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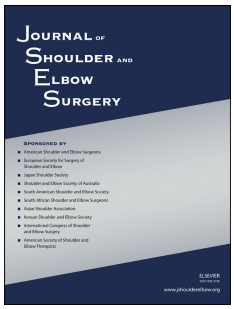

Clinical outcomes and recurrence rate of four procedures for recurrent anterior shoulder instability: ASA, “Remplissage,” Open and Arthroscopic Latarjet. A Multicenter study.

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Clinical outcomes and recurrence rate of four procedures for recurrent anterior shoulder instability: ASA, “Remplissage,” Open and Arthroscopic Latarjet. A Multicenter study.

Short title: Shoulder instability: four surgical procedures compared

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Clinical Outcomes and Recurrence Rate of Four Procedures for Recurrent Anterior Shoulder Instability: ASA, Remplissage, Open and Arthroscopic Latarjet: A Retrospective Multicenter Study

ABSTRACT

The aim of the present study was to compare the clinical outcomes of four surgical techniques in patients with recurrent anterior shoulder dislocation, glenoid bone loss (GBL) < 15% and Instability Severity Index (ISI) score >3.

Methods: A retrospective multicenter study was conducted on 226 patients who underwent one of four different techniques (Bankart plus ASA, Bankart plus Remplissage, Latarjet, Arthro-Latarjet). The inclusion criteria were: recurrent dislocation, GBL<15%, and Instability Severity Index (ISI) score >3. The exclusion criteria were: GBL>15%, voluntary instability, multidirectional instability, preexisting osteoarthritis, throwing athletes first dislocation and ISI score<3. Follow-up ranged from 24 months to 6 years. Hyperlaxity was clinically evaluated according to Neer and Coudane-Walch tests. Clinical outcomes were assessed using the Rowe score and the Western Ontario Shoulder Instability Index (WOSI) for each technique. Before surgery, all patients underwent magnetic resonance imaging and computed tomography scanning. The Pico area method was used to assess the percentage of GBL. The operations were performed by 10 experienced surgeons; the functional outcomes were evaluated by 2 independent observers.

Results: A total of 226 patients who met the inclusion criteria were included in the present series. A total of 89.2% of patients in the ASA group reported an excellent Rowe score at the final follow-up, and their scores on the WOSI scale, improved from 838 to 235 points. A total of 79.9% of patients in Remplissage (R) group reported an excellent Rowe score at the final follow-up, and their scores on the WOSI scale improved from 1146 to 465 points. A total of 98.5% of patients in the Latarjet (L) group reported an excellent Rowe score at the final follow-up, and their scores on the WOSI scale improved from 1456 to 319 points. A total of 81.6% of patients in the Arthro-Latarjet (AL) group reported an excellent Rowe score at the final follow-up, and their scores on

the WOSI scale improved from 1250 to 221 points. The recurrence rates were as follows: ASA group (7%), Remplissage group (6.1%) Latarjet group (1.5%), Arthro-Latarjet group (0%). Patients in the open Latarjet group had 15.5% (10/66) more complications

Conclusion: The use of ASA and Remplissage to augment the Bankart repair have been demonstrated to be effective for restoring joint stability, yielding good clinical outcomes similar to the Latarjet procedure in patients affected by recurrent anterior dislocation with GBL <15% and an ISI score score>3. Soft tissues augmentations of the Bankart repair have been demonstrated to be effective for addressing anterior soft tissue deficiency and dysfunction and critical Hill-Sachs lesions.

Level of evidence: Level III; Retrospective Comparative Study

Keywords: Traumatic shoulder instability; Arthroscopic subscapularis augmentation; glenoid defect; latarjet; "Remplissage"; Hill-Sachs lesion.

The treatment of chronic anterior shoulder instability still remains a challenging topic for orthopedic surgeons since the cause of instability is multifactorial.

Soft tissue damage and dysfunctions, such as the elongation of the coracohumeral ligament and laxity of the upper third of the subscapularis, play an important role in compromising shoulder stability, especially in younger patients who engage in contact sports.

