ORIGINAL ARTICLE

Outcomes of two surgical revision techniques for recurrent anterior shoulder instability following selective capsular repair

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KEYWORDS
Shoulder instability; Bankart; Latarjet; Capsuloplasty; Failure

Summary
Introduction: Conventional capsulolabral reconstruction for anterior shoulder instability fails with recurrent instability in up to 23% of cases. Few studies have evaluated surgical revision strategies and outcomes. The objective of this study was to evaluate clinical and radiographic outcomes in a homogeneous series of surgical revisions after selective capsular repair (SCR).
Hypothesis: Observed anatomic lesions can guide the choice between repeat SCR and coracoid transfer (Latarjet procedure).
Materials and methods: From January 2005 to January 2009, 11 patients with trauma-related recurrent anterior shoulder instability (episodes of subluxation and/or dislocation) after SCR were included. Mean age was 31 years (range, 19–45 years). At revision, a glenoid bony defect was present in six patients. Repeat SCR was performed in five patients and coracoid transfer in six patients.
Results: After a mean follow-up of 40 months (range, 24–65 months), no patient had experienced further episodes of instability. However, four patients had a positive apprehension test. External rotation decreased significantly by more than 20° after both techniques. The Simple Shoulder Test, Walch-Duplay, and Rowe scores were 10.5, 79, and 85, respectively. No patient had a subscapularis tear. Of these 11 patients, nine were able to resume their sporting activities and eight reported being satisfied or very satisfied with the subjective outcome. Radiographs showed fibrous non-union of the coracoid transfer in one patient.
Conclusion: In patients with recurrent anterior shoulder instability after SCR, repeat SCR and coracoid transfer produce similarly satisfactory outcomes. The size of the glenoid bone defect may be the best criterion for choosing between these two procedures. However, open revision surgery may decrease the range of motion, most notably in external rotation.

Level of evidence: Level IV.
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Introduction

Open reconstruction of the capsule and labrum in patients with antero-inferior shoulder instability is followed by recurrent instability in 3 to 23% of cases [1–6]. Factors that influence this failure rate may include patient characteristics (age and type and level of sports activities) and the anatomic lesions (bony defects in the glenoid and humerus and quality of the capsule). Open surgery is classically recommended in patients with recurrent instability, although arthroscopic surgery may have the dual advantage of preserving the subscapularis tendon and permitting an accurate intraoperative assessment of the anatomic lesions [7–12]. With both open and arthroscopic techniques, repeat capsulolabral reconstruction seems to produce poorer outcomes compared to primary surgery [10–14].

The objective of this study was to assess midterm outcomes of revision surgery for recurrent instability in a homogeneous series of patients previously managed with selective capsular repair (SCR).

Material and method

Inclusion and exclusion criteria

We conducted a single-centre retrospective study of patients who underwent revision surgery for recurrent anterior shoulder instability after SCR between January 2005 and January 2009. Only patients for whom clinical and radiographic data were available at least 24 months after the revision procedure were included.

We excluded patients with recurrent instability within 6 weeks after primary SCR, shoulder pain without clearly documented instability episodes, or posterior-superior rotator cuff lesions.

All patients gave their written informed consent to the use of data regarding their surgical management for a scientific study.

Demographic data and choice of the revision technique

We included 11 patients, nine men and two women with a mean time from primary SCR to recurrence of 33 months (range, 7–84). The right shoulder, which was the dominant side, was involved in six patients. The recurrence was consistently caused by a trauma, which was moderate in five cases and major in six cases (sustained while playing a contact sport in five patients and during a motor vehicle accident in one patient).

The revision technique was selected based on the preoperative evaluation of bony lesions by computed tomography (CT)-arthrography and standard radiography (anteroposterior view in external, neutral, and internal rotation and lateral view of the glenoid [Bernageau’s view]). A bony defect in the glenoid was the main criterion for performing a coracoid transfer procedure and was present in six patients. Repeat SCR was performed in the remaining five patients.

Table 1 lists the demographic characteristics and preoperative anatomic lesions in the 11 included patients.

