Acta Orthop. Belg., 2009, **75**, 727-735

ORIGINAL STUDY

Improved range of motion after medial-based T capsular shift for recurrent post-traumatic anterior shoulder dislocation

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Postoperative function and recurrence rates are reportedly similar following open and arthroscopic procedures for recurrent anterior instability of the shoulder. However, various studies have reported greater restriction of shoulder mobility with open stabilisation.

Sixty-two patients with post-traumatic recurrent anterior instability of the shoulder underwent anatomic reconstruction of the capsular-labral complex using a medial-based T capsular shift. They were investigated preoperatively and 53 of them were re-examined at an average of 41.5 months after operation. Function and stability improved : the Rowe score increased from 33.2 to 80.6, the Constant score from 81.5 to 89.8 points.

Pre- and post-operative mobility of the affected shoulder was reduced in all planes of movement compared to the contralateral side. Passive mobility did not deteriorate in any direction with surgery. Passive adduction, forward flexion and external rotation in 90° abduction of the arm improved significantly and active mobility rose to the values of the contralateral side. The restriction of mobility noted postoperatively thus appears as a consequence of the underlying pathology rather than of the surgical procedure.The recurrence rate after primary stabilisation was 1.6%. Based on these findings, the medial-based T capsular shift remains an appropriate surgical option in the treatment of chronic post-traumatic anterior instability of the shoulder.

Keywords : recurrent dislocation ; open repair ; medial T shift repair ; capsular shift.

INTRODUCTION

The most widely used technique in modern shoulder instability surgery was developed by Bankart in 1923 (*3*). His technique is still regarded as the basis for all open and arthroscopic procedures. In recent decades, many modifications of the ventral capsular reconstruction were developed and arthroscopic techniques were introduced. In addition, the indication for extra-anatomic procedures was defined.

It is generally assumed that restriction of mobility is an unavoidable consequence of all these procedures. Open procedures reportedly entail a greater limitation of the range of motion than arthroscopic procedures (*4,35*). Hubbel *et al* did not report restriction of mobility after 30 arthroscopic stabilisations, but they found a 10° to 40° reduction in external

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No benefits or funds were received in support of this study

rotation in 9 out of 10 patients after open reconstruction (*13*). Loss of external rotation after Bankart repair or anterior capsulorrhaphy was confirmed by others (*23,24*). Geiger *et al* however found no change in external rotation (*11*).

Patients inquire about the influence of the surgical repair on pain, function, work and sports capability and possible sequelae, but are particularly interested in the probability of re-dislocation and of a possible restriction of motion (*15,16,17*). We investigated whether a restriction of movement should indeed be expected in the long term after an open anatomic procedure (reconstruction of the labrum combined with medial-based T capsular shift) similar to the O'Brien-Warren procedure (*1,14,18,19,25, 28,34,37*). If an appreciable impairment resulted, we would have to reconsider the indication for surgery and the selection of the surgical technique.

MATERIALS AND METHODS

A study was conducted involving 62 consecutive patients who had undergone open capsular-labral reconstruction between January 1st 1996 and December 31st 2000 for recurrent anterior shoulder dislocation. Their average age was 30.5 years. The majority were males. In 66% of the patients, the first dislocation occurred during sports. Soccer and handball as well as bicycle riding and snowboarding were the foremost high-risk sports in our patients. Eight dislocations resulted from an accident at work. The right shoulder and the dominant shoulder were affected more frequently.

For methodological reasons, we had to exclude patients with bilateral shoulder stabilisation. Patients with previous operations were included, since this did not influence postoperative restriction of movement (table I). Fifty-three patients (85.5%) were followed up over a mean time period of 41.5 months. Nine patients

Table I. — Patient data

Main patient data	
Post-traumatic recurrent dislocation (n)	62
Age	30.56 (16-67) years
Gender	46 male, 16 female
Operated side	right 33, left 29
Surgery on the dominant side	39
Follow-up, shoulders	53 (85.5%)
Follow-up duration (months)	41.45 (SD 14.3)
Interval from initial dislocation until surgery	6.16 years (2 mo.-32 years)
Mechanism of initial instability : sports accident work accident other accidents	37 7 18
Number of dislocations before surgery	6.4 (SD 14)
Operations prior to open stabilisation	15 patients
No operations prior to open stabilisation	47 patients
Return to work	12.4 weeks
Same profession as preoperatively	62
Return to sports : no limitation mild limitation moderate limitation not interested in sports	18 32 12 9

Table II. — Arthroscopic findings (n = 62)

