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ORIGINAL PAPER

Long-term results of arthroscopic Bankart repairs for anterior instability of the shoulder in patients aged thirty years or older

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Abstract

Introduction Bankart repair is a popular treatment for anterior shoulder instability. However, long-term failure rates of arthroscopic Bankart repair remain higher than Latarjet procedures. The purpose of this study was to report long-term results of arthroscopic Bankart repair in patients greater than 30 years old and analyze risk factors of failure following arthroscopic Bankart repair that are independent of younger age.

Materials and methods Between January 1999 and December 2003, 41 patients aged 30 years or older treated with arthroscopic Bankart repair for anterior shoulder instability were evaluated. Outcome measures included pain (VAS), range of motion, post-operative Walch-Duplay, WOSII scores, complications, failure rate, and risk factors of failure. Failure was defined as recurrent dislocation or subluxation.

Results At a mean 12-year follow-up (range; 10–15 years), the failure rate of arthroscopic Bankart repair in patients aged 30 years and older was 37%. The mean post-operative Walch-Duplay score was significantly higher in patients who had no recurrence compared to those who had had recurrence of instability (100 versus 90, p=0.02). An ISIS score≥3 (p=0.02), a glenoid bone lesion (p=0.06), and a Hill-Sachs lesion>15% defect (p=0.001) were risk factors for recurrent instability. When considering a modified ISIS score that accounted for bony defects on the glenoid and humeral side, patients with an ISIS score <3 + no glenoid lesion + Hill-Sachs ≤ 15% had a recurrence rate of 0%.

Conclusion The failure rate of arthroscopic Bankart repairs in patients over 30 was higher than previously reported. Specifically, patients with an ISIS >3 and bony glenoid defects and/or Hill-Sachs lesions > 15% may be at higher risk for recurrent instability following an isolated arthroscopic Bankart repair. Alternative stabilization techniques may need to be considered for this subset of patients.

Keywords Anterior instability · Arthroscopic Bankart repair · ISIS score

Level of Evidence: Level IV, Case Series, Treatment Study

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Introduction

Recurrent anterior shoulder instability is more frequently observed in patients less than 30 years old [1–3]. The two most common surgical interventions include arthroscopic Bankart repair [3] and the Latarjet procedure [4]. However, indications for each procedure remain debated among surgeons. In a surgeon survey study from 2010, 90% of surgeons (except French surgeons) preferred soft tissue Bankart repair for initial treatment of shoulder instability [5, 6]. Advantages of a Bankart repair include the fact that a soft tissue procedure provides easier solutions than failed Latarjet procedure in case of recurrence and revision surgery in case of recurrence and the fact that a Bankart repair is associated with a very low complication rate if we accept recurrences [7]. However, the recurrence rate following arthroscopic Bankart repair has been reported between 0 and 29.6% [8–11] compared to 3–11.6% following Latarjet [10–13]. In 2007, Balg et al. [7] proposed the ISIS score to help the surgeon decide between arthroscopic Bankart repair and Latarjet. Initially, a score greater than 6 was used to recommend a Latarjet. Later work by Phadnis et al. [14] recommended lowering this threshold to 3 based on a recent study showing that if a patient had an ISIS≤3, there was a 4% risk of failure, as compared with a 70% chance of failure if the ISIS was≥ 4. In addition to bone loss, recurrent instability has been shown to be significantly more common in the younger population. Nakagawa et al. identified age as the greatest risk factor for recurrent instability after an arthroscopic Bankart repair, with patients less than 20 demonstrating significantly higher rates of recurrent instability [15]. Long-term results of arthroscopic Bankart repair remain limited [16–18]. Traditionally, these publications have included patients from all age groups limiting the ability to assess risk factors for recurrence independent of age. The purpose of this study was to report long-term results of arthroscopic Bankart repair in patients aged 30 years or older in order to analyze risk factors of failure in an older population with less risk of recurrent instability. We hypothesized that the failure rate of arthroscopic Bankart repairs in patients ≥30 years old would be similar to the rate of recurrent instability reported in the literature after a Latarjet procedure.

