Arthroscopic Latarjet

2 or 4 Cortical Buttons for Coracoid Fixation? A Case-Control Comparative Study

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Background: While 2 screws are traditionally used for coracoid bone block fixation, no gold standard technique has yet been established when using cortical buttons.

Purpose: To compare anatomic and clinical outcomes of the arthroscopic Latarjet procedure using either 2 or 4 buttons for coracoid bone block fixation.

Study Design: Cohort study; Level of evidence, 3.

Methods: A total of 23 patients with 4-button fixation (group 4B) were matched for age at surgery, sex, and follow-up to 46 patients who had 2-button fixation (group 2B). All patients underwent guided arthroscopic Latarjet (using coracoid and glenoid guides), and a tensioning device was used to rigidify the suture button construct and get intraoperative bone block compression. The primary outcome was assessment of bone block positioning and healing using computed tomography scans performed at 2 weeks and at least 6 months after surgery. The mean ± standard deviation follow-up was 49 ± 7 months (range, 24-64 months).

Results: The bone block healing rate was similar in both groups: 91% in group 4B versus 95.5% in group 2B. The transferred coracoid was flush to the glenoid surface in 21 patients (91%) in group 4B and 44 patients (96%) in group 2B (P = .6); it was under the equator in 22 patients (96%) in group 4B and 44 patients (96%) in group 2B ($P \geq .99$). There was no secondary bone block displacement; the rate of bone block resorption was similar between the groups: 28% in group 4B and 23% in group 2B (P = .71). Patient-reported outcomes, return to sports, and satisfaction were also similar between the groups. The operating time was significantly longer in group 4B (95 vs 75 minutes; P = .009).

Conclusion: A 4-button fixation technique did not demonstrate any anatomic or clinical advantages when compared with a 2-button fixation technique, while making the procedure more complex and lengthening the operating time by 20 minutes. A 2-button fixation is simple, safe, and sufficient to solidly fix the transferred coracoid bone block. The use of drill guides allows accurate graft placement, while the use of a tensioning device to rigidify the suture button construct provides high rates of bone block healing with both techniques (>90%).

Keywords: anterior shoulder instability; arthroscopic Latarjet; cortical buttons; glenoid bone loss; coracoid transfer

Although technically difficult, the arthroscopic Latarjet is gaining greater acceptance for the treatment of recurrent anterior shoulder instability in patients with glenoid deficiency.[11,29,30] In an attempt at replicating the open procedure, we initially fixed the transferred coracoid via arthroscopy using 2 metal screws.[29,40,41,43] Although mechanically effective,[22,26,33] screw fixation remains a major source of complications (up to 30%) and the main reason for revision surgery and hardware removal (up to 7%).[2,14,17,20,22,24,32,36] Despite providing stable fixation, metal screws have been associated with severe hardware[24,36] and neurological[18,20-22] complications. Additionally, screw trajectory and positioning of the graft flush to the glenoid surface are challenging when performing an arthroscopic approach using a "freehand" technique.[4]

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In an effort to make the arthroscopic Latarjet procedure easier, safer, and more reproducible, the senior author (P.B.) described in 2010 a novel arthroscopically guided Latarjet technique (using specific coracoid and glenoid drill guides),[11,13] and in 2013, he first advocated for a novel fixation method using 2 titanium buttons connected with a high-strength suture for fixation of the transferred coracoid.[10] The early clinical experience demonstrated that the guided approach for arthroscopic Latarjet optimized graft positioning accuracy and that the use of 2 cortical buttons was a safe and reliable alternative to screw fixation, providing high rates of bone block healing and avoiding complications reported with screws.[6] In 2019, on a series of 137 patients with a minimum 2 years of follow-up, these excellent results were confirmed with a bone block healing rate of 95%, accurate positioning of the graft, 93% return to sports, a 3% recurrence rate, and no complications.[9] Other clinical[43,44] and biomechanical[27,34,41] studies have confirmed that cortical buttons are a viable option for coracoid fixation in the arthroscopic Latarjet procedure.

Recently, there have been concerns that a fixation system using 2 cortical buttons may not be strong enough to prevent displacement or rotation of the bone block and withstand forces to allow osseous healing.[34,39,43] These concerns led some surgeons to advocate using a stronger construct with 4 cortical buttons (instead of 2) to achieve rotational control of the graft and superior bone compression.[34,39,43] Currently, there are no data assessing clinical and anatomic outcomes with the use of 2 versus 4 buttons for bone block fixation, and the choice depends mainly on surgeon preference. While 2 metal screws are traditionally used to affix the transferred coracoid to the glenoid during the Latarjet procedure (open and arthroscopic), no gold standard technique has yet been established for using cortical buttons, and the question remains whether it is preferable to use 2 or 4 buttons to fix the coracoid bone block during the arthroscopic Latarjet.