Surgical technique

All 11 procedures were performed by the same senior surgeon (MM).

The patient was supine with the head on a pad and the upper body in 20° of flexion. The shoulder was examined under general anaesthesia and interscalenic block to confirm the direction of the instability, passive range of motion, and magnitude of anteroposterior humeral head translation. The deltopectoral approach was re-opened and an L-shaped incision was made in the subscapularis tendon taking care to spare the deep capsular layer and lower muscle fibres [16].

For repeat SCR, the capsule was opened vertically on the humeral side, 5 to 10 mm medial to the lateral subscapularis tendon stump. The arthroscopy incision extended from the rotator cuff interval to the lower edge of the humeral head, parallel to the anatomic neck. The intra-articular lesions were evaluated and appropriate procedures were performed to treat all abnormalities: recurrent labral lesions were re-attached using absorbable anchors (Panalok RC®, De Puy Mitek, Raynham, MA, USA) and the capsule was tightened as described by Neer and Foster [17].

For coracoid transfer, the coracoid process was osteotomised at its base with a continuous 1-cm fragment of the coraco-acromial ligament. The capsule was opened vertically on the glenoid side, along the anterior glenoid rim. The damaged labrum was removed, the neck of the scapula freshened, and the coracoid transplant secured with a single 4.5-mm compression screw laid flat in a subequatorial position. A routine check was performed to ensure that the coracoid transplant did not overhang the glenoid rim. The joint capsule was closed reinforced using the coraco-acromial ligament stump, without inducing retightening [18].

At the end of the procedure, the subscapularis tendon was sutured in the anatomic position using separate stitches and non-absorbable braided sutures.

The postoperative rehabilitation programme was identical after SCR and after coracoid transfer. The elbow was immobilised at the side for 6 weeks to protect the subscapularis tendon re-attachment. Pendulum exercises were started on the first postoperative day. Self-passive mobilisation in the plane of the scapula under supervision by a physical therapist was started at week 2, without external rotation beyond the neutral position. Starting at week 6, range of motion in all planes was recovered gradually. External rotation with the elbow at the side was limited to 60° until week 12, when muscle-strengthening exercises and participation in non-contact sports were started. Contact sports were not allowed until month 5.

Preoperative and postoperative evaluations

Preoperative data were collected from the medical records. At last follow-up, a clinical and radiological evaluation was performed by an independent observer. Passive and active ranges of motion were assessed including forward elevation, external rotation with the elbow at the side (ER1) and with the arm abducted at 90° (ER2), and internal rotation evaluated as the highest vertebral level reached with the tip of the thumb.

Table 1  Demographic details and anatomic lesions.

<table>
<thead>
<tr>
<th>Patient #</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<td>30</td>
<td>39</td>
<td>20</td>
<td>45</td>
<td>29</td>
<td>34</td>
<td>33</td>
</tr>
<tr>
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<td>−</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>+</td>
<td>+</td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td>Sports category according to Duplay [15]</td>
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<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>2</td>
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</tr>
<tr>
<td>Level of competition</td>
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<td>+</td>
<td>+</td>
<td>−</td>
<td>0</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>0</td>
<td>−</td>
<td>+</td>
</tr>
<tr>
<td>Bony lesions</td>
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<td>HS</td>
<td>HS</td>
<td>HS</td>
<td>HS</td>
<td>HS and glenoid</td>
<td>HS and glenoid</td>
<td>HS and glenoid</td>
<td>HS and glenoid</td>
<td>HS and glenoid</td>
<td>HS and glenoid</td>
</tr>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>44</td>
<td>20</td>
<td>39</td>
<td>45</td>
<td>42</td>
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<td>+</td>
<td>+</td>
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<td>+</td>
<td>+</td>
<td>+</td>
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<td>+</td>
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<tr>
<td>Hyperlaxity</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Revision technique</td>
<td>SCR</td>
<td>SCR</td>
<td>SCR</td>
<td>SCR</td>
<td>SCR</td>
<td>Coracoid transfer</td>
<td>Coracoid transfer</td>
<td>Coracoid transfer</td>
<td>Coracoid transfer</td>
<td>Coracoid transfer</td>
<td>Coracoid transfer</td>
</tr>
</tbody>
</table>

ER1: external rotation with the elbow at the side; Disloc.: dislocation; Sublux.: subluxation; HS: Hill-Sachs lesion (Malgaigne).
Table 2  Clinical outcomes at last follow-up.

