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Outcomes of arthroscopic cortical-button Latarjet procedure with minimum 5-year follow-up

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Background: The surgical treatment of anterior shoulder instability with arthroscopic cortical-button Latarjet procedure has been the subject of very few medium and long-term studies. The aim of this study was to analyze the clinical and radiologic results of arthroscopic cortical-button Latarjet procedure with minimum 5 years follow-up.

Method: This is a monocentric retrospective study including 40 patients who have undergone shoulder stabilization with primary arthroscopic cortical-button Latarjet procedure and been reviewed with minimum 5 years follow-up. The average age at the time of surgery was 26.6 years (16-59; ±10) and 92.5% were sporty individuals. The average Instability Severity Index score was 6 points (2-9; ±1.6). The clinical evaluation involved active range of motion measurement, apprehension test, Rowe and Walch-Duplay scores, Subjective Shoulder Value and Net Promoter Score. Radiologically, evolution of the bone graft and degenerative arthritis of the shoulder joint were analyzed at the last follow-up.

Results: At an average follow-up of 71 months (60-97; ±12), 3 patients (7.5%) experienced recurrence as a dislocation or subluxation, which was responsible for revision in 1 case. Moreover, apprehension persisted in 6 (16%) patients. There were no significant restrictions in recovery of active ranges of motion, including external rotation. Return to sports was effective in 94.6% of cases. The average Rowe and Walch-Duplay scores were 87 points (15-100; ±20) and 88 points (15-100; ±19) respectively. Subjective Shoulder Value was 91% (10-100; ±16) and NET Promoter Score was 9.3 points (5-10; ±1,3). Radiologically, degenerative arthritis occurred in 18.7% of patients, mainly asymptomatic stage 1 (9.4%). Bone healing was acquired in 72% of cases and partial lysis of the bone block in 41%.

Conclusion: At an average follow-up of 6 years, arthroscopic cortical-button Latarjet procedure is effective, enabling return to sport in 95% of cases. Onset of asymptomatic arthritis seems similar to conventional techniques but justifies a longer-term follow-up.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Latarjet; arthroscopy; anterior shoulder instability; cortical-button; arthritis; bone block; sport injury; apprehension

University of Toulouse Hospital in France ethical committee approved this study (RnIPH2023-58).

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The coracoid block Latarjet procedure based on a triple locking effect is one of the surgical options for treating anterior shoulder instability.[27] This indication draws on radio-clinical arguments including Instability Severity Index (ISI) score, glenoid bone substance loss and Hill-Sachs humeral head lesion.[3] Historically, open surgery with double screw fixation for bone blocks exposed patients to a low rate of recurrence and high return-to-sport rate.[33] The incidence of degenerative arthritis occurred in 25% of patients on average after 10 years of follow-up and could reach 61% after more than 30 years according to the literature.[9,20,33]

As of 2003, Lafosse et al[26] proposed an arthroscopic approach enabling, among others, treatment of the associated injuries (superior labrum anterior posterior, humeral avulsion glenohumeral lesion, long biceps pathology, cuff tendon tear) individually during the same operating time. Yet, screw-related complications were reported and Boileau et al[5] developed a technique based on cortical-button fixation with specific guides, helping to place accurately and safely the bone block.[2,19,23] If the short-term results have been largely reported, few studies have analyzed the medium or long-term results.[15,21,22,29,34]

The aim of our study was to analyze the clinical and radiologic results of arthroscopic cortical-button Latarjet procedure with minimum 5-year follow-up. Our primary hypothesis was that the clinical results were satisfactory with a low recurrence rate and high return to sports. Our secondary hypothesis was that the degenerative arthritis rate was lower than the rate reported in the literature after conventional open surgery.

Material and method

Our study was approved by the Ethics Committee (RnIPH 2023-58), and the patients gave their consent to participate.

