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Original article

Previous arthroscopic Bankart repair is an independent risk factor for an inferior outcome after Latarjet procedure

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ABSTRACT

Background: There is limited evidence that the Latarjet procedure has a worse outcome as a revision operation, after a failed stabilization surgery, compared with when it is the primary procedure for posttraumatic anteroinferior instability of the shoulder joint.
Purpose: To compare the results from Latarjet as a primary operation vs. revision surgery after a failed arthroscopic Bankart repair for posttraumatic anteroinferior shoulder instability. In addition, to assess the effect of preoperative bony pathology on outcome.
Patients and methods: Ninety-nine patients who underwent the Latarjet procedure (47 primary, 52 revision after failed Bankart repair) were analyzed after an average of 3.8 (SD 2.3, range 1–11) years of follow-up. All patients underwent either computed tomography or magnetic resonance imaging preoperatively. Glenoid and humeral bone defects were measured to assess whether the Hill-Sachs lesion was on- or off-track. Clinical outcome measures included the Western Ontario Shoulder Instability Index (WOSI), subjective shoulder value (SSV), and recurrence of instability (dislocation, subluxation, or any perception of instability).
Results: There were no cases of recurrent dislocation in either group. Four patients in the primary surgery group and 13 in the revision group had at least one subluxation or perception of instability after the Latarjet procedure. Patients with a previous arthroscopic Bankart repair had worse outcomes than those undergoing primary Latarjet when assessed by the WOSI: 76 (SD 22) vs. 85 (SD 15), difference in means −9 (95% CI −17 to −1, $p = 0.02$); SSV: 80 (SD 18) vs. 88 (SD 13), difference in means −8 (95% CI −15 to −2, $p = 0.01$); and the recurrence percentage (25% vs. 9%, $p = 0.03$). A multivariate linear regression model adjusted for the length of follow-up, glenoid bone defect size, Hill-Sachs lesion size, and the frequency of preoperative bipolar bone defects (on/off track Hill-Sachs lesions) further increased the difference in WOSI to −12 (95% CI −21 to −4, $p = 0.005$).
Discussion: A previous failed arthroscopic Bankart repair was a significant independent risk factor for inferior outcome. Preoperative bony pathology did not explain the worse outcome from the revision vs. primary Latarjet procedure.
Level of evidence: IV, cohort observational study.

1. Introduction

Patients who undergo the Latarjet procedure as a revision surgery after a failed previous stabilization of anteroinferior shoulder joint instability usually have a satisfactory outcome [1–3]. However, some studies have suggested that previous surgery is a risk factor for a worse outcome after the Latarjet procedure when compared with primary stabilization with a Latarjet operation [4,5]. Most studies reporting results from the Latarjet revision surgery have included a mixed population with multiple previous open or arthroscopic surgeries, or the type of previous surgery has not been described in detail [2–6]. The sling effect of the conjoined tendon and lower subscapularis is an important stabilizing mechanism of the Latarjet procedure [7]. Thus, a patient with a previous arthroscopic Bankart repair, which preserves the subscapularis tendon integrity, may be a good candidate for a revision Latarjet operation. Limited evidence, however, suggests that the results of Latarjet revision procedure after a failed arthroscopic Bankart repair may

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still be worse than after a primary Latarjet, with the recurrence rate of instability up to 14% compared with 1.4 to 8.5% after primary surgery [1,8–10].

Although bone defects and the glenoid track concept have received much attention in association with Bankart repairs, relatively little is known about the role of bipolar bone defects with the Latarjet procedure [4,11–17]. The Latarjet operation can usually sufficiently restore the glenoid arc and arthroscopic coracoid transfer can restore off-track Hill-Sachs lesions to on-track lesions [15,16]. However, Mook et al. suggested that an off-track Hill-Sachs lesion may persist after coracoid transfer and this could explain the subjective perception of instability after the Latarjet procedure [14]. They also suggested that this could be predicted preoperatively by measuring coracoid size [14]. More severe bony pathology after failed arthroscopic Bankart repair and a persistent off-track Hill-Sachs lesion could be explanations for the worse clinical results and subjective feelings of instability after Latarjet revision surgery.