<table>
<thead>
<tr>
<th>Patient #</th>
<th>1</th>
<th>2</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>3</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>Mean</th>
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</thead>
<tbody>
<tr>
<td>Elevation pre/post (degrees)</td>
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<td>180/180</td>
<td>180/180</td>
<td>180/140</td>
<td>175/170</td>
<td>180/180</td>
<td>180/180</td>
<td>180/170</td>
<td>180/180</td>
<td>180/160</td>
<td>179/172</td>
<td></td>
</tr>
<tr>
<td>ER1 pre/post (degrees)</td>
<td>90/65</td>
<td>60/55</td>
<td>90/60</td>
<td>85/60</td>
<td>65/45</td>
<td>60/40</td>
<td>90/60</td>
<td>85/70</td>
<td>90/50</td>
<td>60/50</td>
<td>70/50</td>
<td>76/55*</td>
</tr>
<tr>
<td>ER2 pre/post (degrees)</td>
<td>100/80</td>
<td>90/75</td>
<td>100/80</td>
<td>85/75</td>
<td>95/60</td>
<td>90/80</td>
<td>110/90</td>
<td>90/80</td>
<td>120/60</td>
<td>90/80</td>
<td>90/75</td>
<td>97/76*</td>
</tr>
<tr>
<td>Duplay (points)</td>
<td>70</td>
<td>100</td>
<td>100</td>
<td>90</td>
<td>60</td>
<td>90</td>
<td>55</td>
<td>100</td>
<td>40</td>
<td>85</td>
<td>80</td>
<td>79</td>
</tr>
<tr>
<td>Rowe (points)</td>
<td>73</td>
<td>95</td>
<td>95</td>
<td>93</td>
<td>71</td>
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<td>79</td>
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<td>85</td>
<td>50</td>
<td>100</td>
<td>30</td>
<td>100</td>
<td>80</td>
<td>77</td>
</tr>
<tr>
<td>SST (points)</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>9</td>
<td>10</td>
<td>9</td>
<td>12</td>
<td>7</td>
<td>12</td>
<td>12</td>
<td>10.5</td>
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<tr>
<td>Follow-up (months)</td>
<td>31.5</td>
<td>65</td>
<td>43</td>
<td>25</td>
<td>49</td>
<td>31.5</td>
<td>47</td>
<td>50.5</td>
<td>32</td>
<td>38</td>
<td>24</td>
<td>40</td>
</tr>
</tbody>
</table>

Pre: preoperative; Post: postoperative; ER1: external rotation elbow at the side; ER2: external rotation arm abducted; IR: internal rotation; *P < 0.05.
The subscapularis tendon was assessed clinically using the lift-off test and the belly-press test [19]. The apprehension test was performed to evaluate anterior shoulder stability [20].

Objective outcomes were measured using the Simple Shoulder Test (SST), Rowe score, and Duplay score [21,22]. To assess subjective outcomes, a simple rating scale was used (very satisfied, satisfied, disappointed or dissatisfied), as well as the Simple Shoulder Value adapted for sports activities (SSV-sport) [23].

At last follow-up, standard radiographs included antero-posterior views in internal, neutral, and external rotations as well as a Bernageau view. Healing of the coracoid transplant was assessed in patients who had had a coracoid transfer procedure. Glenohumeral osteoarthritis was evaluated according to the Samilson classification system [24].

Statistical analysis

Value distribution was assessed using the Agostino-Pearson test. Mean preoperative and postoperative values were compared using the t-test for paired data and the Mann-Whitney test for unpaired data. The significance level was set at 0.05. Medcalc v.8.0 software (Mariakerke, Belgium) was used to perform the statistical tests.