We therefore performed the present study to compare the results, at a minimum 2 years of follow-up after an arthroscopically guided Latarjet procedure, using 2 or 4 cortical buttons for coracoid bone block fixation. We hypothesized that bone block positioning and healing, as well as clinical outcomes, would be superior with the 4-button fixation as compared with the 2-button technique. Additionally, we aimed to compare the rates of potential complications and the operative time for the 2 fixation techniques.

METHODS

Study Design

We included patients with traumatic recurrent anterior shoulder instability with an Instability Severity Index Score ≥3 and anterior glenoid defect >20% of the glenoid surface based on computed tomography (CT) scans.[11] We excluded patients with other shoulder bone block stabilization procedures, voluntary instability, acute instability, or associated rotator cuff tear. Patients with shoulder hyperlaxity (external rotation >90°) and those with previous failed soft tissue stabilization (Bankart repair, capsular shift, etc) were not excluded. This study was approved by our institutional review board (IULS-2017-02).

Between July 2015 and December 2018, 69 patients with recurrent anterior instability who met the inclusion criteria underwent an arthroscopically guided Latarjet with cortical button fixation and were included. A total of 23 consecutive patients (23 shoulders) had an arthroscopic Latarjet with 4 buttons for bone block fixation (group 4B), and 46 consecutive patients (46 shoulders) had 2-button fixation (group 2B). Patients who received a 4-button technique were matched (1:2) to those who received a 2-button technique based on sex, age at surgery, and follow-up. Two patients initially designated to group 4B were enrolled in group 2B because they had too small a coracoid process. All patients underwent surgery by the same shoulder surgeon (P.B.) using the same guided arthroscopic Latarjet technique and same implants. All patients gave their consent, and the study was approved by the local ethics committee. All 69 patients were prospectively followed and available for clinical evaluation at a minimum of 2 years after surgery. The mean ± standard deviation; follow-up was 49 ± 7 months (range, 24-64 months).

Surgical Procedure

All arthroscopic Latarjet procedures were performed using a set of specific instruments (Latarjet Guided System; Smith & Nephew). We used specific titanium buttons (Bone-Link; Smith & Nephew) approved by the US Food and Drug Administration for bone fixation. The procedures were performed with the patient in the "lazy beach-chair" position. The neurovascular structures (axillary and musculocutaneous nerves) were systematically identified and protected before doing the subscapularis split and coracoid transfer.

The arthroscopically guided Latarjet was described previously in detail via 5 steps[5,8] (Figure 1): (1) coracoid preparation and drilling, (2) glenoid preparation and drilling, (3) subscapularis split, (4) coracoid transfer and fixation, and (5) Bankart repair. Bone block transfer and fixation were performed using 2 or 4 cortical buttons. The suture-tensioning device was used to rigidify the suture button construct. A tension of 100 N was applied 3 times: a first time to remove the creep from the suture, a second time to secure the knot, and a third time to provide bone block compression. At the end of the procedure, a Bankart repair using suture anchors (Suturefix; Smith & Nephew) was performed.

Depending on the fixation technique chosen (2 or 4 buttons), single- or double-barrel coracoid and glenoid guides were used (Figure 2).

Postoperative Rehabilitation

The rehabilitation protocol was the same for both groups. The arm was immobilized for 2 weeks in a neutral rotation sling, and pendulum exercises were started the day after surgery. At 2 weeks, the patient was seen for a CT scan to assess the bone block positioning, and brace use was discontinued. Formal rehabilitation with a physical therapist started at 4 weeks, and swimming pool therapy was