The purpose of this study was to compare the results from the Latarjet procedure as a primary operation vs. a revision procedure, after a failed arthroscopic Bankart repair, for anteroinferior posttraumatic shoulder joint instability.

2. Methods

2.1. Patients

The study plan was approved by the hospital administration (Blinded Hospital 243/2017). A search of the electronic patient records database identified 122 patients who had a Latarjet operation for posttraumatic recurrent anteroinferior instability (recurrent dislocation or subluxation) of the shoulder joint between 2008 and 2016 at our institution. Ten patients with epilepsy and recurrent seizures were excluded. The remaining 112 patients had an open Latarjet procedure either as primary surgery ($n = 55$) or revision surgery ($n = 57$) after a failed arthroscopic Bankart repair. Demographic and clinical data were retrospectively collected from patient records and from radiographs. All patients were contacted by postal mail after an average of 3.8 (SD 2.3, range 1–11) years of follow-up. Thirteen patients could not be contacted or were unwilling to participate in the study, leaving 99 patients (47 primary, 52 revision) for the final analysis (Table 1).

2.2. Methods

2.2.1. Surgical technique

The indication for the Latarjet procedure in primary cases was usually participation in contact or collision sports, or a glenoid or humeral bony defect that was considered a contraindication for Bankart repair. Most patients had a combination of these risk factors. After a failed arthroscopic Bankart repair, all cases regardless of the bony pathology were categorically revised with a Latarjet procedure. The revision cases included patients from our hospital's cachment area as well as cases referred for revision surgery from other hospitals. All patients had positive anterior apprehension signs during the clinical examination. Clinical findings and imaging studies confirmed the diagnosis of anteroinferior posttraumatic instability of the shoulder joint. A standard surgical technique slightly modified from that of Edwards and Walch [18] was used in all cases; the coracoid was fixed on the glenoid neck with two 4.5 mm cannulated screws, without routinely closing the capsule. Postoperative treatment included 3 weeks of immobilization using a sling, followed by gradual range-of-motion exercises and strengthening. Unlimited activities were usually allowed 3–4 months after surgery.

2.3. Methods of assessment

2.3.1. Radiologic measurements

Preoperative imaging included computed tomography (CT) with 2- and 3-dimensional reconstructions in 68 patients and magnetic resonance imaging (MRI) in 31 patients. For CT imaging, the resolution was 0.45 × 0.45 mm and spacing was 0.5 mm. The MR sequences applied were axial T1 weighted and Proton Density, and sagittal T1 weighted and T2 weighted sequences. The slice thickness for both orientations was 3.0 mm with a 0.3 to 0.6 mm gap between the slices. An independent radiologist blinded to the clinical data measured glenoid bone defects (defect = d in mm) using the best fit circle (diameter = D in mm) method (PICO) either from 3-dimensional CT reconstructions or oblique sagittal MR images (Fig. 1) [19–21]. The proportional glenoid defect was expressed as a percentage (d/D × 100%). The width of the glenoid track was calculated using the formula 0.83xD–d [12,17]. The Hill-Sachs interval (HSI), which is the distance from the infraspinatus insertion to medial border of the Hill-Sachs defect, was measured from axial MR images and estimated from axial CT scans (Fig. 1) [11,19–21]. If the HSI was greater than the glenoid track, the Hill-Sachs lesion was defined as off-track [14]. The maximal width of the waist of the coracoid process was measured from axial slices, as proposed by Mook et al. [14]. This measure was added to the preoperative glenoid track to estimate the postoperative glenoid track and assess whether Hill-Sachs-lesions would be on- or off-track after the Latarjet procedure [14]. All measurements were accurate to 1 mm.