Results

All included patients were re-evaluated for the study; none was lost to follow-up.

Clinical outcomes

At last follow-up at least 24 months, and on average 40 months (range, 24–65 months), after revision surgery, none of the patients had experienced further episodes of dislocation or subluxation. However, four patients reported apprehension in abduction and external rotation, two after coracoid transfer surgery and two after repeat SCR (patients #1, #6, #7, and #9).

Table 2 reports range of motion values before and after revision surgery. At last follow-up, trends toward motion-range limitation in all planes were noted after both surgical techniques. However, only external rotation with the elbow at the side (ER1) and with the arm abducted at 90° (ER2) showed statistically significant limitations (−21°).

The lift-off and belly-press test results did not suggest a subscapularis tear in any of the patients. Clinically, the resisted internal rotation manoeuvre showed a decrease in muscle strength compared to the healthy side in two patients [25].

Mean values of the SST, Duplay score, and Rowe score were 10.5 (range, 7–12), 79 (range, 40–100), and 85 (range, 58–100), respectively.

Resumption of previous sports activities at the same level was achieved by 9 (80%) patients and the mean SSV-sport value was 77% (range, 30–100). Subjectively, the outcome was considered very satisfactory or satisfactory by eight patients; the disappointment reported by the remaining three patients was chiefly ascribable to persistent apprehension (patients #1, #7, and #9).

Figure 1  A. Preoperative Bernageau view (arrow: bony defect in the anterior glenoid rim). B. Radiograph at last follow-up after coracoid transfer.

Radiographic outcomes

The coracoid transfer healed fully in 5 of 6 patients. The remaining patient (#11) had fibrous non-union of the bone block. All bone blocks were properly positioned, i.e., flush with the glenoid rim on Bernageau’s view and under the equator on the anteroposterior view. In none of the patients did the standard radiographs show any evidence of screw breakage or bone block lysis (Fig. 1A and B).

At last follow-up, Samilson grade 1 glenohumeral osteoarthritis was noted in 1 patient, who had been managed with repeat SCR. No radiographic joint-space changes were visible in any of the other 10 patients.

Discussion

The outcomes documented in this study validate the surgical choices made in our patients. However, the goal of restoring stability was only partially achieved, because four of 11 patients had a positive apprehension test and, more importantly, because increased stability was obtained only at the cost of decreased glenohumeral range of motion.

The management of recurrent shoulder instability after surgical therapy is still a complex issue [7]. Some patients may respond to conservative therapy consisting in strengthening the muscles and adjusting the balance between internal and external rotation. However, surgery is mandatory in patients who have major functional impairments [26–28]. After failure of capsulolabral reconstruction, revision surgery requires a highly detailed preoperative evaluation of the lesions to avoid repeating potential mistakes in selecting the best procedure [26,27,29].

In a study of open revision surgery, Cho et al. [12] found recurrent antero-inferior labral detachment in 88% of cases and extension of this lesion in only 11% of cases. Tauber et al. [29] reported capsule distension in 22% of cases and inferior glenohumeral ligament detachment from the humerus in 5% of cases. Importantly, glenoid bony defects were noted in 30 to 60% of cases and a Hill-Sachs lesion in over 90% of cases [26,27,29,30]. Fritsch et al. [30] described fractures of the anterior glenoid rim weakened by the anchors used initially to re-attach the labrum. The lesions found in our patients were consistent with earlier reports: nearly all the patients (10/11) had recurrence of the Bankart lesion and six had bony defects in the glenoid rim.

Although the preoperative imaging work-up is a valuable tool, standard radiography has a number of limitations [31]. A method recently devised by Sugaya et al. based on 3D-reconstructed CT without arthrography provides estimates of glenoid bony defect size that are fairly close to intraoperative findings [32]. However, in our study, patients underwent CT-arthrography. Advantages of CT-arthrography performed before revision surgery are the detection of concomitant subscapularis tendon lesions (a potential complication of previous surgery), recurrent Bankart lesion, and capsule distension or tears [27]. The method described by Gerber and Nyffeler ensures a reproducible evaluation of the glenoid bony defect [15].