Arthroscopic findings in post-traumatic recurrent dislocation		
Labrum lesions :	ALPSA	27
	Bankart	11
	Bony Bankart	12
	Perthes	6
	Others	6
SLAP lesion grade II-IV		13
Additional lesions :	supraspinatus rupture (incl. partial)	10
	subscapular rupture (incl. partial)	3
	fracture of coracoid	3
Suture anchors :	4	0
	3	35
	2	27
Hill-Sachs lesion		62

ALPSA : anterior labroligamentous periosteal sleeve avulsion ; SLAP : superior labral tear from anterior to posterior.

did not present for follow-up : three patients had to travel too far and three others were satisfied with the result of the operation and saw no reason for an examination. One patient was not satisfied with the result and had undergone a second operation, and two patients could not be reached. The operations were performed by two surgeons only. The independent investigator was not involved in the surgeries.

The major arthroscopic findings are summarized in table II. A Hill-Sachs lesion was found in all patients investigated. For fixation, two anchors were used in 35 cases and 3 anchors in 27 cases.

Patient selection

All patients had a history of recurrent dislocations or subluxations. The main clinical findings were a positive anterior apprehension and relocation test (arm placed in abduction combined with external rotation) and a positive anterior load and shift test. At least one previous operation was done in 15 patients (24.2%), with two of them having undergone two operations and one had undergone three operations. No patient had evidence of atraumatic instability or multidirectional hyperlaxity.

Surgical procedure

The principle of the operation combines a reconstruction of the labrum and a selective medial-based T capsular shift *(12)*.

With the patient in beach chair position, and after diagnostic arthroscopy, the shoulder was entered using a deltopectoral approach. The subscapularis tendon was detached 1 cm medial to its insertion on the lesser tuberosity and was separated from the joint capsule by sharp dissection. A T-shaped capsular incision was made with a vertical leg 0.5 cm medial to the glenoid and a horizontal incision opposite the midpart of the glenoid (fig 1a). The capsular-labral complex was mobilised. The scapular neck was then trimmed anteriorly over a distance of about 1.5 cm, and 2-3 anchors were placed on the glenoid margin directly at the bone/cartilage boundary (Mitek GII or Panaloc). The caudal capsular flap was shifted cranially and medially (fig 1b) and the cranial flap caudally and medially (fig 1c). Both flaps were secured in place with the suture anchor threads. The capsule was thus duplicated in the region of the labrum and served as neo-labrum if the remains of the labrum had to be resected or were no longer present. The sutures were tensioned with the arm in 40° of abduction and 10° of external rotation. The subscapularis tendon was reinserted at its anatomical position.

Postsurgical treatment

Postoperatively, the arm was immobilised for three weeks in a Gilchrist fixation bandage. During this period external rotation was avoided and isometric passive mobilisation was allowed as far as pain permitted. Active movements assisted or not, were commenced the fourth

Fig. 1. — Medial capsular shift : medial-based T-shaped incision 0.5 cm medial to the glenoid rim and shift of the inferior capsule to medial and superior, and of the superior capsule to medial and inferior.

postoperative week and forward flexion and abduction up to 90° as well as external rotation to the 0° position were allowed. From the seventh postoperative week, forward flexion and abduction without limitations and external rotation up to 45° were allowed. Sporting activities were permitted from the sixth postoperative month at the earliest.

Follow-up evaluation

The Rowe score was developed especially to evaluate shoulder instabilities. It comprises elements for evaluation of shoulder instability (50%), everyday functions (30%) and passive mobility (20%) (*30,31,32*). The Constant score is the most widespread general shoulder score. It does not comprise any special criteria with regard to stability (*5,6,7,22*). Strength was measured at the wrist in 90° abduction in the scapular plane.

The passive mobility was determined using a protractor, with fixation of the shoulder blade. We measured abduction/adduction, anteflexion/retroflexion and external rotation/internal rotation with 0° abduction and 90° abduction of the arm. The active mobility was determined for abduction and forward flexion without fixation of the shoulder blade.

Stability was tested using several maneuvres : the apprehension test, the Jobe and Moynes relocation test, the Hawkins anterior and posterior load and shift test, the Gagey hyperabduction test and the sulcus sign. Furthermore, the patients were asked their subjective appraisal.

Recurrent dislocations, a persisting instability and also general intraoperative and postoperative problems were registered as specific complications.

Statistical methods

For descriptive purposes, we report mean values and standard deviations for the scores and motion values, and percent values with respect to nominal data. Differences between preoperative and postoperative values are analysed using sign tests at an *alpha*-level of $p \leq .05$. Abduction, flexion, and rotation values were compared for the different groups of diagnosis by non-parametric testing (Mann-Whitney *U* test). The same was done for the various surgical methods used.