2.3.2. Clinical outcome measures

The primary outcome measure was the Western Ontario Shoulder Instability Index (WOSI) [22]. The secondary outcome measures included the subjective shoulder value (SSV) as well the recurrence of instability, which was defined as the presence of re-dislocation, subluxation, or any subjective perception of instability [23]. The WOSI score and SSV were expressed as percentages (0 to 100%), with 100% indicating a normal shoulder. Questionnaires including WOSI and SSV, with inquiries about new injuries, recurrence of dislocation, subluxations or instability symptoms and possible new operations, were delivered to the patients by postal mail. Those patients who did not respond were contacted by telephone and the same forms were completed during an interview.

Table 1
Patient demographics by group.

	Primary surgery $n = 47$	Revision surgery $n = 52$	p
Age at surgery, mean, years (range)	32 (SD 14)	33 (8)	0.70
Follow-up, mean, years (range)	2.9 (SD 1.4)	4.6 (SD 2.6)	< 0.01
Sex, *n*, male/female	36/11	42/10	0.60
Number of previous arthroscopic Bankart repairs			
0	47		
1		44	
2		7	
3		1	

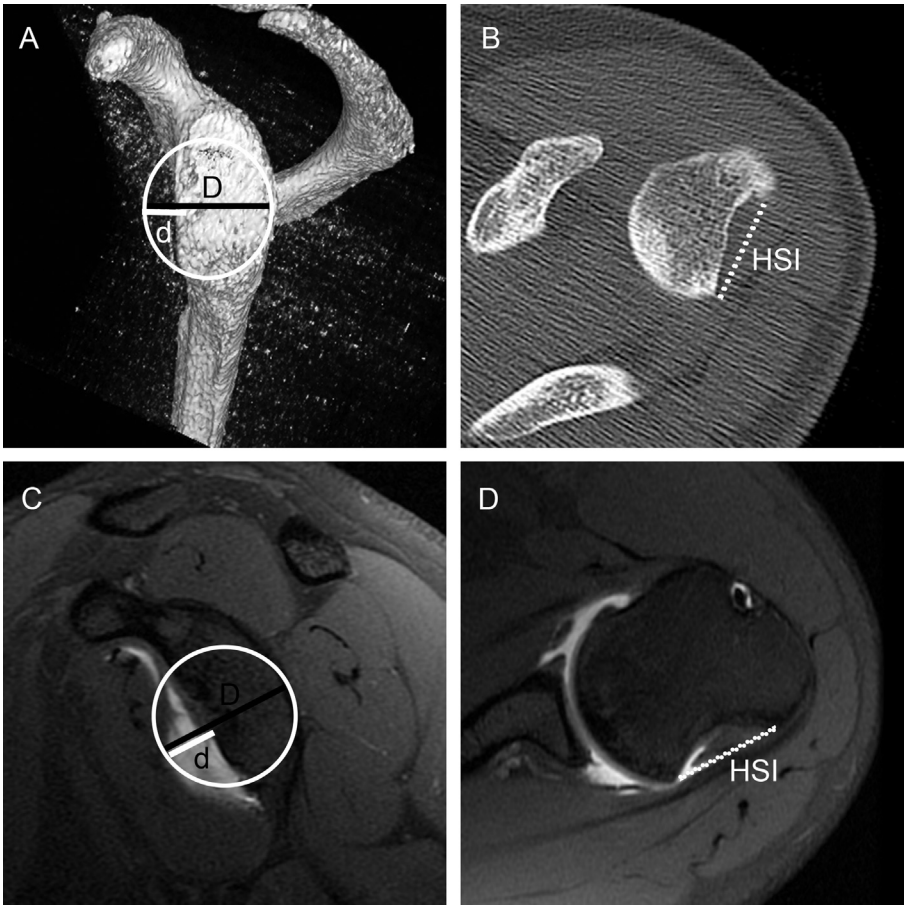

Fig. 1. Radiological measurements for bony glenoid defects and Hill-Sachs defects. Glenoid defects were assessed using the best fit circle method applying the circle diameter from 3D CT reconstructions (A) and from oblique sagittal T2-weighted MR sequences (C). Similarly, Hill-Sachs defects were evaluated from axial CT scans (B) and from oblique axial T2-weighted MR sequences (D). The width of the glenoid track= 0.83xD–d. The Hill-Sachs interval (HSI) = the distance from the infraspinatus insertion to medial border of the Hill-Sachs defect. Off-track= HSI > glenoid track, on-track = HSI < glenoid track.