Furthermore, the presence of glenoid and humeral bone loss has been well demonstrated to be an important risk factor for recurrence in patients with chronic shoulder instability.

In recent decades of the twentieth century arthroscopic anatomical capsule-labral repair has been ~~a~~ considered the best surgical option in individuals with chronic anterior instability, although it has also been shown to be associated with, a 20-60% increase in the risk of recurrence in the presence of risk factors[37,27,43,4]. Therefore, for individuals with an (ISI score > 3) the Latarjet procedure is currently recommended [9,28].

More recently, the concept of glenoid or humeral bone defects has evolved into a more dynamic scenario with “on-track” or “off-track” Hill-Sachs lesions [11]. In patients with “off-track” humeral bone defect, the risk of recurrence is even higher, therefore, a simple capsule-labral repair is not indicated. Wolf et al have described the “remplissage” procedure which aims to fill the Hill-Sachs defect with a tenodesis of the infraspinatus converting the intra-articular lesion into extra-articular and recentering the humeral head, by pulling it back [31]. Such tenodesis reduces the risk of recurrence[44,5,26,29].

In contrast, the Remplissage procedure might be less effective ~~in~~ for restoring shoulder stability among patients with concomitant anterior capsular deficiency. More recently, arthroscopic subscapularis augmentation (ASA) combined with Bankart repair (consisting of a tenodesis of the upper third of the subscapularis, has been proposed to treat patients with poor anterior glenohumeral ligaments. The ASA technique has a triple effect: it restores coracohumeral tension addresses the stretched part of the subscapularis tendon and augments capsule-labral insufficiency without causing external rotation restriction [34].

The open or arthroscopic Latarjet [45,3,6] procedure has emerged in the past decade as one of the most successful options to address chronic instability in patients with a high risk of recurrence [1,25] as these procedures are associated with the lowest recurrence rate in the literature: 2.9% for the arthroscopic technique and 5.7% for the open technique. However, this is a nonanatomical procedure with nonnegligible intra- and postoperative complications. The overall complication rates are 23.7% for the arthroscopic technique and 15.3% for the open technique [8].

The aim of the present multicenter study was to compare outcomes, recurrence and complications of four surgical techniques in patients with recurrent anterior dislocation, glenoid bone loss <15% and an ISI score>3.

We hypothesized that outcomes of all patients ~~will~~ would be similar regardless of surgical technique; soft tissue augmentation of the Bankart repair could be effective in restoring shoulder stability in patients with capsule-ligamentous deficiency and critical Hill-Sachs lesions.

METHODS

This was a retrospective case- control study of 226 patients to compare the clinical outcomes of four surgical techniques (Bankart plus, ASA, Bankart plus Remplissage, Arthro-Latarjet and open Latarjet) for the treatment of anterior shoulder instability in a homogeneous cohort of patients. The study was conducted between December 2020 and March 2022 in patients with a minimum follow-up of 24 months and a maximum follow-up of 6 years. Ethical committee approval of the local institution was obtained for our study.

The surgical procedures were performed by 10 different experienced surgeons: ASA (M.M., M.D., C.M.), Remplissage (A.D., F.R., S.C.), arthro-Latarjet (R.C., P.P.), open Latarjet (A.D., F.R., R.L.). Ethical committee approval of the local institution was obtained from our study.

All the ASA and Remplissage procedures were performed in a lateral decubitus position.

According to the original technique that has been described in the literature, the ASA consists ~~a~~ of tenodesis of the upper third of the subscapularis on the glenoid neck.

A tendon fixation bone hole, should be made over the top of the glenoid corner, slightly posterior to the anterior margin of the glenoid surface, to ensure a good bone stock for the anchor fixation. The superior portion of the subscapularis tendon had to be perforated at least 5mm from its upper border, with a penetrator device slightly flush with the articular surface and the tenodesis was performed with a 2.9 Pushlock loaded with multistrand tape (LabralTape; Arthrex, Naples, FL, USA) The tendon should be fixed at the 2-o'clock position on the right shoulder and the 10-o'clock position on the left shoulder, maintaining the arm in neutral rotation. In the Remplissage procedure the infraspinatus tenodesis was performed using a single triple-suture anchor in a parachute configuration. All the ArthroLTG procedures were performed in the beach-chair position. The 7-portal technique was performed as described by Lafosse and a dedicated instrumentation **(**Depuy Mitek,) was used.

