The effectiveness of arthroscopic stabilisation for failed open shoulder instability surgery

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We identified ten patients who underwent arthroscopic revision of anterior shoulder stabilisation between 1999 and 2005. Their results were compared with 15 patients, matched for age and gender, who had a primary arthroscopic stabilisation during the same period.

At a mean follow-up of 37 and 36 months, respectively, the scores for pain and shoulder function improved significantly between the pre-operative and follow-up visits in both groups (p = 0.002), with no significant difference between them (p = 0.4). The UCLA and Rowe shoulder scores improved significantly (p = 0.004 and p = 0.002, respectively), with no statistically significant differences between groups (p = 0.6). Kaplan-Meier analysis for time to recurrent instability showed no differences between the groups (p = 0.2).

These results suggest that arthroscopic revision anterior shoulder stabilisation is as reliable as primary arthroscopic stabilisation for patients who have had previous open surgery for recurrent anterior instability.

Operations for open stabilisation of the shoulder are reliable, time tested, and can yield excellent results.1-5 Advancements in arthroscopic techniques over the past two decades have led to a growing trend towards arthroscopic treatment of anterior instability, with recent studies demonstrating the outcomes to be comparable to those of open surgery.6-9 However, there is little information on arthroscopic stabilisation as a revision procedure following failure of a primary open repair. Rowe10 first described a series of 39 patients undergoing open stabilisation for recurrent anterior instability of the shoulder after a previous open stabilisation. More than 80% had a good result. Zabinski et al11 evaluated 43 patients who had undergone one or more revision procedures, after failure of a previous open repair. Of 23 shoulders with unidirectional instability, 15 (65%) had good or excellent results.

Meehan and Petersen12 studied 25 patients with failed open or arthroscopic reconstruction who underwent open revision. A satisfactory outcome was reported in 84%.

Open stabilisation may be difficult after previous operations at the same site. The tissue planes, particularly between the subscapularis and the anterior capsule of the shoulder, may be difficult to identify and the anatomy may be distorted. The potential advantages of arthroscopic repair include the relative ease with which the glenoid labrum can be repaired without disrupting the subscapularis and the anterior shoulder capsule, a shorter operating time, and improved cosmesis.

The aim of this study was to evaluate the outcomes of arthroscopic stabilisation in patients who had previous open surgery for recurrent anterior instability, and to compare those results with the results of primary arthroscopic stabilisation in patients with unidirectional anterior instability. We hypothesised that revision arthroscopic stabilisation in patients with a failed primary open procedure would produce similar outcomes to those undergoing primary arthroscopic stabilisation.

Patients and Methods

We identified 13 patients with a mean age of 31 years (21 to 56) who, between 1999 and 2005, had undergone arthroscopic revision of a shoulder stabilisation by the senior author (GACM) after failure of a previous open reconstruction for anterior glenohumeral instability. Of these patients, 11 had unidirectional anterior instability; ten were available for analysis of their outcome at a mean follow-up of 37 months (12 to 89). We identified a further 72 patients who underwent primary arthroscopic stabilisation for recurrent anterior instability by the senior author during the...
same period. Of these, 15 matched for age and gender were chosen for comparison at a mean follow-up of 36 months (13 to 62). Matching was governed by the age at operation, gender, method of fixation, surgical technique, and the method of anaesthesia. Patients with superior labral anteroposterior lesions only, those with multidirectional instability, posterior instability, full-thickness rotator cuff tears and previous surgery to the shoulder were excluded. The initial glenohumeral subluxation/dislocation was due to trauma in all the patients in both primary and revision groups.

