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Arthroscopic Transglenoid Bankart Suture Repair with Modifications of Caspari's Technique

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Recent advances in arthroscopic surgery have given new options for dealing with anterior glenohumeral instability with less morbidity than the open procedure. The early literature discussing arthroscopic Bankart suture repair is favorable, however limited long-term follow-up studies have yet to prove its success. This study reports our experience with arthroscopic transglenoid Bankart suture repair with a minimum 2-year follow-up. Arthroscopic transglenoid Bankart repair was performed in 23 cases of anterior shoulder instability with some modifications of Caspari's suture technique. First, the suture material was #1 PDS and the number of sutures was 4 or 5. Second, the insertion site of the guide pin was moved to 1 o'clock on the right shoulder and to 11 o'clock on the left shoulder to prevent slippage of the guide pin. With this technique, we obtained 87% satisfactory results analyzed by the Rowe functional grading system. There was no suprascapular or axillary nerve injury. Two patients had redislocations and one patient had recurrent subluxation. Five patients complained of suture-knot irritation problems.

Key Words: Shoulder, anterior instability, arthroscopic Bankart procedure

Recent advances in arthroscopic surgery have given new options for dealing with anterior glenohumeral instability with less morbidity than the open procedure (Caspari and Savoie, 1991; Benedetto and Glotzer, 1992; Lane *et al.* 1993). The anterior inferior glenohumeral ligament (AIGHL) and the labral complex have been known as important checking structures of anterior shoulder dislocation (Turkel *et al.* 1981). The open techniques of recurrent shoulder dislocation have shown satisfactory results in most cases, but after this operation a marked loss of external rotation has frequently followed (Barry *et al.* 1985; Collins *et al.* 1986). The development of arthroscopic fixation methods has contributed to maximal recovery of shoulder motion, although follow-up has been short (Morgan and Bodenstab, 1987; Caspari, 1988; Benedetto and Glotzer, 1992). Arthroscopic techniques are usually divided into 3 different categories to repair the Bankart lesion; staple fixation (Johnson, 1986), suture technique (Caspari and Savoie, 1991), and bioabsorbable tacks (Altchek *et al.* 1989).

Matthews *et al.* performed the arthroscopic stapling method popularized by Du Toit and Roux in 25 cases to repair the Bankart lesion and reported the recurrence of instability in 20% of cases and loosening of the staple in 1 case (Du Toit and Roux, 1965; Matthews *et al.* 1988). With this method, many authors have reported a similar recurrence rate; Burger *et al.* (1990) (13%), Hawkins (1989) (16%), and Gross (1989) (33%). Zuckerman and Matsen analyzed complications in 37 patients who were given an open repair using a screw or staple.

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They reported that an inappropriate placement of the screw or staple was found in 10 cases with displacement or loosening in 24 cases and articular surface damage in 41% of patients (Zuckerman and Matsen, 1984). A secondary operation to remove hardware was needed in 33% of patients. Warner *et al.* performed the arthroscopic Bankart repair using the biodegradable cannulated screw and reported a 10 % recurrence rate (Warner *et al.* 1991).

Caspari *et al.* performed an arthroscopic multiple suture technique to repair the Bankart lesion in 49 patients who had anterior unidirectional instability of the shoulder (Caspari, 1988; Casparie and Savoie, 1991). They reported 96% satisfactory results were obtained without the loss of external rotation. Morgan and Bodenstab reported excellent results in all 25 patients who were stabilized arthroscopically with a transglenoid absorbable suture technique (Morgan and Bodenstab, 1987). Peterson and Newton also reported success in 24 of 25 shoulders undergoing arthroscopic Bankart repairs using the Caspari suture punch (Peterson and Newton, 1991). Bennedetto and Glotzer reported no recurrence of dislocation or subluxation in 22 patients treated with an arthroscopic Bankart procedure and followed-up for a minimum of 2 years (Bennedetto and Glotzer, 1992). Recently, however, less successful results have appeared in the literature. Grana *et al.* recommended caution in the use of arthroscopic stabilization in competitive athletes (Grana *et al.* 1993). Youssef *et al.* reported a 27% failure rate in 30 shoulders treated with an arthroscopic Bankart procedure (Youssef *et al.* 1995). They also commented on the need for long-term follow-up because the average time to redislocation was 22 months (range 6 to 40 months). Recently, Gill *et al.* reported the long-term follow-up results of open Bankart repair (Gill *et al.* 1997). Through minimum 8-year follow-up, they obtained good or excellent results in 52 of 56 patients (92.8%).

