through the arthroscope, can be directly observed and properly repaired with the open technique.

One of the presumed advantages of arthroscopic techniques of shoulder stabilization is an improvement in postoperative shoulder motion. In our series, 84% of the patients regained all or nearly all of their shoulder motion. Our results in terms of range of motion approximate those in reports on arthroscopic stabilization in similar patients[3,18]. We do, however, think that there may be a role for arthroscopic stabilization in selected patients. We continue to consider arthroscopic techniques for the treatment of throwing athletes with subtle anterior instability and lower-demand individuals who have a Bankart lesion.

In summary, we believe that open stabilization is a predictable method of restoring shoulder stability in American football players. Motion and function need not be sacrificed in exchange for stability. Our results appear to be superior to those reported after arthroscopic stabilization in a similar population. ■

Michael J. Pagnani, MD
David C. Dome, MD
Tennessee Orthopaedic Alliance, 2410 Patterson Street, Suite 106, Nashville, TN 37203

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