Materials and methods

Patients selection

Following IRB approval, a retrospective review of all primary arthroscopic Bankart repairs performed in our institution for recurrent traumatic anterior shoulder instability between January 1999 and December 2003 was performed. Fifty-two patients aged 30 years and older were identified. Patients with a history of volitional instability, those with an associated rotator cuff tear or proximal humerus fracture, and those with less than ten years of follow-up were excluded. All eligible patients were contacted and invited to return for clinical evaluation. Eleven patients were lost to follow- up, leaving 41 patients (31 men, 10 women) (79% of eligible) available for review.

Surgical technique

All procedures were performed by the senior shoulder authors in the lateral position with a double traction system. The labrum was mobilized and affixed to the glenoid face using three or four suture anchors ((3.5 mm PANALOK® (Mitek®, Raynham, MA) or 2.8 mm Biofastak® (Arthrex®, Naples, FL) depending on the size of the tear. Post-operatively, patients were immobilized in a simple sling for four weeks. Active assisted motion was initiated at four weeks, with progression to active range or motion and strengthening at six weeks. Patients were allowed to resume full activities, without restriction at six months.

Clinical evaluation

A chart review was conducted for all preoperative patient history, range of motion, and radiographs. From this information, the ISIS score was calculated [7] (Table 1). Active forward elevation, abduction, and external rotation with the arm

Table 1 Patients' characteristics

Age at the time of surgery	38 (range, 30–72)
Gender	
Male	31 (75%)
Female	10 (25%)
Dominant side	35 (85%)
Mean ISIS score	1.29 (range, 0–6)
Glenoid bone loss (n=27)	
Grade 0	16 (60%)
Grade 1	8 (30%)
Grade 2	2 (7%)
Grade 3	1 (3%)
Hill-Sachs lesion (n=32)	
Mean D/R ratio	0.15 (range, 0–0.34)
D/R ≤ 0.15	17 (53%)
D/R > 0.15	15 (47%)
D/R >0.2	8 (25%)

Grade 0, normal glenoid; grade 1, glenoid abrasion; grade 2, glenoid fracture; grade 3, >20% glenoid bone loss

D depth of the Hill-Sachs lesion on the anteroposterior radiographs in internal rotation, *R* radius of the humeral head on the anteroposterior radiographs in internal rotation

on the side (ER 1) and with the arm abducted (ER 2) were recorded in degrees. Pain was graded using the visual analog scale (VAS). The apprehension test [19] and the relocation test were performed for each patient. Subjective satisfaction was determined by asking the patients to compare the shoulder with before surgery and to assign a rating of better (1), the same (2), or worse (3). Functional results were assessed using the Duplay and Walch score [20] and the Western Ontario Shoulder Instability Index (WOSII) [21, 22]. Post-operative failure was defined as recurrence of dislocation or subluxation.

Radiographic parameters

Pre-operative radiographs for each shoulder were reviewed by three shoulder surgeons. These routinely included an anteroposterior view in internal, neutral, and external rotation and Bernageau view of the shoulder [23]. The Hill-Sachs lesion was assessed by calculating the ratio between the depth of the Hill-Sachs lesion (D) and the humeral head radius (R) following the method described by Hardy et al. [24] (Fig. 1). Pre-operative glenoid bone loss was evaluated on the comparative Bernageau view and graded as follows: grade 0, normal glenoid; grade 1, glenoid abrasion; grade 2, glenoid fracture; and grade 3, >20% glenoid bone loss (Fig. 2). Hill-Sachs lesions were categorized as a small lesion (Hardy ratio < 15%) or an important lesion (Hardy ratio >15%). For a second analysis, the Hill-Sachs lesion was categorized as a small lesion (Hardy ratio < 20%) or an important lesion (Hardy ratio >20%) to determine which cutoff value would be the best.

Risk for failure

After completion of in-person patient evaluation, a univariate analysis was performed to assess for risk factors of recurrent glenohumeral instability. We assessed the influence of age, depth of the Hill-Sachs lesion, glenoid bone loss, ISIS score, and post-operative external rotation.