This is a monocentric retrospective study with prospective data collection, including a series of patients who were operated on from 2015 to 2018. The inclusion criteria were patients presenting with (1) chronic anterior shoulder instability, (2) operated on using arthroscopic cortical-button Latarjet procedure, and (3) reviewed with minimum 5-year follow-up. The exclusion criteria were patients with a surgical history for homolateral shoulder impairment.

Operating technique

The surgery was carried out by a surgeon specializing in shoulder surgery.[6] The patient was installed in a semi-seated position, under general anesthesia and interscalene block. The intervention involved 5 anterior routes and 5 successive stages performed according to Boileau et al.[5]

1. Coracoid preparation: release of the pectoralis minor muscle and coraco-acromial ligament, debridement of the inferior side, positioning of the anterior part of the cortical-button and osteotomy (1.5 cm).
2. Glenoid preparation: debridement of the scapular neck, insertion of an anchor after the 3:00 position, to perform a Bankart repair later on step 5.
3. Sub-scapular split: positioning of an intra-articular retractor transfixing the muscle and opening a ''safety window'' to protect the axillary nerve.
4. Bone block fixation: transfer of the coracoid bone through the split created, definitive fixation by posterior cortical-button (controlled compression at 100 N).
5. Bankart lesion repair: one anchor placed above the bone block aimed to fix the labrum and tighten the capsule from south to north.

Postoperative care

The shoulder was partially immobilized in a sling for 3 weeks. The patient started pendular exercises immediately, with active range of motion recovery limiting external rotation at neutral position for up to 45 days. Strengthening exercises were initiated thereafter. Resumption of risky sports was allowed after 3 months depending on clinical and radiologic evolution: a negative apprehension test and healed bone block (on standard X-rays completed with CT-scan in any doubt) were primary conditions.

Clinical evaluation

Clinical data were analyzed by a single examiner (J.P.) independent of the surgeon. Epidemiologic, preoperative and 1-year postoperative data were collected in medical files.

After 5 years of follow-up, the patients were specifically recontacted for a face-to-face or telephone consultation (including interview and video). Information on recurrent episodes of dislocation or subluxation, further surgery, return to sports, and its level were collected. Active joint mobility was measured in anterior elevation, external rotation elbow at side (ER1), external rotation at 90° of abduction (ER2) and internal rotation (IR, valued on the Constant Score[13]) on a digital goniometer (for face-to-face and teleconsultation). Shoulder stability was evaluated by apprehension test at 90° abduction and maximum external rotation. Finally, the following objective scores were calculated: Rowe, Walch-Duplay, Subjective Shoulder Value and Net Promoter Score (NPS).[17,28,35]

Radiologic evaluation

Preoperatively, the standard x-ray included A/P view in neutral rotation to evaluate shoulder arthritis according to