A subscapularis split was performed and two 3.5 mm cannulated bicortical screws were used for graft fixation. In the Open Latarjet a subscapularis split 2/3 superior 1/3 inferior was performed and two cannulated screws were used for coracoid fixation in all patients.

Two independent observers conducted preoperative and postoperative ratings of functional outcomes using consistent methods. After surgery, the arm was immobilized in a brace in the adducted position for 4 weeks for all patients. The rehabilitation program was started at the end of the fourth week, including passive and active shoulder exercises, to increase joint mobility and restore complete ROM After 8 to 9 weeks, recovery of strength and proprioceptive abilities were achieved. Return to sports was allowed after 5 months. The inclusion criteria were: recurrent anterior instability; glenoid bone loss (GBL) <15%; and an ISI score >3. The exclusion criteria were: GBL >15%, voluntary instability, multidirectional instability, pre-existing osteoarthritis, throwing athletes and first incident of dislocation, an ISI score<3.

Hyperlaxity was evaluated according to Neer and Coudane-Walch tests[32]. Preoperatively, all patients underwent MRI to assess Hill Sachs lesions and underwent CT scan examinations by using the Pico Area method to assess GBL measurement was used [2]. Age, sex, number of pre- and postoperative dislocations, type of trauma at first dislocation, type of sports, and postoperative external rotation (ER1-ER2) were assessed and compared with contralateral side. The time between the first dislocation and surgery was also assessed (Table 1). Preoperative and postoperative patient evaluations were conducted using the Rowe score and the Western Ontario Shoulder Instability Index (WOSI) for each technique. Demographics and outcomes data were collected and evaluated by two independent observers.

Statistical analysis

Statistical Package for the Social Sciences 22.0 (SPSS; IBM, Armonk, NY, USA) was used for statistical analysis and was conducted by an expert. To assess differences between categorical demographical data and preoperative characteristics. Regarding the four types of surgery, the chi-square test was used. To assess differences between continuous data (described as the mean ± standard deviation (SD), the ANOVA test was used. ANOVA gives a single statistic and one *P* value indicating that we should support or reject the null hypothesis and stating that-groups were different from each other, however ANOVA does not reveal which groups were different.

The significance level was set at a *P* value of < .05. The 95% confidence intervals (95% CI) were calculated using the Poisson distribution for rates of < 5% and the binomial distribution for rates ≥ 5%.

RESULTS

A total of 226 patients who met the inclusion criteria were included in the present series: Fifty-seven in the Bankart plus ASA (ASA) group (25%); 65 in the Bankart plus Remplissage (R) group (28%). 66 in the Latarjet (L) group (29%); and 38 in the arthro-Latarjet (AL) group (17%). There were 197 males and 29 females.

Patients in the AL group had the longest follow-up (FU) duration, of 57.5 months; the FU duration was 45,5 months in the L group; 44.2 months in the ASA group; 25 months in the R group. The difference in mean age at the time of first dislocation was not significant (22-25 years) (Table 1). The number of dislocations was higher in the L group (9.7, range 7-11) and AL group (8.6, range 5-12) than in other groups.

Patients in the ASA group were more involved in competitive (86%, 49/57) and contact sports (68%, 39/57) than those in the other groups. Hill-Sachs lesions were present in almost all cases.

At the final FU, patients in the ASA group had excellent Rowe scores (89.2%), and their scores on the WOSI scale improved from 838 to 235 points. Patients in the R-group patients also had excellent Rowe scores (76,9%), and their scores on the WOSI scale improved from 1146 to 465 points. Patients in the L-group had excellent Rowe scores (98.5%), and their scores on the WOSI scale improved from 1456 to 319-points. Patients in the AL-group had excellent Rowe scores (81.6%), and their scores on the WOSI scale-improved from 1250 to 221 points. (Table 2, Table 3)

The mean loss of external rotation measured with the arm at the side of the trunk (ER1) and with the

arm at 90° of abduction (ER2) was higher in the "remplissage" group 31,% (ER1) and 27.6% (ER2) differences compared with the contralateral side.(Table 4).