We have performed arthroscopic suture repairs for chronic anterior unidirectional instability since 1991. We experienced some technical difficulties during the operation and modified some points of Caspari's recommendation. A review of 23 patients who had been operated on with our technique and followed-up for at least 24 months was done. The purpose of this study was to evaluate the results of the arthroscopic Bankart operation using a modification on Caspari's technique, and to present some proposals to modify the procedure.

MATERIALS AND METHODS

From January 1991 to December 1993, we operated on 23 patients. The average follow-up was 34 months (24～51). There were 21 men and 2 women. Their average age at initial dislocation was 22 years (13～36). The average age at operation was 29 years.

The dominant extremity was affected in 18 cases and the nondominant extremity in 5 cases. The duration of the symptoms was less than 5 years in 11 cases; 5 to 10 years in 9 cases; and more than 11 years in 3 cases. Ten or fewer dislocations occurred in 11 cases; 11 to 20 dislocations in 8 cases; and more than 21 dislocations in 4 cases. Twenty-two cases had anterior unidirectional instability and one patient had multidirectional instability.

All patients complained of weakness and fatigue in the affected shoulder. A shoulder apprehension test was positive in all cases. After the induction of anesthesia, glenohumeral stability was assessed (Altchek *et al.* 1989). We graded instability from grade I to III, with grade I indicating that the humeral head could be translated to the glenoid rim, but not over it; grade II indicating that the humeral head could be subluxated over the rim, but would not lock into a dislocated position; and grade III indicating that the humeral head could be dislocated. Seven cases showed grade II instability and 16 cases showed grade III instability.

Operative findings

Twenty of 23 shoulders (87%) revealed the Bankart lesion. Three of 23 shoulders (13%) had the anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion (Neviaser, 1993). The Hill-Sachs lesion was found in 21 cases (91.3%). Upon operation, the Bankart and Hill-Sachs lesions were graded according to Rowe's criteria (Rowe *et al.* 1984). The Bankart lesion was defined as; mild-separation of the capsule and labrum from half of the glenoid rim

Table 1. The Bankart lesion and ALPSA lesion

Bankart lesion	No. of patients (%)
Severe	2(8.7)
Moderate	11(47.8)
Mild	7(30.4)
None	3(13.1)
Total	23(100)

Table 2. The Hill-Sachs lesion

Hill-Sachs lesion	No. of patients (%)
Severe	1(4.3)
Moderate	7(30.5)
Mild	13(56.5)
None	2(8.7)
Total	23(100)

by a distance of 0.5 cm; moderate to severe-separation of the capsule and labrum from the entire anterior rim of the glenoid by a distance of 1 cm; and severe - separation of the capsule and labrum from the entire anterior and inferior rim of the glenoid by a distance of 2 or 3 cm (Table 1). Also the severity of Hill-Sachs lesion was graded in accordance with the following dimensions; mild-2.0 cm long and 0.3 cm deep; moderate-4.0 cm long and 0.5 cm deep; and severe-4.0 cm long and 1.0 cm deep (Table 2).

Surgical technique

We used the arthroscopic Bankart procedure with Caspari's suture technique with some modifications (Caspari, 1988; Caspari and Savoie, 1991). After induction of general anesthesia, the patient is placed on the unaffected side and the injured arm is suspended in the traction apparatus. The arm is positioned at approximately 45 degrees of abduction and 15 degrees of forward flexion. Ten to 15 pounds of weight are used to maintain distraction during the procedure.

A standard posterior portal is established 2 cm inferior and 1 cm medial to the posterolateral corner of the acromion. Systematic diagnostic arthroscopy is done using a 30-degree 4 mm arthroscope placed at a standard posterior portal. The arthroscope is then removed from the sheath and the Wissinger rod is inserted into the sheath and is penetrated through the anterior capsule in the triangle to the superolateral side of the coracoid process. After incising the skin over the rod, another sheath is inserted along the Wissinger rod. The anterior portal is completed through the above procedures. The detached portion of the anterior inferior glenohumeral ligament (AIGHL) and glenoid labrum is debrided by a motorized shaver. If the anterior capsule is separated from the glenoid rim and scapular neck without a labral tear (ALPSA lesion), the ALPSA lesion (Neviaser, 1993) converts into a Bankart lesion. Then a bleeding surface is made through the abrasion on the anterior glenoid neck.