After failed capsulolabral reconstruction, the presence of a glenoid bony defect suggests a need for coracoid transfer surgery [7,27,29]. The coracoid transfer procedure described by Latarjet increases glenohumeral stability via three mechanisms; the lower part of the subscapularis muscle acts as a sling when it is pressed against the humeral head by the conjoined tendon during abduction and external rotation of the arm, the transferred coracoid process acts as a bone block, and suturing of the coraco-acromial ligament strengthens the joint capsule [18]. The use of an iliac-crest graft to fill the glenoid bony defect has been suggested. Donor-site morbidity is the main disadvantage of this technique. However, Tauber et al. [29] found no instances of failure among 19 patients managed with iliac-crest grafts.

In patients without bony defects in the glenoid rim, another treatment option consists in repeated capsulolabral reconstruction. The presence of an isolated Hill-Sachs lesion does not necessarily contra-indicate repeat SCR [16]. In our study, five patients with Hill-Sachs lesions were successfully managed with repeat SCR. However, the engaging nature of Hill-Sachs lesions as assessed in abduction and external rotation seems of crucial importance [33] but could not be evaluated in our study of patients managed with open surgery. An original procedure that was described recently, known as remplissage, combines antero-inferior capsulolabral reconstruction with posterior capsulotenodesis to fill the Hill-Sachs lesion [34]. In a prospective series of arthroscopic Hill-Sachs remplissage in 42 patients including nine undergoing revision for recurrent anterior instability, no recurrences were recorded and all patients were able to return to their previous level of sports activities [35].

A critical point in revision surgery for anterior shoulder instability is the quality of the subscapularis tendon and muscle incised during the primary procedure. Sachs et al. [36] found an incompetent subscapularis in 23% of patients with a 27% decrease in internal rotation strength compared to the healthy side. After primary SCR, a significant decrease in strength in the lift-off position was noted in 40% of cases in an earlier study [1]. In our series, none of the patients had objective evidence of subscapularis tendon damage before or during revision surgery or at last follow-up. Therefore, it is always technically possible to lift the tendon off the capsule for repeat SCR, provided faultless technique is used. In contrast, two patients reported decreased internal rotation strength compared to the healthy side.

Table 3 lists the main case-series studies of surgical revision after initial capsulolabral reconstruction or bone block surgery performed arthroscopically or by an open approach. Rowe et al. [28] reported the first evaluation of outcomes in shoulder instability after revision surgery by open labral re-attachment and capsuloplasty: after a mean follow-up of 4 years, only 8% of patients had persistent shoulder instability. Zabinski et al. [40] found poorer outcomes in patients with multidirectional instability. Furthermore, Levine et al. [14] reported a 44% failure rate in patients with multiple prior stabilisation procedures and noted that attraumatic and voluntary recurrences carried a poor prognosis. Cheug et al. [38], in contrast, found no instances of complete dislocation among 12 patients re-evaluated more than 12 years after repeat SCR, although three patients experienced subluxation. Outcomes after revision surgery involving coracoid transfer were evaluated in a single study, by Schmid et al. [39]. The recurrence rate was only 4%, although 14% of patients had a positive apprehension. In our series, the absence of recurrent instability is encouraging but the high

Revision after selective capsular repair

Table 3 Main published case-series studies of surgical revision for recurrent anterior shoulder instability.