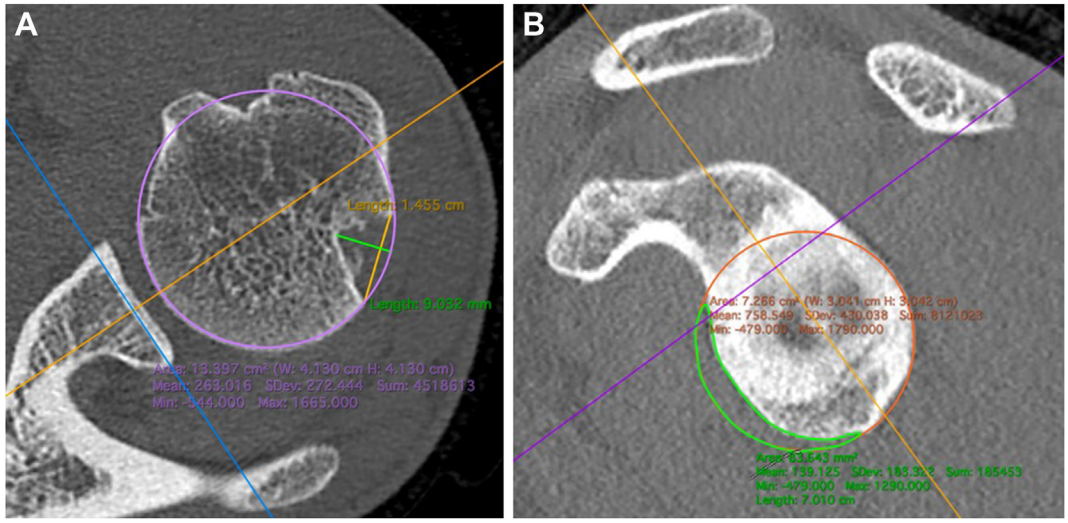

Figure 1 (**A**) CT scan analysis of humeral bone loss (axial section view). According to the method of Cho et al.[23] In this example, the depth of the Hill-Sachs lesion is 9.032 mm, the width of the lesion is 14.55 mm and humeral head diameter is 41.30 mm. (**B**) CT scan analysis of glenoid bone loss (sagittal section view). According to the method of Sugaya et al.[24] In this example, the total glenoid area is 726.6 mm^2 and the total bone substance loss area is 83.64 mm^2.

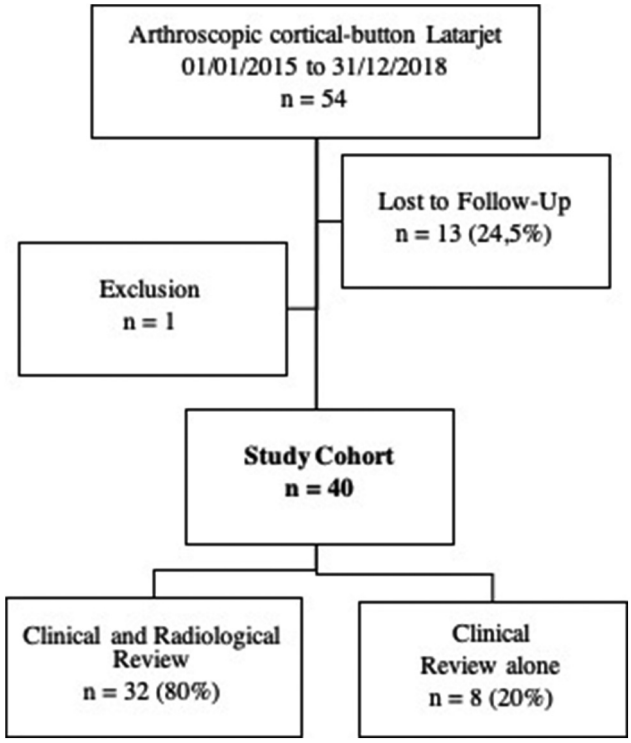

Figure 2 Flowchart diagram.

Table I Epidemiologic characteristics

Clinical parameters n = 40	Data (minimum-maximum)
Age at surgery (yr)	26.6 ± 10 (16-59)
Sex	
Male	33 (82.5%)
Female	7 (17.5%)
Hypermobility (ER1 > 85°)	16 (40%)
Dominant limb operated on	25 (62.5%)
Manual trades	22 (55%)
Tobacco	18 (45%)
Sports activity	37 (92.5%)
Overhead or contact sport	33 (82.5%)
Competition level	17 (46%)
Average number of preoperative dislocations or subluxations	13 ± 16 (1-50)
Time between 1st dislocation and surgery (mo)	56 ± 61 (6-240)
Average ISI score (points/10)	6 ± 1.6 (2-9)
Radiologic Parameters	
Average depth of Hill-Sachs lesion/HHD (%)	11 ± 5 (5-24)
Average width of Hill-Sachs lesion/HHD (%)	32 ± 11 (12-54)
Average glenoid bone loss (%)	14 ± 5 (3-24)
Preoperative arthritis	2 (5%)

ER1, External Rotation Elbow at Side; *ISI*, Instability Severity Index; *HHD*, Humeral Head Diameter.