The mean preoperative ISI score was higher in the ASA group, 61% of patients scored more than 6 points (Table 5).

Failure of previous surgery was reported among 29% (11/38) of patients in the AL group, which was a higher proportion than that in the other groups. Patients in the open Latarjet group had 15.5% (10/66) more complications. The rate of recurrence was 0% in the arthro-Latarjet group 1.5% in the Latarjet group, 7% in the ASA group, and 6.1% in the remplissage group (Table 6).

Revision surgeries were as follows: one ASA procedure after Latarjet failure; two ASA+Graft and two Latarjet procedures after the four ASA failures; one Latarjet procedure after the four Remplissage failures, two patients underwent physical therapy and one was lost at follow-up.

DISCUSSION

The most important finding of this study is that all the four surgical techniques were effective in reducing symptoms and improving shoulder functional status. Furthermore, Bankart-plus ASA and Bankart plus "Remplissage" procedures drastically reduce the failure rate of simple Bankart repair in patients with GBL less than 15% yielding similar outcomes to the Latarjet procedure in the medium-term follow-up [5,22,34].

The cause of instability is multifactorial, anterior soft tissue damage and dysfunction and critical Hill-Sach lesions play an important role in compromising shoulder stability especially in patients practicing contact sports.

Several studies [40,41] have demonstrated that elongation of the coracohumeral ligament, anterior capsular stretching, poor quality capsular tissue and not only the Bankart lesions may be as responsible for the glenohumeral dislocation. Furthermore, after multiple dislocations, the upper part of the subscapularis tendon is lax [36,10,23,18,39]. The ASA technique, augmenting the Bankart lesion from the front, restores anterior soft tissue disfunction and recenters the humeral head, pushing it posteriorly [34].

Another common condition in patients with chronic shoulder instability that has been shown to be an important risk factor for recurrence is the bone loss, often bipolar.

Hill-Sachs lesions, depending on size, orientation and site, can engage the GBL defect, the so-called off-track lesion [12,20,16]. However if a lesion is on- or off-track, it is inaccurate to calculate with the current glenoid track paradigm. [21, 30,35, 17,33]. Remplissage addresses this pathology from

the back and converts the Hill-Sachs lesion from intra-articular to extra-articular, recenters the humeral head, pulling it back, tightening the posteroinferior capsule [15,19].

Hence, remplissage might cause a minimal limitation of the external rotation, [38] however, this possibility is not functionally relevant. Latarjet acts with a triple effect: the bone block effect, the capsular effect, and the most important anterior hammock effect which is due to the action of the conjoined tendon and inferior band of the subscapularis muscle.

The purpose of this paper was to compare the clinical outcomes of four different techniques commonly used in surgical treatment of chronic shoulder instability.

A total of 226 cases were examined: 57 ASA and 65 Remplissage, 66 Latarjet 38 Arthro-Latarjet. Both pre- and postoperative patient evaluations were conducted using the Rowe score and the Western Ontario Shoulder Instability Index (WOSI) score for each technique employed. Almost all patients reported either good or excellent results. In detail the Rowe scores were excellent for a high proportion of patients in the arthro-Latarjet (83.3%), Latarjet (98.5%), ASA (89.2%), and remplissage (76.9%) groups. Notably, in subjective evaluation both Latarjet and arthro-Latarjet patients reported considerable improvement between pre- and postoperative conditions.

In particular, ligamentous laxity in ASA patients (Table 2) led to increased patient tolerance of articular instability in 19 preoperative cases. WOSI scores revealed highly positive results for all techniques considered**.** As shown in Table 3, WOSI scores reveal that the largest difference between preoperative and postoperative scores was observed in the Latarjet group (1137 points), indicating improvement in shoulder instability apprehension.