Statistical analysis

Continuous data is described as mean ± SD (range) or median (25–75% quartile). Categorical data is described as number (percentage). Range of motion was compared using paired parametric tests. Correlations between functional scores and the apprehension test were assessed using Pearson's product moment coefficient. Univariate analysis was used to assess the association of potential risk factors and failure. For univariate analysis, the two continuous variables (age and depth of the Hill-Sachs lesion) were analyzed as binary variables. Pre-operative glenoid bone loss was categorized as follows: no loss, grade 0, and loss, grades 1, 2, and 3. A Student t-test and Mann-Whitney-Wilcoxon test were used for continuous variables and the chi-square test or Fisher exact test for categorical variables. $p<0.05$ was considered statistically significant. Statistical analyses were done using R software (v 10.13/ R Development Core Team (2011)).

Results

Clinical outcome

The mean age at the time of surgery was 38 ± nine years (range, 30–72 years), with an average follow-up of 12 years (range, 10–15 years). The dominant side was affected in 35 patients (85%). Pre-operative characteristics are detailed in Table 1. The mean pre-operative ISIS score was 1.3 (range, 0–6), with six patients having an ISIS score ≥3.

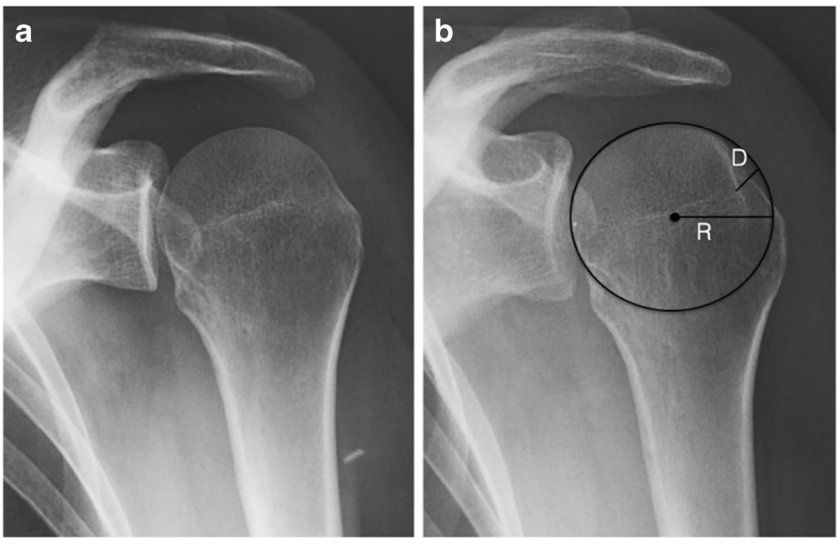

Fig. 1 Assessment of the Hill-Sachs lesion by calculating the ratio between the depth of the Hill-Sachs lesion (D) and the humeral head radius (R). **a** Anteroposterior view in internal rotation of a left shoulder with no Hill-Sachs lesion. **b** Anteroposterior view in internal rotation of a left shoulder with a Hill-Sachs lesion: D/R>0.2