Table 2
The effect of the number of previous arthroscopic Bankart stabilizations on the Western Ontario Shoulder Instability Index (WOSI), subjective shoulder value (SSV), and recurrence.

Number of previous arthroscopic Bankart repairs	0 (n = 47)	1 (n = 44)	≥ 2 (n = 8)	p
WOSI, mean	85 (SD 15)	79 (SD 20)	60 (SD 28)	0.02
SSV, mean	88 (SD 13)	82 (SD 17)	68 (SD 18)	0.01
Recurrence, n (%)	4 (9%)	10 (23%)	3 (38%)	0.04

2.4. Statistical analysis

Summary data are presented as the mean and standard deviation (SD) unless otherwise stated. Continuous data were analyzed with Student's t-tests and analysis of variance (ANOVA) with 95% confidence intervals (CI). Categorical data were analyzed using chi-square or Fischer exact tests. A multivariable adjusted linear regression model was created to assess the impact of previous arthroscopic Bankart repair on our primary endpoint (WOSI score). The length of follow-up, glenoid bone defect, HSI, and frequency of preoperative bipolar bone defects (on/off track Hill-Sachs lesions) were the adjusting variables. A value of $p < 0.05$ was considered significant.

3. Results

There were no cases of recurrent dislocation in either group. Four (9%) patients in the primary surgery group and 13 (25%) in the revision surgery group had experienced at least one subluxation or perception of instability during follow-up ($p = 0.03$). Patients with a previous arthroscopic Bankart repair had worse outcomes than those undergoing primary Latarjet when assessed by the WOSI: 76 (SD 22) vs. 85 (SD 15), difference in means − 9 (95% CI − 17 to − 1, $p = 0.02$) and SSV: 80 (SD 18) vs. 88 (SD 13), difference in means − 8 (95% CI − 15 to − 2, $p = 0.01$). As the number of previous arthroscopic Bankart operations increased, all outcome measures indicated a worsening result (Table 2). The patients who had a previous failed arthroscopic Bankart repair had significantly longer follow-up, more glenoid erosion, a significantly larger HSI, and more off-track Hill-Sachs lesions compared with primary cases (Table 3). The coracoid dimension or predicted postoperative on/off–track Hill-Sachs lesions did not differ between the groups (Table 3).

According to the multivariate regression model, the patients who had a previous failed arthroscopic Bankart repair scored − 12 points (95% CI − 21 to − 4, $p = 0.005$) lower on the WOSI than patients undergoing a primary Latarjet operation when adjusted by the length of follow-up, glenoid bone defect, HSI, and frequency of preoperative bipolar bone defects (on/off track Hill-Sachs lesions).

Table 3
Preoperative radiological measurements.

	Primary Surgery $n = 47$	Revision Surgery $n = 52$	p
Glenoid defect %	21 (SD 8)	24 (SD 9)	0.04
Width of Hill–Sachs interval, mean, mm	13 (SD 9)	17 (SD 9)	0.04
On-track/off-track Hill–Sachs lesions	33/14	25/27	0.03
Coracoid thickness, mean, mm	11 (SD 1.9)	12 (SD 1.6)	0.30
Estimated postoperative on-track/off-track Hill–Sachs lesions	46/1	49/3	0.36

3.1. Complications and reoperations

No major complications (nerve injuries, postoperative infections) were noted in either group. One patient in the revision group underwent arthroscopy and labral debridement due to pain at 18 months after the Latarjet procedure. No patient had further surgery due to instability.

4. Discussion

Patients undergoing a revision Latarjet procedure after a failed arthroscopic Bankart repair had worse outcomes than those undergoing a primary Latarjet procedure for posttraumatic anteroinferior shoulder instability. Preoperative glenoid, humeral, or bipolar bony pathologies and predicted postoperative on/off track Hill–Sachs lesions failed to explain this difference in outcome between the groups. The number of previous stabilizations was the only variable that explained the worse results from the revision Latarjet operation.