<table>
<thead>
<tr>
<th>Study</th>
<th>Number of patients</th>
<th>Mean FU (mo.)</th>
<th>Primary technique</th>
<th>Revision technique</th>
<th>Recurrent dislocation/subluxation (%)</th>
<th>Osteoarthritis at last FU (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cho et al. [12]</td>
<td>26</td>
<td>42</td>
<td>Bankart@</td>
<td>Bankart O</td>
<td>11.5</td>
<td>NR</td>
</tr>
<tr>
<td>Rowe et al. [28]</td>
<td>24</td>
<td>48</td>
<td>Bankart O Putti Platt Other</td>
<td>Bankart O</td>
<td>8</td>
<td>NR</td>
</tr>
<tr>
<td>Meehan et al. [37]</td>
<td>25</td>
<td>60</td>
<td>Bankart@ Bankart O SCR SCR</td>
<td>Bankart@ SCR</td>
<td>16</td>
<td>28</td>
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<tr>
<td>Taubert et al. [29]</td>
<td>41</td>
<td>49</td>
<td>Bankart@ Bankart O Coracoid transfer</td>
<td>Bankart O SCR Bone block</td>
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<td>54</td>
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<tr>
<td>Levine et al. [14]</td>
<td>50</td>
<td>56</td>
<td>Bankart@ Bankart O</td>
<td>Bankart O SCR Bone block</td>
<td>17</td>
<td>0</td>
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<tr>
<td>Cheung et al. [38]</td>
<td>12</td>
<td>264</td>
<td>NR</td>
<td>SCR</td>
<td>25</td>
<td>NR</td>
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<tr>
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<td>38</td>
<td>Bankart@ SCR</td>
<td>Bone block</td>
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<td>27</td>
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<tr>
<td>Zabinski et al. [40]</td>
<td>43</td>
<td>&gt; 60</td>
<td>Bankart O RCS Coracoid transfer</td>
<td>Bankart O RCS Bone block</td>
<td>37</td>
<td>32</td>
</tr>
<tr>
<td>Arce et al. [41]</td>
<td>16</td>
<td>31</td>
<td>Bankart@ Bankart O</td>
<td>Bankart@</td>
<td>19</td>
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</tr>
<tr>
<td>Bartl et al. [8]</td>
<td>56</td>
<td>37</td>
<td>Bankart@ Bankart O</td>
<td>Bankart@</td>
<td>11</td>
<td>NR</td>
</tr>
<tr>
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<td>Bankart@ Bankart O</td>
<td>Bankart@</td>
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<tr>
<td>Castagna et al. [42]</td>
<td>17</td>
<td>60</td>
<td>Coracoid transfer</td>
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<td>16.7</td>
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</tr>
<tr>
<td>Boileau et al. [9]</td>
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<td>43</td>
<td>Bankart O SCR Coracoid transfer</td>
<td>Bankart@</td>
<td>5</td>
<td>15%</td>
</tr>
</tbody>
</table>

FU: follow-up; mo., months; Bankart@: arthroscopic Bankart repair; Bankart O: open Bankart repair; SCR: selective capsular repair; NR: not reported.

The rate of persistent apprehension (4/11) indicates incomplete restoration of glenohumeral stability.

After revision surgery by open Bankart repair, Cho et al. [12] found that external rotation with the elbow at the side was decreased by only 10° compared to the healthy side. In our study, the decrease exceeded 20° after both surgical techniques. This limitation was greater than after primary surgery [1–6,43,44]. One possible explanation is subscapularis tendon fibrosis after the repeat tenotomy. Furthermore, prolonged joint protection against external rotation may result in motion range limitation, despite appropriate adjustment of the rehabilitation programme.

Arthroscopic surgery results in less involvement of the subscapularis tendon. Published case-series studies in selected patients showed that arthroscopic revision surgery with labrum re-attachment produced promising results with recurrence rates ranging from 5% to 19% [8,9,11,41,42]; arthroscopy also allows the repair of glenoid bony defects if needed [45,46]. No studies comparing conventional to arthroscopic surgery have been published to date.

Our study exhibits the limitations inherent in the retrospective design with a small number of patients and no strict comparison of outcomes between the two surgical techniques. The choice of the technique in our patients was guided by the presence of glenoid bony defects visible on the preoperative imaging studies. However, all our patients underwent the same primary stabilisation technique (SCR) and none was lost to follow-up.

Conclusion

In patients with recurrent instability after SCR, either repeat SCR or coracoid transfer can be considered. Both techniques provide satisfactory midterm outcomes. The existence of bony defects and their location (glenoid and/or humerus) may guide the choice between these two techniques. However, outcomes after revision surgery seem less favourable than after primary surgery in terms of motion-range recovery, most notably in external rotation.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

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