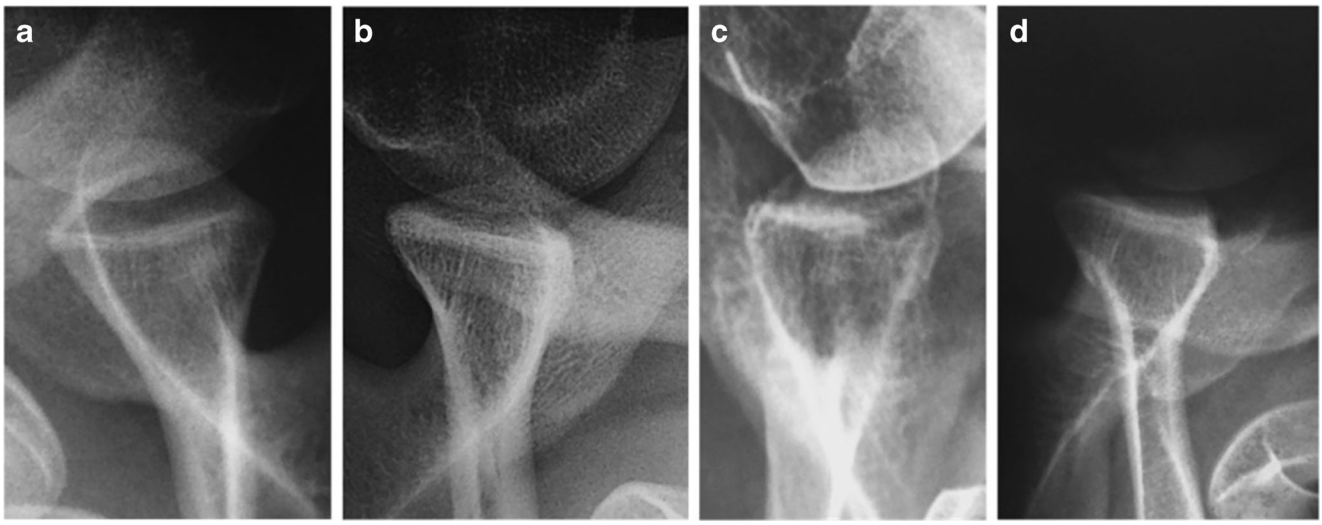

Fig. 2 Pre-operative glenoid bone loss evaluation on comparative Bernageau views: grade 0, normal glenoid (**a**); grade 1, glenoid abrasion (**b**); grade 2, glenoid fracture (**c**); grade 3, >20% glenoid bone loss (**d**)

At a follow-up of 12 years (range, 10–15 years), the overall failure rate was 37% (15/41). Ten patients sustained a recurrent dislocation and five patients sustained recurrent subluxation. Of the ten patients with recurrent dislocation, six had traumatic recurrence (1 during the practice of martial arts, 2 fell from a high place, 1 boat accident, and 2 motor vehicle accidents). Of the five patients with recurrent subluxation, one was traumatic.

Of the ten shoulders with recurrent dislocations, three were treated conservatively. Seven ultimately underwent re-operation: five coracoid bone blocks (Latarjet), one revision arthroscopic Bankart repair, and one revision arthroscopic Bankart repair and remplissage.

Following Bankart repair, the mean abduction, ER 1, and ER 2 of the operated shoulders were significantly less than that of the contralateral shoulders (p=0.03, p=0.001, and p=0002, respectively). Range of motion is detailed in Table 2. At follow-up, the mean VAS score was 0.8 (range, 0–8) with 3 patients (7%) reporting a VAS score >3. Subjectively, 73% of the patients rated their result as much better or better. The mean Duplay and Walch score was 99.7. This was 100 for the 26 patients who did not have any recurrence and 90 for the 15 shoulders (37%) sustaining recurrent instability (p=0.02). The mean WOSII score was 373. Again, the mean WOSII for patients without recurrent instability was 342 (16%) and 437 (21%) for those with recurrent instability (p=0.22).

Radiographic parameters

Pre-operative radiographs were available for 32 patients (78%). The mean D/R ratio of the Hill-Sachs lesion was 15% (range, 0–34%). This ratio was greater than 20% in eight patients (25%), greater than 15% in 15 patients (47%). On the pre-operative comparative Bernageau views, glenoid bone loss was graded: 0 in 19 patients (59%), one in nine patients (28%), two in three patients (10%), and three in one patient (3%).

Prognostic factors

Thirty-two patients with complete clinical and radiographic data were evaluated for risks of recurrent instability. In our series of patients aged 30 and over, age was not found to be a risk factor of failure (p=0.19). Two prognostic factors were found to be associated with failure: ISIS score≥3 (p=0.02) and deep Hill-Sachs lesions (≥ 15%, p=0.001). Eighty-three percent of patients who had a pre-operative ISIS score ≥3 developed recurrent instability versus 26% of the patients with a pre-operative ISIS score < 3. Seventy-four percent of the patients who had a pre-operative Hill-Sachs lesion > 15% developed recurrent instability versus 17% of the patients with a pre-operative Hill-Sachs lesion ≤ 15%. However, when this was adjusted to a Hill-Sachs lesion > 20%, all shoulders