Samilson and Prieto classification and a Bernageau view.[4,37] A CT scan (Fig. 1 *A* and *B*) assessed the Hill-Sachs lesion according to the method by Cho et al[12] and glenoid bone loss was measured using Sugaya's method.[38]

During the immediate postoperative period, a CT scan reviewed the position of the block in the frontal and sagittal plane according to Dalmas et al criteria.[14]

Table II Clinical results

Clinical results n = 40	1 yr postop	Last follow-up	*P*-value
Recurrence of instability	2 (5%)	3 (7.5%)	>.99
Further surgery	0	1 (2.5%)	
Positive apprehension	7/38 (18%)	6/37 (16%)	>.99
Return to sport			
	33 (89.2%)	35 (94.6%)	**<.001**
Lower level	12 (32.5%)	3 (8.1%)	
Same level	18 (48.6%)	26 (70.3%)	
Higher level	0	3 (8.1%)	
Change in sports type	3 (8.1%)	3 (8.1%)	
Improvement in sports level between 1 y postoperation and the last follow-up	-	15 (40%)	-
SSV daily life (%)	93 ± 15	91 ± 16	>.99
SSV sport (%)	85 ± 20	86 ± 19	>.99
Rowe/100 points	94 ± 23	87 ± 20	.2
Walch-Duplay/100 points	90 ± 21	88 ± 19	.9
Net Promoter Score/10 points	9.2 ± 1.5	9.3 ± 1.3	>.99

Bold indicates statistical significance.
SSV, Subjective Shoulder Value.

Table III Average mobility preop, at 1 yr and at last follow-up

Parameters n = 40	Preoperative	1 yr postsurgery	Last follow-up	*P*-value
	Data (min-max)	Data (min-max)	Data (min-max)	Mean difference Δ (Preoperative/ Last follow-up)
AAE (°)	163 ± 18 (90-180)	162 ± 15 (100-180)	176 ± 10 (130-180)	**.001 Δ = +12**
ER 1 (°)	68 ± 19 (30-100)	61 ± 18 (25-90)	67 ± 14 (40-90)	.9 Δ = −1
ER 2 (°)	91 ± 10 (50-110)	87 ± 11 (50-110)	89 ± 13 (45-110)	.4 Δ = −2
IR 1 *(points)*	8.7 ± 1 (8-10)	8.8 ± 1.2 (6-10)	9.1 ± 1 (6-10)	.08 Δ = +.5

AAE, Active Anterior Elevation; *ER1*, External Rotation at Side; *ER2*, External Rotation Elbow to 90°; *IR*, Internal Rotation (Constant Scoring: Buttocks = 2 pts, Sacrum = 4 pts, L3 = 6 pts, T12 = 8 pts, T7 = 10 pts).

At the last follow-up, a standard A/P view x-ray in neutral rotation and a Bernageau view[4] evaluated the evolution of the graft (osteolysis, healing/nonunion) and joint arthritis according to Samilson and Prieto classification.[37] Osteolysis was deemed total if the block was no longer visible over 2 x-ray views and partial in the event of reduction along its length and/or width by at least 50% on one x-ray view. The criteria for nonunion were based on the absence of bone continuity between the graft and the glenoid bone, and/or displacement of more than 2 mm in the graft. Three independent readings were made by the junior orthopedic surgeon (J.P.), a junior radiologist (H.H.) and a senior orthopedic surgeon (N.B.).

Statistical analysis

The statistical analysis was carried out using EasyMedStat (version 3.30.2; www.easymedstat.com, Neuilly Sur Seine, France). Continuous results were compared with ANOVA tests, Kruskal–Wallis tests, unpaired Student's T-test, Welch's T-test, Mann–Whitney U-test according to data distribution. Continuous variables were expressed by their mean, extremes and standard deviation. Discrete results were compared with a Chi-square test or Fisher's exact test. The alpha risk was set at 5%. Inter-observer reproducibility was assessed by the intra-class coefficient (Shrout and Fleiss, 1979).