After replacing the anterior cannula to the suture punch cannula, a 70-degree arthroscope is substituted through the posterior portal and a suture punch is inserted through the anterior cannula. Four or 5 PDS #1 (Ethicon, Sommerville, NJ, USA) sutures are made at the separated inferior glenohumeral ligament and the glenoid labrum from the 6 o'clock to the 3 o'clock direction on the right shoulder. All sutures are pulled out through the anterior portal. The guide pin is inserted into the cannula and penetrated from the glenoid neck at 1 o'clock on the right shoulder and 11 o'clock on the left shoulder to the inferomedial aspect of the infraspinatus fossa. As the pin is observed to exit posteriorly, a small incision is made to allow it to exit the skin. The eye of the guide pin is also placed out of the suture punch cannula. The sutures are then placed through the eyelet at the end of the pin which is pulled through the glenoid neck and out through the posterior incision. As traction is applied to the sutures, the superior shift of the capsule and the multiple attachment points of the sutures are visualized, and satisfactory positioning and stability are confirmed. Then the arm is abducted and externally rotated while an anteriorly directed force is applied to the humeral head to test for stability. The shoulder is then removed from traction and the arm is externally rotated 15 degrees. The sutures are pulled tightly to approximate the repaired ligament to the glenoid neck, divided into two bundles, each of which is

passed through the infraspinatus fascia with a free round needle, and tied together. The small anterior and posterior skin incisions are sutured.

Postoperative management

Patients are immobilized by applying a Velpeau bandage for 2 to 3 weeks. Then active and passive exercises in the sling are started. At 6 weeks postoperatively, active and passive full range of motion exercises, except terminal abduction and external rotation, are permitted. After 3 months, gentle muscle strengthening exercises with full range of motion are started. Regular sporting activities that require overhead activities such as throwing are allowed after 6 months, but contact sports are discouraged for 9 months to 1 year.

RESULTS

Clinical evaluation using the Rowe functional grading system (Rowe *et al.* 1978, Table 3) showed that 18 patients were rated as excellent, 2 as good, 1 as fair, and 2 as poor (Table 4). So satisfactory results were obtained in 20 of 23 patients (87%). All 3 cases involving the ALPSA lesion that were managed by the suture technique after periosteal dissection showed excellent results. In cases where the number of dislocations was less than 10 occurences, fair and poor results were 14.2% (2/14). In those with more than 11 dislocations, fair and poor results were 11.1% (1/9). The number of dislocations was not related to the clinical outcome (Table 5). In cases where the Bankart lesion was mild or absent, fair and poor results were 10% (1/10). In those where the Bankart lesion was moderate or severe, fair and poor results were 15.3% (2/13). The extent of the Bankart lesion was not related to clinical outcome. In cases where the Hill-Sachs lesion was mild or absent, fair and poor results were 6.6% (1/15). In those where the Hill-Sachs lesion was moderate or severe, fair and poor results were 25% (2/8). But we couldn't conclude that the severity of the Hill-Sachs lesion was related to the clinical outcome because the number of severe Hill-Sachs lesions was so small.

Redislocation occurred in 2 cases (8.7%); sub-

Table 3. Rowe functional grading system

Scoring system	Units
1) Stability	
No recurrence, subluxation	50
Apprehesion in certain position	30
Subluxation	10
Recurrent dislocation	0
2) Motion	
100% of normal external rotation	20
75% of normal external rotation	15
50% of normal external rotation and 75% of normal elevation	5
50% of normal elevation and no external rotation	0
3) Function	
No limitation in work or sports	30
Mild limitation	25
Moderate limitation	10
Marked limitation	0
4) Total units possible	100
Excellent: 100~90	
Good: 89~75	
Fair: 74~51	
Poor: 50 or less	

Table 4. Results of Caspari's technique

Results	No. of patients (%)
Excellent	18(78.3)
Good	2(8.7)
Fair	1(4.3)
Poor	2(8.7)
Total	23(100)

Table 5. Results & No. of dislocations

	<5	5~10	11~20	>20
Excellent	5	6	3	4
Good		1	1	
Fair		1		
Poor		1	1	
Total	5	9	5	4