RESULTS

We noted at follow-up a marked improvement in both scores : the average Rowe score was 80.6 and the average Constant score 89.8 points (table III), a functional gain of 47.4 and 8.3 points respectively.

Passive mobility at follow-up did not show any appreciable loss in comparison to the preoperative values (tables IV & V, column 1). We even found an improvement for adduction, forward flexion and external rotation of the abducted arm (tables IV & V, column 1). However, when the postoperative ROM was compared with the healthy side, a loss was found in all planes of mobility (apart from adduction) (table V, column 2). This loss was already present before the operation, as shown in table V, column 3.

Active movement showed a marked improvement in all planes. After the operation, abduction and forward flexion attained the values of the healthy side.

Table III. — Results at time of follow-up : Functional improvement in Rowe and Constant score (points ; SD = standard deviation)

Results at time of follow-up					
Scores	Preop.		Postop.		p value
	Mean value	SD	Mean value	SD	
Rowe	33.2	11,7	80.6	21,5	$p \leq 0.001$
Constant	81.5	19,4	89.8	18,5	$p \leq 0.004$

Table IV. — Preop./postoperative gain in mobility and by comparison to the non-operated side

Functional gain in passive ROM			
	Side of recurrent dislocation		Healthy side
	Preoperative	At follow-up	
Abduction°	90	91	98
Adduction°	29	42	42
Fwd flexion°	149	168	175
Retroflexion°	32	33	37
ER° (0° Abd.)	53	55	72
IR° (0° Abd.)	76	79	85
ER° (90° Abd.)	73	84	91
IR° (90° Abd.)	51	53	64

Subjectively, 92% of all patients rated the operation positively (very satisfied or satisfied).

Postoperative absence from work averaged 12.4 weeks (table I). Absence from work was not clearly related to the level of recovered function and range of motion. All patients returned to their preoperative professional occupation.

Four patients suffered temporary paraesthesias in the arm.

Five patients complained of subjective shoulder instability, and three of them presented documented episodes of dislocations. If we exclude the patients with a history of previous shoulder operations and those who had suffered a new significant trauma, we had only one redislocation (1.6%) which occurred following a trivial trauma (table VI). Patients presenting a postoperative dislocation tended to be under 30 years of age, although the influence of age was not statistically significant. The number of preoperative dislocations was also larger in this group.

DISCUSSION

More than ten modifications of the Bankart repair combined with a ventral capsular reconstruction are known. The direction of the capsular incision determines the capsular reefing effect : a vertical incision parallel to the glenoid reduces the capsular volume in the medial/lateral direction, whereas a horizontal incision reduces its volume in the superior/inferior direction (*12,25*).

Our surgical technique consists of a reconstruction of the labrum in combination with a T incision of the capsule with the vertical base medially close to the glenoid (fig 1). With this technique the capsular volume is reduced concentrically (*1,20,25,36*). Following a cadaver study, Gohlke and Jansen favoured the T incision and capsular reefing with a medial vertical leg, since this achieved symmetrical reduction in volume without significant displacement of the head (*12*). The joint capsule is shifted in the direction of the course of the medial gleno-

Table V. — Relations in ROM

Passive Range of Motion – comparison of preoperative, postoperative and contralateral range –			
	1) Comparison preop. / FU	2) Comparison FU / non-op. side	3) Comparison preop. / non-op. side
Abduction	↔ $p \leq 0.405$	↓ $p \leq 0.007$	↓ $p \leq 0.002$
Adduction	↑ $p \leq 0.001$	↔ $p \leq 0.070$	↓ $p \leq 0.001$
Fwd flexion	↑ $p \leq 0.001$	↓ $p \leq 0.013$	↓ $p \leq 0.001$
Retroflexion	↑ $p \leq 0.031$	↓ $p \leq 0.012$	↓ $p \leq 0.001$
ER in 0° Abd.	↔ $p \leq 0.450$	↓ $p \leq 0.001$	↓ $p \leq 0.001$
ER in 90° Abd.	↑ $p \leq 0.012$	↓ $p \leq 0.001$	↓ $p \leq 0.001$
IR in 0° Abd.	↔ $p \leq 0.868$	↓ $p \leq 0.001$	↓ $p \leq 0.001$
IR in 90 ° Abd.	↔ $p \leq 0.324$	↓ $p \leq 0.001$	↓ $p \leq 0.001$

Column 1) preoperative mobility / mobility at follow-up ;
Column 2) postoperative mobility / non-operated contralateral side at follow-up ;
Column 3) preoperative mobility / non-operated contralateral side preoperatively.
Symbols : ↔ = identical values, ↓ = decreased values, ↑ = increased values ; FU = follow-up ; Abd. = Abduction, ER = external rotation ; IR = internal rotation.

humeral ligament. Also, the blood supply to the ventral capsule is less compromised by this type of incision (*2*). This anatomic procedure should entail less restriction of mobility than found using other procedures. However, a greater reduction in external rotation was found in cadaver experiments after capsular repair with a glenoid-based than with a lateral based T (humeral-based) T capsular shift (*8*).