Results

Population studied

From January 2015 to December 2018, 54 patients underwent arthroscopic Latarjet surgery for chronic anterior instability. One patient was excluded due to previous surgery and 13 patients were lost to follow-up before minimum 5-year follow-up. In total, 40 patients were included

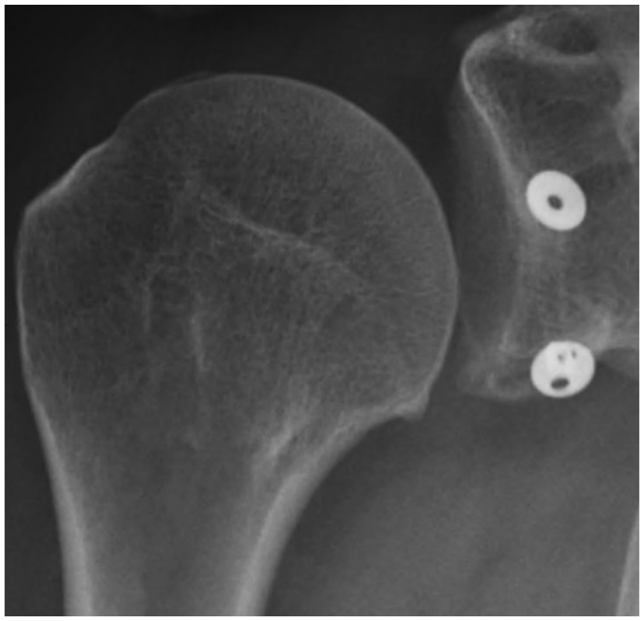

Figure 3 Samilson and Prieto Stage 1 - X-ray A/P view.

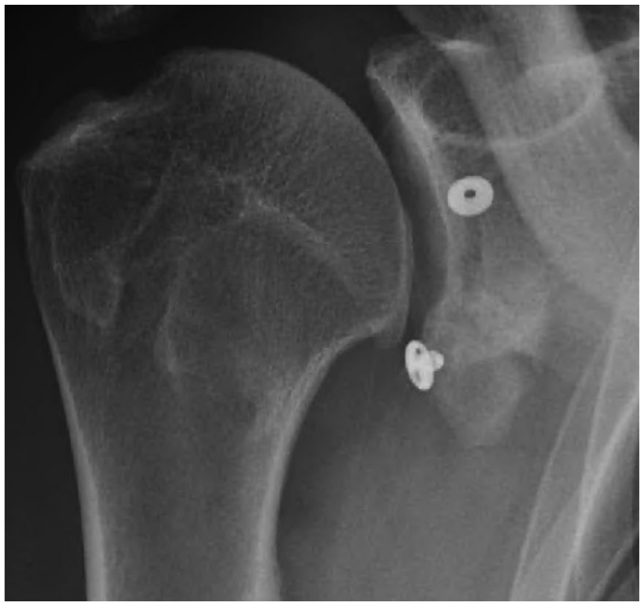

Figure 4 Samilson and Prieto Stage 2, associated with nonunion - X-ray A/P view.

in the statistical analysis (23 patients were assessed face-to-face and 17 on teleconsultation) (Fig. 2).

The epidemiologic characteristics are reported in Table I. The average age at the time of surgery was 26.6 years. Patients presented an average of 13 episodes of instability before surgery. 92.5% of patients took part in sports before the procedure and the average ISI score was 6 points. The mean depth of the Hill-Sachs lesion was 11% of the humeral head with a mean width of 32%; mean glenoid bone loss was 14% (3-24).