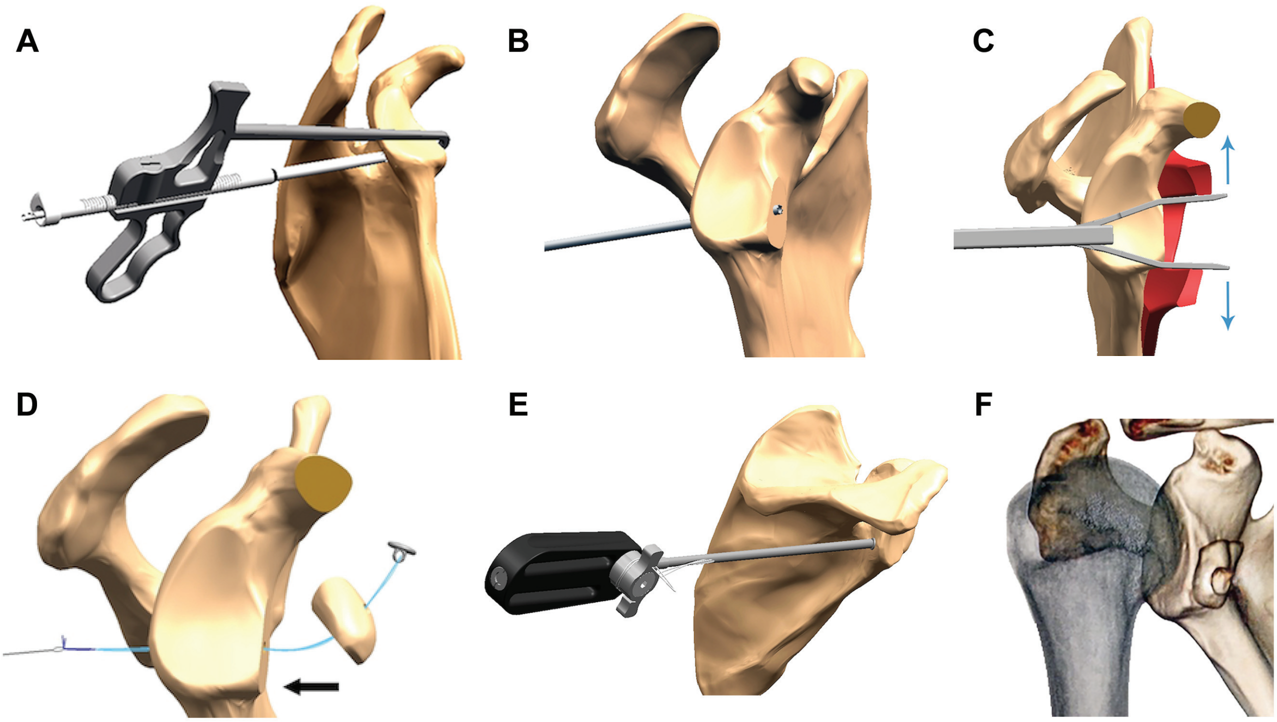

Figure 1. Arthroscopically guided Latarjet with 2-button fixation. (A, B) A single-barrel glenoid guide is used to drill a channel through the glenoid from posterior to anterior. (C) A spreader is used to split the subscapularis muscle and create a window for the passage of the coracoid bone block. (D) By pulling on the suture posteriorly, the surgeon transfers the coracoid bone block toward the anterior glenoid neck. (E) After adding the posterior button and tightening a sliding-locking knot, the surgeon uses the tensioning device to apply tensile force (100 N) on the suture and rigidify the construct. (F) Perfect matching between coracoid and glenoid drilling is a key feature to obtain reproducible and reliable bone block positioning. The blue arrows show the spreader opening for the subscapular split the black arrow shows the path of the bone block through the subscapularis muscle split: compression of the bone block on the glenoid with the endo button.

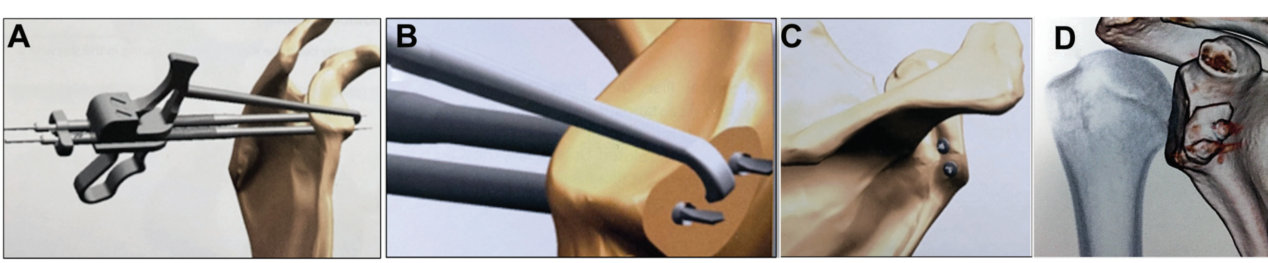

Figure 2. Arthroscopically guided Latarjet with 4-button fixation: (A, B) A double-barrel glenoid guide is used to drill 2 channels through the glenoid from posterior to anterior; (C, D) the coracoid bone graft is fixed using 4 buttons (2 anterior and 2 posterior).

encouraged. No heavy lifting was allowed for the first 12 weeks. Return to noncollision sports was allowed at 3 months, while return to collision sports was allowed at 6 months after CT scan to confirm healing of the bone block.