Table 6. Limitation of external rotation

L.O.M.	No. of patients (%)
None	18(78.3)
<10	3(13.0)
10~20	2(8.7)
>20	0(0.0)
Total	23(100)

luxation in 1 case (4.3%); and knot irritation in 5 cases (21.7%). The external rotation was normal and symmetric in 18 cases (78.3%). The limitation of external rotation was less than 10 degrees in 3 cases (13%) and less than 20 degrees in 2 cases (8.7%) (Table 6). The knots were located in the inferomedial aspect of the infraspinatus fossa in 11 cases (47.8%), and in the center or superomedial aspect in 12 cases (52.2%). Knot irritation problems occurred in 5 cases. At three months postoperatively, 9 patients complained about a knot irritation problem. But at 6 months postoperatively, only 5 patients complained about this. Knots were removed in 2 patients at 6 months postoperatively. Redislocation of the shoulder occurred in 2 cases. One patient had a redislocation because of a severe direct trauma during an ice hockey game against our advice at 2 months postoperatively. He received a second operation and had a 20-degree loss of the external rotation of the affected shoulder. Probably this resulted from excessive tension of the anterior joint capsule. The other had a redislocation while playing soccer at 8 months postoperative. One patient of fair grade complained of persistent pain and instability sensation, but later it was determined he had a psychological problem. He improved through muscle-strengthening exercises.

DISCUSSION

The frequency of the Bankart and Hill-Sachs lesion in anterior unidirectional instability of the shoulder differs according to articles. Adams (1948) found 87% of the Bankart and 82% of the Hill-Sachs lesion in 180 cases of recurrent shoulder dislocation retrospectively. Berg and Ellison reported 89% of the Bankart and 59% of the Hill-Sachs lesion in 69 patients retrospectively, and also noted that the extent of the Bankart lesion was not related to clinical results (Berg and Ellison, 1990). In our series, we found the Bankart lesion in 20 of 23 patients (87%) and the Hill-Sachs lesion in 21 patients (91.3%) during arthroscopic examination. In 3 cases without the Bankart lesion, we observed joint capsule laxity due to the ALPSA lesion. The clinical results were not related to the extent of the Bankart lesion, but they were poorer in moderate and severe Hill-Sachs lesions than those with a mild lesion. This result was statistically significant, but we couldn't have concluded that clinical results are related to the severity of the Hill-Sachs lesion because the number of severe Hill-Sachs lesion was only one.

Morgan and Bodenstab have stated that the arthroscopic technique has general complications and carries the risk of suprascapular nerve injury (Morgan and Bodenstab, 1987). Kevin and Jaffrey reported scapulothoracic penetration of a beath pin during arthroscopic Bankart suture repair, and recommended the use of a motorized drill instead of a mallet in inserting a beath pin as Morgan and Bodenstab did (Morgan and Bodenstab, 1987; Kevin and Jaffrey, 1991). We also used a motorized drill and there was no suprascapular nerve injury in our series.

Caspari and Caspari and Savoie recommended that AIGHL and the labral complex be repaired with 5-8 knots of #2 monofilamentous absorbable sutures (Caspari, 1988; Caspari and Savoie, 1991). We obtained sufficient stability and avoided crowding by using only 4 or 5 knots of #1 PDS sutures. Also Caspari recommended that the entry point of a guide pin should be 2 o'clock on the right and 10 o'clock in the left shoulder and exit through the inferomedial aspect of the infraspinatus fossa (Fig. 1). But we found that a guide pin usually slipped in order to maintain the above-mentioned entry point because the shape of the glenoid was elliptical and the angle between the direction of the guide pin and the anterior glenoid neck was too acute. Actually, the guide pin couldn't exit the inferomedial aspect of the infraspinatus fossa through the glenoid neck because the infraspinatus fossa of the scapula formed a round curvature along the thoracic rib cage. So the

Fig. 1. Guide pin insertion point by Caspari's technique. (10 o'clock in left shoulder)

Fig. 2. Guide pin insertion point by modified technique. (11 o'clock in left shoulder)

inferomedial placement of the guide pin in the infraspinatus fossa as Caspari recommended was difficult to determine in the glenoid neck. So we inserted the guide pin at 1 o'clock of the glenoid neck on the right shoulder and 11 o'clock on the left shoulder, and tried to exit in the inferomedial aspect of the infraspinatus fossa (Fig. 2). In 12 of 23 cases (52.2%), knots were formed at the supermedial or center of the infraspinatus fossa. Theoretically, the superomedial placement of the guide pin could hurt the suprascapular nerve. However, there was no suprascapular nerve injury in the follow-up period. Also we recommend the use of the anterosuperior portal instead of the anterior portal in order to insert the guide pin at 1 o'clock in the right shoulder and 11 o'clock in the left shoulder.

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