Radiographs were obtained for all patients before operation, including anteroposterior, axillary and supraspinatus outlet views. Loss of glenoid bone was quantified at the time of arthroscopy as previously described by Burkhart et al.13 Surgical technique. Both primary and revision arthroscopic stabilisation were carried out using the Suretac Bioabsorbable device (Aucufex Microsurgical, Mansfield, Massachusetts) and/or the Mitek Bioknotless anchors (Mitek Surgical Products, Norwood, Massachusetts) in accordance with the technique described by Warner and Warren,14 and Speer et al.15 From March 2003 the surgeon (GACM) changed from using tacks to using anchors, accounting for the use of two different fixation devices. The procedure was performed with the patient in the beach-chair position under regional anaesthesia. After evaluation under anaesthesia, three arthroscopic portals were established, one posterior and two anterior. Any labral lesion, including a Bankart lesion, was identified during general arthroscopic inspection. The osseous anterior rim of the glenoid was abraded from superior to inferior to create a bleeding surface. The capsulolabral complex was mobilised to evaluate the possibility of reattachment. The Suretac or Bioknotless device was then inserted into holes drilled at the bottom of the rim, usually at the 2 o’clock, 4 o’clock, and 5 o’clock positions, and the capsulolabral complex was compressed against the anterior rim of the glenoid. Outcome measures. Data concerning shoulder instability, patient satisfaction, clinical examination, the operative technique, including the performance of a Bankart repair, capsular shift, and the use of different anchor systems, were obtained in a prospective fashion for each patient.

The period of follow-up in the arthroscopic revision group was defined as the interval from the first revision stabilisation to the time of current follow-up, and in the primary group from the time of initial stabilisation to the most recent follow-up. The functional outcome at review was determined by direct interview and physical examination. Standardised patient-determined and examiner-determined outcomes were obtained prospectively before operation, six months afterwards, and at the most recent follow-up. These included patient-determined pain scores, a stiffness score and an overall function score, as previously described by Hayes et al.19 To facilitate comparison with previous reports, the Rowe1 and University of California, Los Angeles (UCLA) shoulder scoring systems20 were used.

Clinical testing was performed by an independent observer, an orthopaedic or sports medicine fellow, and included assessment of the stability of the glenohumeral joint on the basis of the apprehension and relocation tests. The anterior apprehension test was performed with the patient in the supine position. The shoulder was ab ducted to 95° and rotated externally until the point of apprehension.21 The test was positive when apprehension was noted or was volunteered by the patient. Load and shift tests were also carried out on all patients to evaluate the magnitude and direction of glenohumeral translation.22 The sulcus sign was graded,21 based on the distance between the inferior margin of the lateral aspect of the acromion and the humeral head. A distance < 1 cm was rated 1+, of 1 cm to 2 cm as 2+, and > 2 cm as 3+. The range of movement of the shoulder was measured by visual assessment and included forward flexion, abduction, external and internal rotation.18 The muscle strength of the shoulder in four planes was measured using an HFG-45 Hand Held Force Gauge (Transducer Techniques, Temecula, California).18 Work activity was rated on four levels: 1 for no activity, 2 for light, 3 for moderate, and 4 for heavy activity. Sports activity was also rated on four levels: 1 for no sports, 2 for hobby sports, 3 for club sports and 4 for national sports. Redislocation was defined as the shoulder ‘coming out of the joint’ and requiring reduction by either the patient or by a medical practitioner. Resubluxation was defined as an episode in which the patient felt that the humeral head translated partially out of the joint and spontaneously ‘relocated’.

Statistics. Results are reported as mean values and standard error of the mean (SEM). Comparisons between groups were made with two-way paired Student’s t-tests, Mann-Whitney U tests and Kruskal-Wallis one-way analysis of variance on ranks using Sigma Stat, Version 3.1 (Systat Software Inc., Richmond, California). For all statistical tests, statistical significance was set at an α error of 0.05 and a β error of 0.2.

Results

Primary arthroscopic group. The primary stabilisation group consisted of 15 men with a mean age of 36 years (15 to 57) undergoing arthroscopic stabilisation of the shoulder for recurrent anterior instability. The mean time from the initial traumatic dislocation to primary stabilisation was 13 months (3 to 29). The number of episodes of instability prior to operation was 2.7 (2 to 8). In 12 of the 15 patients the dominant arm was affected.

At operation 13 Bankart lesions and two Bankart lesions with a concomitant superior labral anteroposterior lesion were seen. Three patients had evidence of a small Hill-Sachs lesion, and two showed mild degenerative changes on the surface of the glenoid. Only one patient had a bony Bankart lesion of < 10% of the inferior surface of the glenoid. The shoulders were stabilised by three Suretacs in six patients and three Mitek Bioknotless anchors in nine.
There was a significant improvement in the mean pain score at a mean follow-up of 36 months (13 to 62) (t-test, p = 0.003), in patient-perceived shoulder stiffness at 36 months (Mann-Whitney, p = 0.02), and in the mean shoulder function at six and 36 months (t-test, p = 0.002), compared with the pre-operative levels (Table I). The mean time from the operation to return to full-time work was 3.6 months (SEM 1.9) and that from operation to sports activity was 4.0 months (SEM 1.8).