Regarding external rotation, Latarjet patients reveal postoperative ER1 higher limitation when compared to other techniques. This result might be due to the lower percentage of ligamentous laxity in patients in the Latarjet group. A higher limitation in external rotation was seen in the Remplissage group (Table 4). Regarding redislocation rate, the Latarjet group had better outcomes, (1,5%). Moreover, the open Latarjet group had a significant higher rate of complications (15,5%) (Table 6) [14].

We examined the correlation between the Injury Severity Index Score (ISIS) and the type of surgery performed (Table 5). This finding reveals that in patients with ISI score between 4 and 6 , all the four surgical techniques can be used. We also observed that 47,4% of the patients in ASA group with a score>6 showed good results. Furthermore, this study demonstrates, again, that the ISI score cannot be used to determine the proper surgical tecniques as confirmed by numerous studies.[13,9]

The present comparison of the four above mentioned techniques demonstrated good results for all procedures and proved that the addition of soft tissue procedures, such as ASA and Remplissage, to the simple Bankart repair can lead to results quite similar to open or arthroscopic Latarjet, but with a lower rate of complications and without altering the anatomy of the coracoacromial arch. Furthermore, Arthro-Latarjet is still to be considered a valid technique but necessitates a long learning curve and should be performed only by expert surgeons [7,42,24].

The elevated failure rate of simple Bankart repair, reported in the literature, confirmed the fact that anterior capsular dysfunction and posterior critical Hill-Sachs lesions were not addressed by antero-inferior capsular repair.

LIMITATIONS

There are several limitations in this paper. This was a retrospective study and a longer FU is necessary. On-off track Hill Sachs lesions were not calculated, which may have affected patient selection. Time and the cost of each individual technique were not considered. The minimal clinically important difference (MCID) or patient acceptable symptom state (PASS) were not evaluated.

CONCLUSION

ASA and Remplissage augmenting the Bankart repair have been demonstrated to be effective for restoring joint stability with clinical outcomes similar to the Latarjet procedure in patients affected by recurrent anterior dislocation with GBL <15% and an ISI score >3. Soft tissue augmentations of the Bankart repair have been demonstrated to be effective for addressing anterior soft tissue deficiency and disfunction and critical Hill-Sachs lesions.

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Table 1. Baseline demographical and clinical characteristics (numbers and percentages or means and 95% CIs) ofparticipants in the study according to the type of surgery

	Arthro-Latarjet	Latarjet	ASA	Remplissage	
Number	38	66	57	65	
Sex (M/F)	35/3 92.1	55/11 83.3	51/6 89.5	56/9 86.2	0.
Age	27.3 (24.8-29.8)	32.7 (30.2-35.2)	29.8 (27.5-32.1)	26.7 (24.7-28.7)	<0.
Follow-up (months)	57.5 (53.1-61.9)	45.5 (39.7-51.3)	44.2 (40.0-48.4)	25.0 (19.5-30.6)	<0.
Shoulder operated (R/L)	22/16 57.9	39/27 59.1	33/24 57.9	40/25 61.5	1.
Dominant arm (R/L)	34/4 89.5	62/4 93.9	47/9 82.4	56/9 87.7	0.
Number of luxation	8.6 (5.2-12.0	9.7 (7.6-11.8)	6.5 (5.3-7.6)	5.7 (4.7-6.7)	<0.
Age at first luxation	24.3 (21.2-27.3)	25.2 (22.8-27.5)	24.2 (22.1-26.3)	22.4 (20.6-24.3)	0.1
Months from first luxation to surgery	32.5 (27.4-37.6)	77.7 (58.7-96.7)	44.1 (24.5-63.6)	50.0 (33.2-66.8)	0.0
Competitive sport (Y/N)	32/6 84.2	45/21 68.2	49/8 86.0	34/31 52.3	<0
Contact sport (Y/N)	14/24 36.8	10/56 15.2	39/18 68.4	13/52 20.0	<0
Shoulder Hyperlaxity Y/N)	8/30 21.1	15/51 22.7	19/38 33.3	18/47 27.7	0.
ER1 contralateral	76.7 (73.4-79.2)	53.6 (51.0-56.1)	72.6 (69.0-76.2)	77.8 (74.6-81.1)	<0.
ER2 contralateral	84.6 (83.0-86.1)	95.6 (92.1-99.2)	91.9 (90.2-93.6)	82.5 (80.0-85.0)	<0.
Glenoid loss contour (Y/N)	38/0 100.0	12/54 18.2	18/39 31.6	12/53 18.5	<0
Hill-Sachs (Y/N)	38/0 100.0	61/5 92.4	51/6 89.5	64/1 98.5	0.
Previous surgery.	11.	5.	2	3.	>0.001