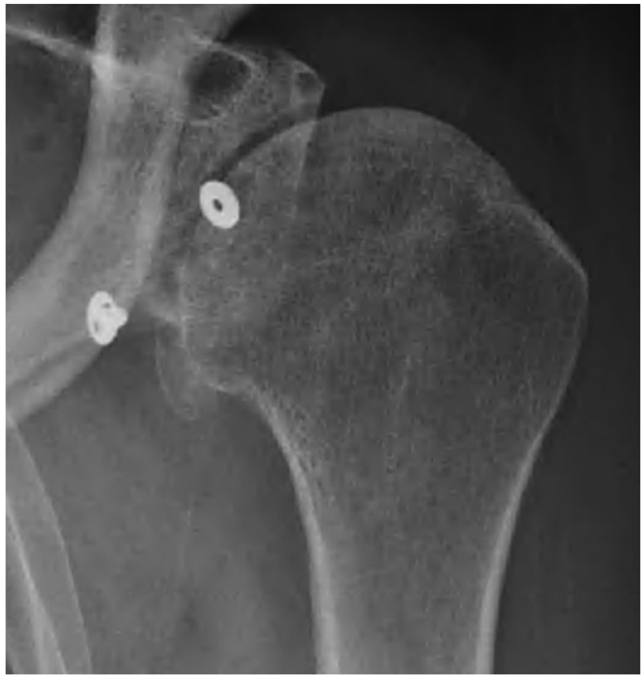

Figure 5 Samilson and Prieto Stage 3, associated with partial osteolysis - X-ray A/P view.

Table IV Radiologic results

Radiologic results	N (%)
Postoperative CT Scan (n = 40)	
Bone block positioning on the sagittal view	
Equatorial	6 (15%)
Sub-equatorial	34 (85%)
Bone block positioning on the axial view	
Flush	27 (67.5%)
Medialized	2 (5%)
Optimal	11 (27.5%)
X-Rays at follow-Up (n = 32)	
No gleno-humeral arthritis	26 (81.3%)
Gleno-humeral arthritis (S&P)	6 (18.7%)
Stage 1	3 (9.4%)
Stage 2	2 (6.3%)
Stage 3	1 (3%)
Osteolysis	
Absence	16 (50%)
Partial	13 (40.6%)
Total	3 (9.4%)
Evolution of bone block	
Healed	23 (71.9%)
Nonunion	6 (18.7%)

S&P, Samilson and Prieto Classification.

Overall functional results

At an average follow-up of 71 months (60-97), the mean Rowe, Walch-Duplay, Subjective Shoulder Value and Net Promoter Score scores were respectively 87 points, 88

Table V Comparative analysis of patients without degenerative arthritis (group A) vs. patients with arthritis (group B) at the last follow-up

Clinical parameters, n = 32	Group A n = 26 (81%) Data (minimum-maximum)	Group B n = 6 (19%) Data (minimum-maximum)	*P* value
Sex			.06
Male	23	3	
Female	3	3	
Age at surgery (yr)	23 ± 5 (16-35)	43 ± 14 (19-59)	**.002**
Age at last follow-up	29 ± 5 (22-40)	48 ± 14 (24-66)	**.022**
Dominant side operated on	17	4	>.99
Contact/combat/noncombat sport	22	3	.055
Sports competition	12	1	.606
Number of dislocations	15 ± 17 (1-50)	14 ± 19 (2-50)	.51
Period between 1st episode and surgery (mo)	37 ± 33 (6-144)	92 ± 99 (6-240)	.47
Manual trades	15	2	.38
Hypermobility	10	2	>.99
Tobacco	14	2	.65
Score ISI (/10)	6 ± 1.7 (2-9)	5 ± 2 (3-9)	.30
Recurrence of instability	3	0	>.99
Subjective apprehension	6	1	>.99
SSV daily life (%)	89 ± 19 (10-100)	92 ± 11 (75-100)	.94
SSV sport (%)	85 ± 21 (10-100)	87 ± 10 (75-100)	.61
Rowe (/100)	85 ± 23 (15-100)	92 ± 10 (75-100)	.79
Walch – Duplay (/100)	85 ± 22 (15-100)	93 ± 8 (80-100)	.62
Net Promoter Score (/10)	9 ± 1.5 (5-10)	10 ± 0 (10-10)	**.048**
Radiologic parameters, n = 32			
Bone block positioning on the sagittal view			.31
Equatorial	4	2	
Sub-equatorial	22	4	
Bone block positioning on the axial view			>.99
Flush	17	5	
Medialized	2	0	
Optimal	7	1	
Osteolysis			.41
Absence	14	2	
Partial	9	4	
Total	3	0	
Healed	19	4	.6
Nonunion	4	2	.6