The strength improved significantly in all planes between the pre-operative examination and the final follow-up (t-test, p < 0.01). The range of movement improved in all planes (t-test, p < 0.05) with the exception of internal rotation (t-test, p = 0.5). No positive apprehension sign was found in any patient after the operation.

The UCLA (Fig. 1) and Rowe scores improved significantly between pre-operative evaluation and follow-up at six (Kruskal-Wallis one-way ANOVA, p < 0.01 and p = 0.02, respectively) and 36 months (Kruskal-Wallis one-way ANOVA, p < 0.004 and p = 0.002, respectively). The overall clinical result of surgery was graded according to Rowe as excellent in nine patients, good in four, fair in one and poor in one.

Regression analysis revealed that the method of repair of the Bankart lesion, whether by tacks or by anchors, had no significant effect (p = 0.6) on clinical outcome.

Revision arthroscopic group. The revision stabilisation group consisted of ten men with a mean age of 35 years (23 to 55). The mean time from the initial traumatic dislocation until the first stabilisation was 30 months (22 to 58). The mean interval between the initial operation and the recurrence of instability was 97 months (28 to 240). The mean time from open stabilisation to the revision arthroscopic procedure was 121 months (18 to 264). In seven of the 10 cases the dominant arm was affected.

At operation nine Bankart lesions and one Bankart with a concomitant superior labral anteroposterior lesion were noted. Five patients showed evidence of an old Hill-Sachs lesion. Four had mild degenerative changes on the surface.

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**Table I. Outcome scores and clinical data in patient groups. Data displayed are mean (SEM)**

<table>
<thead>
<tr>
<th></th>
<th>Primary stabilisation</th>
<th>Revision stabilisation</th>
<th>Primary vs revision stabilisation (p-value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-operative</td>
<td>Follow-up</td>
<td>Pre-operative</td>
</tr>
<tr>
<td>Pain (max 12)</td>
<td>7.1 (0.5)</td>
<td>1.4 (0.3)</td>
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<tr>
<td>Stiffness (max 5)</td>
<td>1.3 (0.3)</td>
<td>0.9 (0.2)</td>
<td>&lt; 0.05</td>
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<tr>
<td>Shoulder overall (max 5)</td>
<td>2.9 (0.3)</td>
<td>4.6 (0.3)</td>
<td>&lt; 0.01</td>
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</table>

Range of movement (°)

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forward flexion</td>
<td>158 (3)</td>
<td>176 (5)</td>
<td>0.008</td>
<td>165 (5)</td>
<td>176 (2)</td>
<td>0.18</td>
<td>0.3</td>
<td>0.8</td>
<td></td>
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<tr>
<td>Abduction</td>
<td>140 (3)</td>
<td>178 (2)</td>
<td>0.004</td>
<td>143 (2)</td>
<td>174 (3)</td>
<td>0.10</td>
<td>1.0</td>
<td>0.2</td>
<td></td>
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<tr>
<td>External rotation</td>
<td>60 (5)</td>
<td>77 (4)</td>
<td>0.02</td>
<td>50 (4)</td>
<td>82 (4)</td>
<td>&lt; 0.01</td>
<td>0.06</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td>Internal rotation</td>
<td>T9</td>
<td>T11</td>
<td>0.5</td>
<td>T11</td>
<td>T10</td>
<td>0.6</td>
<td>0.2</td>
<td>0.5</td>
<td></td>
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</table>

Strength (N)

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal rotation</td>
<td>60 (3)</td>
<td>91 (4)</td>
<td>&lt; 0.01</td>
<td>88 (4)</td>
<td>96 (4)</td>
<td>0.54</td>
<td>0.2</td>
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<tr>
<td>External rotation</td>
<td>62 (3)</td>
<td>89 (4)</td>
<td>&lt; 0.01</td>
<td>70 (2)</td>
<td>95 (2)</td>
<td>&lt; 0.05</td>
<td>0.4</td>
<td>0.6</td>
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<tr>
<td>Supraspinatus</td>
<td>60 (5)</td>
<td>89 (3)</td>
<td>&lt; 0.01</td>
<td>69 (3)</td>
<td>92 (3)</td>
<td>0.38</td>
<td>0.5</td>
<td>0.4</td>
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<tr>
<td>Adduction</td>
<td>72 (4)</td>
<td>111 (4)</td>
<td>&lt; 0.01</td>
<td>105 (6)</td>
<td>134 (4)</td>
<td>&lt; 0.01</td>
<td>0.06</td>
<td>&lt; 0.05</td>
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</table>