Yang et al. reported on a cohort of 52 patients (34 underwent revision surgery after failed previous stabilization and 18 underwent primary surgery) who had been treated with modified Latarjet procedures [4]. They identified previous surgery and hyperlaxity measured with the Beighton score as risk factors for inferior outcome after the Latarjet procedure. Privitera et al. studied 109 patients and found that previous stabilization was associated with a lower rate of returning to sports [24]. Neither of these studies described the type or number of previous stabilization surgeries in detail. In contrast, Rannaletta et al. found that the Latarjet procedure was equally efficient in revision and primary cases in rugby players with recurrent anteroinferior instability [25]. Rossi et al. recently compared Latarjet procedure as primary ($n = 46$) and revision surgery ($n = 54$) and they found, on the contrary to our results, equally good results in both groups [6]. Previous surgery in these studies included both open and arthroscopic Bankart repairs. Yang et al. and Privitera et al. used WOSI score whereas Rannaletta et al. and Rossi et al. used the Rowe score as primary outcome measure which is probably not as sensitive as WOSI for instability symptoms [4,6,24,25].

Mook et al. suggested that persistent off-track Hill-Sachs lesions could explain the perception of instability after the Latarjet procedure, and they recommended adding arthroscopic remplissage to the open Latarjet operation [14]. Our data suggest that the estimated postoperative glenoid track concept does not predict postoperative results, as suggested by Mook et al. [14]. Additionally, the postoperative course is probably affected by the resorption or remodeling of the coracoid graft. Kee et al. showed that the coracoid graft will remodel and the end result will be analogous to the original glenoid [26]. Bony defects are unlikely to be the main reason for perception of instability after the Latarjet operation. Using functional MRI, Haller et al. and Shitara et al. showed that shoulder joint apprehension includes reorganization of neural networks in the brain [27,28]. Therefore, the perception of instability might also be caused by memory and not only by mechanical or functional problems with the shoulder joint. Haller et al. also suggest that this complex mechanism of shoulder apprehension might explain unsatisfactory surgical stabilization results [27].

The strengths of our study include a large number of patients and almost equal numbers of patients in each group. All revision cases underwent only arthroscopic Bankart repair as the primary stabilization, no open surgery. The outcome measures were valid and the adjusted difference in WOSI exceeded the minimally clinically important difference of this scoring system [22]. The weaknesses of our study include using both CT and MRI as preoperative imaging and that patients did not undergo clinical examination or postoperative imaging at follow-up. Lack of preoperative scoring is also a weakness and it is possible that the groups were different in terms of WOSI and SSV at baseline. Therefore, we do not know whether the Latarjet procedure improves WOSI scores equally in both groups. We did not record sports and activities at baseline but most of our patient were recreational athletes and it is unlikely that an imbalance here could explain the difference. Although the interobserver reliability of measuring glenoid bone defects is good, the reliability of the HSI measurement is controversial and, therefore, can compromise the on/off-track concept [20,29,30]. Future studies should assess hyperlaxity, postoperative CT-imaging, and preoperative scoring in a matched pair design to confirm our results.

5. Conclusions

It is important that the first stabilization surgery for posttraumatic anteroinferior instability of the shoulder joint is successful. The patients should be informed that primary Latarjet is probably their best option and that a failed previous arthroscopic Bankart may be a risk factor for inferior outcome after the Latarjet procedure.

Disclosure of interest

Tapio Flinkkilä, Rony Knape, Mika Nevalainen, Kai Sirniö, Pasi Ohtonen, and Juhana Leppilahti have no competing interest.

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Author contributions

Tapio Flinkkilä: Design of the study, surgery and patient care, data analysis, manuscript preparation.

Rony Knape: Data collection.

Mika Nevalainen: Radiographic analysis.

Kai Sirniö: Surgery and patient care, critical review of the manuscript.

Pasi Ohtonen: Statistical advice.

Juhana Leppilahti: Critical review of the manuscript.

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