Bold indicates statistical significance.
ISI, Instability Severity Index; *SSV*, Subjective Shoulder Value.

points, 91% and 9.3 points, with no significant differences compared at 1 year (Table II). 95% of patients resumed sports, with 70% at their previous level. Furthermore, 40% of patients improved their level beyond the first post-operative year.

No significant limitation in active range of motion was found in ER1 and ER2 at 1 year and at the final follow-up. Anterior elevation improved significantly by an average of +12° at the final follow-up (Table III).

Recurrence of instability/apprehension

At the last follow-up, 3 (7.5%) patients exhibited recurrence of instability following further trauma, in the form of subluxation or dislocation. Subsequent surgery (2.5%) using Bankart repair combined with Hills-Sachs remplissage was performed with a favorable and stable outcome at the 24 months follow-up.

In addition, persistent apprehension without recurrence was found in 6 patients (16%).

Table VI Intra-class coefficient (ICC)-radiologic analysis

	ICC JOS-JR	ICC JOS-SOS	ICC JR-SOS
Preoperative S&P	0.64	1	0.64
S&P last follow-up	0.69	0.93	0.76
Osteolysis	0.49	0.89	0.59
Pseudoarthrosis	0.28	0.8	0.48

S&P, Samilson and Prieto; *JOS*, Junior Orthopedic Surgeon; *JR*, Junior Radiologist; *SOS*, Senior Orthopedic Surgeon.
<0.4 = poor; 0.4 - 0.59 = average; 0.6 - 0.74 = good; >0.74 = excellent.

Radiologic evaluation

At the last follow-up, 32 x-rays assessments were evaluated for statistical analysis (Table IV). 71.9% of the grafts were healed while osteolysis was observed in 50% of cases: 40.6% partially and 9.4% totally.

In univariate analysis, osteolysis was significantly associated with a lower return-to-sport level, a change in sport type or a cessation of sport (5/8 vs. 10/29; $P = .024$). Similarly, acquired consolidation was significantly associated with a return to sport at the same or higher level (16/29 vs. 4/8 $P = .02$).

Gleno-humeral osteoarthritis was present in 18.7% of cases: 9.4% stage 1 (Fig. 3), 6.3% stage 2 (Fig. 4), 3% stage 3 (Fig. 5). In univariate analysis, only mean age at surgery and at the last follow-up were correlated with the presence of osteoarthritis at the last follow-up. 2 patients were already osteoarthritic preoperatively (stage 1) and only one worsened by one stage at the last follow-up. On the other hand, the presence of osteoarthritis did not influence the functional scores (Table V).

Inter-observer agreement (Table VI) was good for the analysis of osteoarthritis while it was average and poor for those of osteolysis and pseudoarthrosis.

Discussion

Our main hypothesis was confirmed: at an average follow-up of 71 months, arthroscopic cortical-button Latarjet procedure brought about a 95% return to sport and a low recurrence rate of 7.5%. Despite persistent apprehension in 16% of cases, the overall satisfaction rate was high. In contrast, gleno-humeral osteoarthritis was identified in 19% of cases.

To our knowledge, there is only one other study reporting the results of arthroscopic Latarjet with a follow-up of more than 5 years: that of Dumont et al[16] which involved a cohort of 62 patients with a mean follow-up of 76 months (61-101) after screw-fixed bone block.[26] Follow-up by telephone interview only (Western Ontario Shoulder instability Index score) did not allow objective assessment of shoulder stability or joint range of motion. Similarly, no radiologic analysis could be reported in their cohort. Despite a low recurrence rate, 15.6% of patients required further surgery, mainly for screw removal.