Rowe score max 100)

<table>
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<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 (3)</td>
<td>96 (1)</td>
<td>&lt; 0.01</td>
<td>37 (2)</td>
<td>93 (1)</td>
<td>&lt; 0.01</td>
<td>0.2</td>
<td>0.5</td>
<td></td>
<td></td>
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</tbody>
</table>

UCLA score max 35)

<table>
<thead>
<tr>
<th></th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
<th>Pre-operative</th>
<th>Follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 (1)</td>
<td>32 (1)</td>
<td>&lt; 0.01</td>
<td>16 (2)</td>
<td>31 (2)</td>
<td>&lt; 0.01</td>
<td>0.06</td>
<td>0.5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Comparison between primary and revision arthroscopic stabilisation for University of California, Los Angeles (UCLA) shoulder score. Data is displayed as the mean (SEM). Statistically significant differences are shown with an asterisk (* = p < 0.05, ** = p < 0.01 using Students t-test for comparison).

**Fig. 1**

Comparison between primary and revision arthroscopic stabilisation for University of California, Los Angeles (UCLA) shoulder score. Data is displayed as the mean (SEM). Statistically significant differences are shown with an asterisk (* = p < 0.05, ** = p < 0.01 using Students t-test for comparison).
of the glenoid, and one had severe degenerative changes on both the humeral and glenoid aspects. No patient showed loss of bone from the inferior glenoid.

The shoulders were stabilised by three Suretacs in five patients and by four Mitek Bioknotless anchors in five patients. At a mean follow-up of 37 months (12 to 89), there were significant improvements in the pain scores ($t$-test, $p = 0.003$) but the patient perception of shoulder stiffness showed no significant difference between before operation and at follow-up (Mann-Whitney, $p = 0.1$). There were improvements in shoulder function by six and 37 months ($t$-test, $p = 0.008$) (Table I). The mean time from the operation to return to full-time work was 3.8 months (SEM 2.1), and to return to sports activity was 4.3 months (SEM 2.0).

There was a significant increase ($t$-test, $p = 0.005$) in the power of adduction from before the operation (105 SEM 6) and at 37 months (134 SEM 4). No other differences were identified in strength testing before and after operation.

The mean range of external rotation increased significantly from 50° to 82° ($t$-test, $p = 0.008$). Forward flexion, abduction and internal rotation all improved, but not to a level of statistical significance (Table I). A positive apprehension sign was present in only one patient at the final follow-up. Anterior load and shift was graded as 0 in eight patients and as 1+ in one. None of the patients had a sulcus sign.

The UCLA and Rowe scores improved significantly (Mann-Whitney, $p = 0.4$) in the time to return to work and sports. The patient-determined results were also similar for both work and sports (Table II).

At the final follow-up there were no significant differences between the groups in terms of shoulder pain, overall function, range of movement, strength in internal rotation, external rotation and of the supraspinatus, and the UCLA and Rowe shoulder scores. However, patient-determined shoulder stiffness was significantly less ($t$-test, $p = 0.02$) in the revision group at follow-up, compared with the primary group, and the mean strength of adduction was significantly greater ($p < 0.05$) in the revision group (mean 134 N SEM 4) compared with the primary group (mean 111 N SEM 4).

**Complications.** The only complication in either group was redislocation. One patient in the primary group who had a Bioknotless anchor fixation suffered a traumatic dislocation eight months later but required no further surgery. He was rated poor on the Rowe scale at the most recent follow-up. Two patients (20%) had a post-operative dislocation involving overhead trauma at eight months and 60 months after arthroscopic revision stabilisation. The first patient previously had an open Bankart procedure and redislocated eight months after arthroscopic treatment. No further surgery was required following a strengthening programme at physiotherapy. He is currently rated fair on the Rowe scoring system and continues to complain of pain with overhead activities. The second patient, who had a primary Putti-Platt open procedure, underwent another arthroscopic revision stabilisation due to the dislocation and is asymptomatic, and rated excellent on the Rowe scoring system, 22 months later.