Table 2 Post-operative range of motion

	Operated side	Contralateral side	p
Anterior elevation	173° (70°–180°)	176° (120°–180°)	0.06
Abduction	169° (70°–180°)	176° (120°–180°)	*0.03*
External rotation 1	43° (10°–70°)	50° (10°–80°)	*0.001*
External rotation 2	77° (30°–95)	85° (30°–100°)	*0.002*
Internal rotation	T5 (Buttocks–T4)	T5 (T9–T4)	0.80
Gagey	108° (80°–120°)	101° (80°–120°)	0.26

External rotation 1, external rotation with the arm on the side; external rotation 2, external rotation with the arm abducted

developed recurrent instability. This was significantly greater than the rate of 17% in patients with a Hill-Sachs ≤ 20% (p<0.001).

Patients with a pre-operative glenoid lesion also had a higher risk of post-operative instability (55% versus 19%, p=0.06).

Modified ISIS score

Based on the contribution of humeral and glenoid bone loss, a composite score of failure was created using the ISIS score, the depth of a Hill-Sachs lesion, and the presence of a glenoid lesion on a Bernageau view. The composite score was then analyzed.

Among the 13 patients who had an ISIS score <3 + no glenoid lesion + Hill-Sachs ≤ 20%, there was one (8%) recurrence. Among the ten patients who had an ISIS score <3 + no glenoid lesion + Hill-Sachs ≤ 15%, there was no (0%) recurrence.

Discussion

Surgeons continue to debate the indications for arthroscopic Bankart repair and Latarjet procedures for anterior shoulder instability. Increased patient age is generally considered to be protective against recurrent instability in both the native shoulder and after an arthroscopic Bankart repair. However, in this study, patients ≥30 years of age treated with an isolated arthroscopic Bankart repair demonstrated a higher than expected recurrent instability rate (37%) at a mean follow-up of 12 years.

The higher failure rate documented in this study may be partially explained by the long follow-up, which allows for more time to capture recurrent instability events. Similar long-term follow-up studies remain limited [16–18]. Rather, the majority of studies on arthroscopic Bankart repair are reported at short- or mid-term follow-up with recurrence rates ranging from 0 to 29.6% [8–11]. However, the failure rate reported in our series is comparable to that of series with similar follow-up (35–37.5%) but in younger patients (20.3–31 years old) [17, 25, 26] except for one study in which subluxation was not considered a failure [16]. This is in agreement with a recent study from Zimmerman et al. [10] which showed that more than half of arthroscopic Bankart repair failures (61%) occur later than two years post-operatively and continue to occur progressively thereafter. In this study, the definition of failure was recurrence of dislocation or subluxation regardless of mechanism. This definition was chosen given the purpose of the Bankart operation is to restore long-term stability of the glenohumeral joint. We did not stratify failures by mechanism and still considered traumatic redislocations a failure of the procedure, which likely increased our failure rate. However, our rates remain in line with prior reports.

The higher failure rate observed in this study may also be explained by the fact that at the time of inclusion, patients were not selected as well as they are now as the ISIS score has been published by Balg et al. [7]. In our series, where the ISIS score was retrospectively calculated for 37 patients, 6 had a score ≥ 3. Between the time of this cohort's surgery and study evaluation, a score ≥ three has been advocated as a contraindication for arthroscopic Bankart repair. With this recommendation applied, six patients would have met criteria for a Latarjet procedure. The recurrence rate for these six patients was 83%. This confirms the efficiency of this scoring system to help choose the appropriate procedure. However, the current ISIS score may not be sufficient as 26% of patients with a preoperative ISIS score < 3 in this study sustained recurrent dislocation or subluxation at a mean 12-year follow-up. This is significantly higher than the reported recurrence rate (subluxation and dislocation) of 3% to 6% after a Latarjet procedure at similar follow-up [10, 12].