The recurrence rate of 7.5% in our series is comparable to that identified after conventional open surgery even after more than 20 years.[33] In their recent meta-analysis of 1217 bone blocks (579 open, 638 arthroscopic), Deng et al[15] noted recurrence rates ranging from 1.6% to 9%. Contrary to the failure rate, which seemed to increase with time after arthroscopic Bankart repair, we did not find this trend since only one additional case of recurrence occurred between 1 and 5 years.[36]

We observed no restriction in shoulder range of motion at the end of our follow-up period. Indeed, while Girard et al[18] found a significant reduction in external rotation at 3 months in a comparative in favor of open surgery, this difference decreased with follow-up time. For Lädermann et al[24] a higher position of the split during arthroscopy, trapping a larger portion of the sub-scapularis muscle beneath the conjoint tendon, could explain this phenomenon. However, Métais et al[32] in a larger multicenter cohort or the meta-analyses by Hurley et al[22] and Deng et al,[15] ascertained no difference whatever the technique used (open vs. arthroscopy).

Our return-to-sport rate of close to 95% at the final follow-up was also similar to that revealed in other series.[1,7] Buckup et al[8] logically pointed out that a return to sport at the same level was significantly higher in patients practicing a non-traumatic sport or one without arm armoring. In contrast, we found that up to 40% of patients improved their return to sport beyond the first postoperative year. This progression could be linked to a normalization of muscular parameters as demonstrated by Caubère et al[10] in an isokinetic evaluation.

Persistent residual apprehension without recurrence of instability as discovered in 16% of patients in our cohort is comparable with data from the literature.[22] Regardless of the bone block technique, this residual apprehension could have multiple psycho-neuro-somatic origins.[25]

Recent meta-analyses have found a postoperative osteoarthritis rate of between 20% and 60% between 5 and 30 years of follow-up.[15,21,22,29,34] Apart from a technical cause, evolution of arthrosis has been described as 10 to 20 times more frequent in unstable patients.[30] In our series, advanced age at the time of management was identified as a risk factor for the development of osteoarthritis. In the literature, risk factors include a high number of preoperative dislocations, young age at first episode of instability and participation in collision sports.[11] Hypermobility is said to be a protective factor.[31]

50% of our patients had radiographic osteolysis. Zhu et al[39] (open technique with screw fixation) found 90% CT osteolysis at 1 year and Dalmas et al[14] (arthroscopic technique with cortical-button fixation) reported 70%, mostly in the upper and anterior parts of the bone block. Our lower

osteolysis rate could be explained by the imperfection of analysis on standard x-ray compared with CT scan as demonstrated by the intra- and inter-observer correlation test.

Our study had a number of limitations. This was a retrospective study with prospective collection of part of the data. Despite a final cohort of satisfactory size, there was a high lost to follow-up rate explained by the epidemiology of the cohort (young, geographically mobile patients). Sub-group analyses were carried out with small numbers, which could lead to interpretation bias and multivariate analyses could not be performed (each group <30 cases). Osteolysis and nonunion of the bone block were assessed on standard x-rays and concordance analysis showed that the reliability of the results was questionable.

Nevertheless, our study does have its strengths. To our knowledge, there is only one other study with a minimum 5-year follow-up for arthroscopic Latarjet outcomes assessment and our study has the longest follow-up time for the evaluation of cortical-button fixation. In addition, clinical and radiologic evaluation carried out by a practitioner independent of the surgeon or by a center designing the surgical technique.

Conclusion

Arthroscopic cortical-button Latarjet procedure is a viable technique, enabling a return to sports in 95% of cases which significantly improves after the first postoperative year. The low recurrence rate of 7.5% does not seem to worsen with follow-up time. Onset of asymptomatic low-grade arthrosis seems similar to conventional techniques but justifies a longer-term follow-up.

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