Clinical Assessment

All patients were clinically assessed independently by a shoulder surgeon (H.B.) at a minimum 2 years after surgery. Clinical assessment included stability and return to sports, as well as Constant-Murley, Walch-Duplay, and Rowe scores. Recurrence of instability was defined as at least 1 episode of anterior dislocation or subluxation. Patient satisfaction was evaluated using the Subjective Shoulder Value for activities of daily living and for sports activities. We also recorded complications and operative time, defined as the time from incision to skin closure.[40]

Radiological Assessment

CT scans were performed preoperatively, at 2 weeks, and at a minimum of 6 months after surgery to assess bone

TABLE 1
Patient Characteristics[a]

Parameter	Total (N = 69)	Group 4B (n = 23)	Group 2B (n = 46)	*P* Value
Age, y				
At surgery	25 ± 8 (16-49)	24.5 ± 8 (16-49)	25.4 ± 8.5 (17-39)	.65
At first dislocation or subluxation	20.7 ± 6	20.4 ± 5	21 ± 6.5	.7
Sex				≥.99
Female	6 (9)	2 (9)	4 (9)	
Male	63 (91)	21 (91)	42 (91)	
Shoulder hyperlaxity, ER >90°	26 (38)	9 (39)	17 (37)	.7
Dominant side	39 (57)	14 (60)	25 (54)	.81
No. of dislocations before surgery	3.7	3	4	.22
Patients with subluxations	60	21	39	.3
Work-related injury	8 (12)	2 (9)	6 (13)	.7
Smoking status	16 (22)	6 (26)	10 (22)	.74
Instability Severity Index Score	5.2 ± 1.7 (3-9)	5.2 ± 1.7 (4-9)	5.1 ± 1.5 (3-9)	.84
Sports	69 (100)	23 (100)	45 (100)	
Forced overhead	32 (46)	8 (35)	24 (52)	.2
Contact/collision	21 (30)	7 (30)	14 (30)	≥.99
Other	16 (23)	8 (35)	8 (18)	.13
Level of sport				
Recreational	26 (38)	9 (39)	17 (37)	.8
Competitive	38 (55)	12 (52)	26 (57)	.65
Professional	5 (7)	2 (9)	3 (7)	.77
Lesion				
Bankart	69 (100)	23 (100)	46 (100)	≥.99
Hill-Sachs	38 (59)	13 (56)	25 (54)	.8
Glenoid	69 (100)	23 (100)	46 (100)	.65

[a]Data are reported as mean ± SD (range) or No. (%). ER, external rotation.

block positioning, migration or rotation, healing,[9,41] and resorption.[15,19,42] The glenoid was studied in axial and sagittal sections using OsiriX software according to a previous protocol.[6,9] Three successive slices in each plane were retained to analyze the position of the bone block. The "ideal position" of the bone block was therefore defined by a flush position in the horizontal plane and between 3 and 6 o'clock in the vertical plane. The coracoid bone block was considered too lateral if it was 5 mm behind the glenoid and too medial if it exceeded the edge of 5 mm.[6,9] The graft was considered subequatorial if the bone block was positioned between 3 and 6 o'clock, equatorial if the bone block was no more than 25% over the equator, and above equatorial if it exceeded 50%.

Statistical Analysis

Quantitative variables were expressed as mean, standard deviation, and range, and qualitative variables were expressed as absolute and relative frequencies. Comparisons between the groups were performed using the Mann-Whitney *U* test for quantitative variables or the Student *t* test for unpaired samples according to the normality (Shapiro-Wilk) test and using the Fisher test for qualitative variables. $P <$ .05 was considered significant. Statistical analysis was performed using EasyMedStat (Version 2.2; www.easymedstat).

RESULTS

Characteristics

The characteristics of the patients (N = 69) who underwent an arthroscopic Latarjet are summarized in Table 1. As mentioned, the 23 patients with a 4-button fixation (group 4B) were matched for age at surgery, sex, and follow-up to the 46 patients who had a 2-button fixation (group 2B). Additionally, both groups were statistically comparable for the number of instability episodes preoperatively, dominant side, work-related injuries, smoking, hyperlaxity, Instability Severity Index Score, and glenoid and humeral lesions. All patients regularly participated in sports before injury, with half (55%) at a competition level and 5 (7%) at a professional level; all stopped sports because of recurrent anterior shoulder instability. Five patients had previous failed stabilization surgery: 2 in group 4B (2 arthroscopic Bankart procedures) and 3 in group 2B (1 open and 2 arthroscopic Bankart procedures) ($P \geq$ .999).