Our study shows that by adding two extra criteria to the ISIS score, long-term recurrence rates after arthroscopic Bankart repair could be lowered. These criteria are the depth of the Hill-Sachs lesion and the presence of a lesion of the glenoid both assessed on specific views on plain radiographs (standard anteroposterior and Bernageau views). These two criteria are known to be frequently involved in recurrent anterior instability as Kurokawa et al. [27] showed that 86% of the patients with recurrent instability have glenoid lesions, 94% have Hill-Sachs lesions, and 81% have bipolar lesions involving both the glenoid and the humerus. The presence of glenoid lesions and the depth of the Hill-Sachs lesion have both been identified as independent risk factors of recurrence [28, 29] and as a combined risk factor [30]. Therefore, by combining these risk factors to the ISIS score, we were able to calculate a simple composite scoring system to decide pre-operatively which patients should be treated by arthroscopic Bankart repair. Based on this study, a very low rate of recurrence can be expected after arthroscopic Bankart repair in patients with an ISIS score < 3 and with no glenoid lesions on the Bernageau views and with Hill-Sachs lesion < 15% or 20%. A complete pre-operative radiographic evaluation including Bernageau views and measurement of the depth of the Hill-Sachs lesions should be recommended for all patients with recurrent anterior instability in addition to an ISIS Scoring.

This study has multiple limitations. The main limitations of our study include its retrospective design and popularization of newer techniques over time. At the time this surgery was performed, CTs were not routinely performed as part of the pre-operative evaluation, and the pre-operative Bernageau views were not available for all patients, limiting the ability to assess bone loss in a more accurate fashion. Additionally, the concept of the glenoid track, as described by Itoi [31], was not widely known, which may have affected our choice of

procedure in a subset of these patients. It is possible that a portion of these patients may have been better treated with a concurrent remplissage procedure, which may have reduced the long-term recurrent instability rate. Due to the long-term follow-up criteria, there were a high rate of patients lost to follow-up (21%), leading to potential follow-up bias. Patients in this study also are subject to recall bias of their recurrent subluxations, which may have been under-reported. In addition, the study included multiple surgeons with differing techniques which may have affected post-operative range of motion based on the size of capsular advancement which remains subjective during a Bankart repair. Finally, glenoid bone loss and the depth of the Hill-Sachs lesion are criteria that are not completely independent from the ISIS score. However, this study remains important as it shows potential limitations to the ISIS score and suggests alternative radiographic criteria which may improve post-operative outcomes for patients where advanced imaging is not readily available for surgical decision making.

Conclusion

The failure rate of arthroscopic Bankart repairs in patients over 30 was higher than previously reported. Specifically, patients with an ISIS >3 and bony glenoid defects and/or Hill-Sachs lesions > 15% may be at higher risk for recurrent instability following an isolated arthroscopic Bankart repair. Alternative stabilization techniques may need to be considered for this subset of patients.

Author contribution Damien Delgrande : Data curation, investigation, and writing—original draft
Guillaume Lonjon: Formal analysis and methodology
Philippe Hardy: Conceptualization, methodology, and resources
Bradley Schoch: Writing—review and editing and methodology
Jean-David Werthel: Methodology, supervision, and writing—original draft

Availability of data and material Excel spreadsheets are available.

Code availability Not applicable

Declarations

Ethics approval This study was classified as observational (non-interventional) by our local ethics committee statutory and ethical obligations of observational (non-interventional) studies in France: According to the past Huriet law on biomedical research and to the current regulation that went into effect in August 2006 (law n°2004-806), such studies do not require prior submission or approval to/from an IRB, and they do not require written consent. There is a current discrepancy on observational studies between the French legal requirements and the editors' requirements. This observational research on data fulfils current French regulatory and ethical obligations. Each author certifies that his or her institution approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.

Consent to participate Not applicable

Consent for publication Neither the article nor portions of it have been previously published elsewhere; the manuscript is not under consideration for publication in another journal and will not be submitted elsewhere; all authors consent to the publication of the manuscript in *International Orthopaedics*.

Conflict of interest Jean-David Werthel receives royalties for shoulder prosthesis design from FH Orthopedics. Bradley Schoch receives royalties for shoulder prosthesis design from Exactech. The other authors, their immediate families, and any research foundations with which they are affiliated did not receive any financial payments or other benefits from any commercial entity related to the subject of this article.

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