*. Chi Square; **. ANOVA

Table 2 – Mean ROWE scores (95% CI) and level (n. and %) according to the type of surgery

Surgery/ ROWE	Arthro-Latarjet	Latarjet	ASA	Remplissage
Follow-up	93.6 (89.7-97.4)	98.5 (97.4-99.6)	91.7 (87.9-95.5)	93.1 (90.9-95.3)
Level:				
Excellent	31 (81.6)	65 (98.5)	50 (89.2)	50 (76.9)
Good	6 (15.8)	0	2 (3.6)	14 (21.5)
Fair	1 (2.6)	1 (1.5)	2 (3.6)	1 (1.5)
Poor	0	0	2 (3.6)	0

ROWE levels: Excellent (90–100). Good (75–89). Fair (40–74). Poor (0–39)

Table 3 – Mean (95%CI) WOSI scores and difference between baseline and follow-up according to the type of surgery

Surgery/ WOSI	Arthro-Latarjet	Latarjet	ASA	Remplissage
Baseline	1250 (1181-1318)	1456 (1363-1549)	838 (777-900)	1146 (1016-1275)
Follow-up	221 (175-267)	319 (257-381)	235 (171-299)	465 (391-540)
Difference	1028 (997-1060)	1137 (1038-1236)	603 (536-670)	680 (601-760)

Table 4 - External rotations of the operated and contralateral arms and their % difference at follow-up according to the type of surgery

Surgery/ ER	Arthro-Latarjet	Latarjet	ASA	Remplissage
ER1:				
Operated	78.3 (75.6-81.0)	52.7 (49.7-55.8)	66.8 (63.8-69.8)	63.3 (58.6-68.0)
Contralateral	81.5 (79.2-83.8)	57.4 (53.4-61.4)	75.2 (71.9-78.4)	83.4 (81.5-85.4)
% Difference	4.1	8.9	12.6	31.7
ER2:				
Operated	87.2 (85.7-88.7)	92.2 (89.4-95.0)	84.5 (82.8-86.3)	69.2 (63.8-74.7)
Contralateral	89.5 (88.4-90.6)	96.9 (94.2-99.6)	91.8 (90.3-93.4)	88.3 (86.7-89.9)
% Difference	2.6	5.1	8.6	27.6

Table 5. Mean, 95% CI, and numbers and percentages for Instability Severity Index Score(ISIS) subgroups according to the type of surgery.

Surgery/ ISIS	Arthro-Latarjet	Latarjet	ASA	Remplissage
Mean (95%CI)	6.32 (5.95-6.70)	5.68 (5.31-6.05)	7.00 (6.55-7.45)	6.37 (5.91-6.82)
ISIS Subgroup:				
4-6 points. n (%)	23 (60.5)	47 (72.7)	22 (38.6)	28 (46.0)
>6 points. n (%)	15 (39.5)	18 (27.3)	35 (61.4)	25 (38.1)

Table 6. Complications and re-dislocation rate

	arthro-Latarjet	Latarjet	ASA	remplissage	P
Number	38	66	57	65	
Complications	1	10	2	2	0.015
Re-dislocation	0	1	4	~~6~~ 4.	0.294

	~~arthro-Latarjet~~				
~~**Number**~~	~~38~~	~~66~~	~~57~~	~~65~~	
Complication rate	2.63%	15.15%	3.51%	3.08%	
Re-dislocation rate	-	1.52%	7.02%	~~9%~~6.1%	

P of Chi Square