**Kaplan-Meier analysis for time to recurrent instability** showed no differences in the rate of recurrence of instability between the primary and revision groups (Fig. 2).

**Discussion**

We compared the results of revision arthroscopic stabilisation in a group of patients who had a previous open stabilisation with a cohort undergoing primary arthroscopic stabilisation, all by a single surgeon. Our results in patients undergoing revision arthroscopic stabilisation were consistent with those

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**Table II. Comparison of levels of work and sports activity between groups**

<table>
<thead>
<tr>
<th></th>
<th>Primary stabilisation group</th>
<th>Revision stabilisation group</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work activity (SEM)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre-operative</td>
<td>2.66 (0.55)</td>
<td>2.62 (0.70)</td>
<td>0.56</td>
</tr>
<tr>
<td>Post-operative</td>
<td>2.79 (0.62)</td>
<td>2.77 (0.61)</td>
<td>0.72</td>
</tr>
<tr>
<td><strong>Sports activity (SEM)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-operative</td>
<td>2.17 (0.47)</td>
<td>2.73 (0.53)</td>
<td>0.81</td>
</tr>
<tr>
<td>Pre-operative</td>
<td>2.68 (0.59)</td>
<td>2.65 (0.65)</td>
<td>0.76</td>
</tr>
</tbody>
</table>

* Mann-Whitney test
of previous studies. Good to excellent results without significant functional impairment or loss of movement were found in > 75% of patients after revision surgery.

Revision by open stabilisation following previous failed open and arthroscopic stabilisation has yielded poor results in those with multidirectional instability. Young and Rockwood described 40 shoulders in 39 patients who had continuing symptoms after a failed Bristow procedure; 23 had multidirectional instability. Meehan and Petersen assessed factors affecting the outcome from open revision following failure of open and arthroscopic reconstruction and noted that multidirectional instability was one of the factors that led to a poor outcome.

The results from revision for unidirectional instability are better. Rowe assessed 39 shoulders with recurrent instability after primary open repair for a Bankart lesion; 32 had a revision, of which 24 were followed for two years with an overall success rate of 92%. Hawkins and Hawkins had similar success with open revision in 31 shoulders, and Zabinski et al had similar results. Some authors have suggested that large glenoid deficiencies and large Hill-Sachs defects are better suited to open stabilisation and bony reconstruction rather than a soft-tissue repair. Arthroscopic revision arthroscopic repair. At a mean follow-up of 30 months 13 patients (72%) had satisfactory results. There were five failures, three with recurrent instability and two with ongoing pain. Neri et al reported good to excellent results in eight of 11 patients (73%) with a subluxation or dislocation event occurring in three patients (27%) at a mean of 8.7 months post-operatively. These results suggest comparable outcomes between open and arthroscopic revision surgery. However there has been no direct comparison between the results of arthroscopic stabilisation in primary and revision patients.

Our patients showed similar outcomes whether treated by arthroscopic stabilisation in a primary anterior dislocation or with revision arthroscopic techniques in those who had previous shoulder stabilisation surgery. One of the key outcomes of shoulder stabilisation surgery is the maintenance of post-operative stability. Time to recurrent instability showed no significant differences in the rate of recurrent instability between primary and revision arthroscopic stabilisation. Thus, our results suggest that arthroscopic revision stabilisation is as reliable as primary arthroscopic stabilisation for patients who have had previous open surgery for recurrent anterior instability.

Potential weaknesses of our study are that the statistical analysis was performed in a small patient population, the arthroscopic anchor technique was changed during the study from Suretac to Mitek Bioknotless anchors and that no patients with loss of glenoid bone were evaluated. The strengths of the study were that one surgeon performed all the primary and revision arthroscopic procedures, that we used validated outcome methods, and that we focused on patients undergoing stabilisation for unidirectional anterior instability. The results presented in this paper are consistent with the hypothesis that arthroscopic revision stabilisation surgery is as effective as primary arthroscopic stabilisation for recurrent unidirectional anterior shoulder instability in patients without significant glenoid bone loss.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