We did not observe an appreciable reduction in ROM when comparing preoperative and postoperative values (table V, column 1). A significant improvement was even noted in some planes of movement. External rotation was nearly at the same level as preoperatively. However, in relation to the healthy side, a deficit was present both preoperatively and at the time of follow-up. The preoperative loss of ROM compared with the healthy contralateral side, persists after the operation (table V, columns 2 and 3). In our opinion, the restriction of movement observed after the operation is thus not attributable to the surgery but to the pathology itself.

Is the improvement in relation to preoperative range due to absence of apprehension or fear of a new dislocation ? This would be conceivable if only active mobility was involved, but the passive range of motion showed a similar tendency.

It is difficult to compare our results with the often incomplete data in the literature. In most instances, only single movement directions are specified, there is only a comparison with the non-operated contralateral side or no normal values at all are used for appraisal. Neither is the preoperative mobility often specified. Furthermore, in many cases, mobility is reported without any distinction between post-traumatic and atraumatic recurrent dislocations. Jolles *et al* reported results from 22 patients operated

Table VI. — Analysis of postoperative recurrent instabilities

Analysis of postoperative recurrent instability	
Total number of recurrences	3 (4.8%)
Recurrence after serious trauma without previous operation	1 (1.6%)
Recurrence after trivial trauma (previous stabilising surgery)	1 (1.6%)
Recurrence after trivial trauma (no previous shoulder surgery)	1 (1.6%)
Positive apprehension test	1 (1.6%)
Subjective sensation of instability	1 (1.6%)

with the same technique as that applied in our patients. They found a restriction in abduction and flexion of 1° and of external rotation (in 90° abduction) of only 7° compared to the contralateral side (*20*). However, they did not make any comparison with the preoperative ROM. Kartus *et al* and Fabbriciani *et al* report a diminished mobility after open stabilisation as compared to arthroscopic repair (*9,21*). On the other hand, Tjoumakaris *et al* did not find any difference in the postoperative mobility after arthroscopic or open stabilisation (*35*). O'Neill made a detailed comparison of mobility in all movement planes. After arthroscopic stabilisation, he reported poorer results than those found in our study (*27*). In various studies, a restriction of external rotation is specifically described (*10,29*).

The large number of preoperative dislocations (on average, 6.4) and the high percentage of previous operations (24.2%) in our group are unfavourable for the outcome. Previous operations were a criterion for exclusion in almost all studies. A small number (less than 10%) were found in a few papers only (*32,33*). Inclusion of these patients in the evaluation did not really influence our results.

We were unable to achieve the average Rowe scores reported in literature due to the unfavourable starting conditions of our study cohort (low initial score, high rate of preoperative dislocations, previous operations, concomitant injuries, and finally the high attendance of our final follow-up). Nevertheless, the 47.4 points increase is highly significant.

The Constant score showed a significant increase from 81 to 89 points, a finding comparable to various reports in the literature (*20,21*). However, the Constant score is rather inadequate as a general evaluation score for shoulder dislocations since it does not register specific instability criteria. As expected, the functional gain (the difference between preoperative and postoperative value) is less than that obtained with the stability-specific Rowe score.

Concerning the rate of recurrence, only one patient suffered a re-dislocation in our study group, if we apply the same criteria used in other studies and exclude patients with prior repairs. This corresponds to a rate of 1.6% in relation to the total group and is comparable with the general data in the literature (2.1% in relation to the 47 patients without previous surgery). This is also confirmed by the observation of Jolles *et al*, who did not find any recurrences in 23 patients following the same procedure (*20*).

CONCLUSION

The open medial-based T capsular shift provided significant improvement in function and stability illustrated by the Rowe and Constant scores obtained. The procedure had few complications and showed a recurrence rate of only 1.6% after primary operations.

The restriction of postoperative mobility that has been attributed to the surgical technique appeared in this study to be a consequence of the underlying pathology rather than of the procedure. The range of motion was already diminished preoperatively, and did not further deteriorate after the operation. We therefore believe that the procedure remains a suitable surgical approach.

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