Complications and Reoperation

One intraoperative complication occurred in a patient of group 4B: 1 of the sutures broke during passage through the second glenoid tunnel, which led to repeating the procedure via successful insertion of the second cortical

TABLE 2
Coracoid Bone Graft Positioning and Healing as Evaluated on Postoperative Computed Tomography Scans[a]

Parameter	Total (N = 69)	Group 4B (n = 23)	Group 2B (n = 46)	P Value
Bone block positioning				
Vertical plane				
Subequatorial	66	22	44	≥.99
Equatorial	3	1	2	≥.99
Supraequatorial	0	0	0	≥.99
Horizontal plane				
Flush to glenoid rim	65	21	44	.23
Medial to glenoid rim, >5 mm	1	1	0	.33
Lateral to glenoid rim, >5 mm	3	1	2	≥.99
Bone block				
Nonunion	4 (5.7)	2 (9)	2 (4.5)	.061
Fracture	0	0	0	
Rotation or migration	0	0	0	

[a]Values are presented as No. (%).

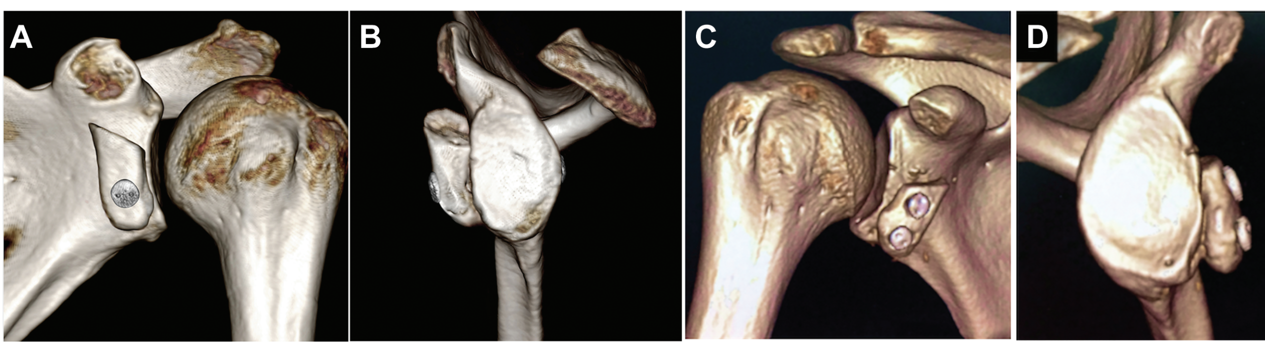

Figure 3. Postoperative 3-dimensional computed tomography scans performed 2 weeks after arthroscopic Latarjet showing coracoid bone block positioning with (A, B) 2-button and (C, D) 4-button fixation.

button. Postoperatively, 1 patient in group 2B had a hematoma that resorbed spontaneously. At last follow-up, no hardware failures and no neurological complications were recorded; no patients required revision surgery.

Radiological Outcomes

Coracoid Graft Positioning. Overall, the bone block was subequatorial in 96% (66/69) of patients and flush to the glenoid surface in 94% (65/69) (Table 2). The transferred coracoid was flush to the glenoid surface in 21 patients (91%) in group 4B and 44 (96%) in group 2B (P = .6); it was under the equator in 22 patients (96%) in group 4B and 44 (96%) in group 2B ($P \geq .999$). No coracoid fracture and no secondary bone block displacement were observed in any of the patients, whichever fixation technique was used (Figure 3).

Coracoid Graft Healing. The bone block healing rate was similar between the groups: 91% in group 4B versus 95.7% in group 2B. Tobacco use was the only risk factor found for nonunion: the 4 patients with bone block nonunion (2 in each group) were all smokers ($P < .001$).

Coracoid Graft Resorption. Graft osteolysis was observed in both groups, mainly on the outer side of the superior portion (Figure 4). The percentage of bone block resorption was similar between the groups: 28% in group 4B and 23% in group 2B (P = .71). However, a slightly greater resorption of the graft on the proximal and superficial part was observed in group 4B (Table 3).

Clinical Outcomes

Recurrence of Instability. Overall, 3 patients (4%) had a recurrence of anterior instability: 1 in group 2B and 2 in group 4B. In group 2B, 1 patient (29 years old) had a recurrence of instability during a trauma in abduction–external rotation that occurred 8 months after surgery. In group 4B, 2 patients had a recurrence of instability; however, 1 was an 18-year-old woman with epilepsy who had a subluxation during a seizure at 10 months postoperatively. The other patient was a 24-year-old man who experienced a single episode of instability in forced abduction–external rotation during martial arts practice. All 3 patients with recurrent instability had a deep, engaging Hill-Sachs lesion.

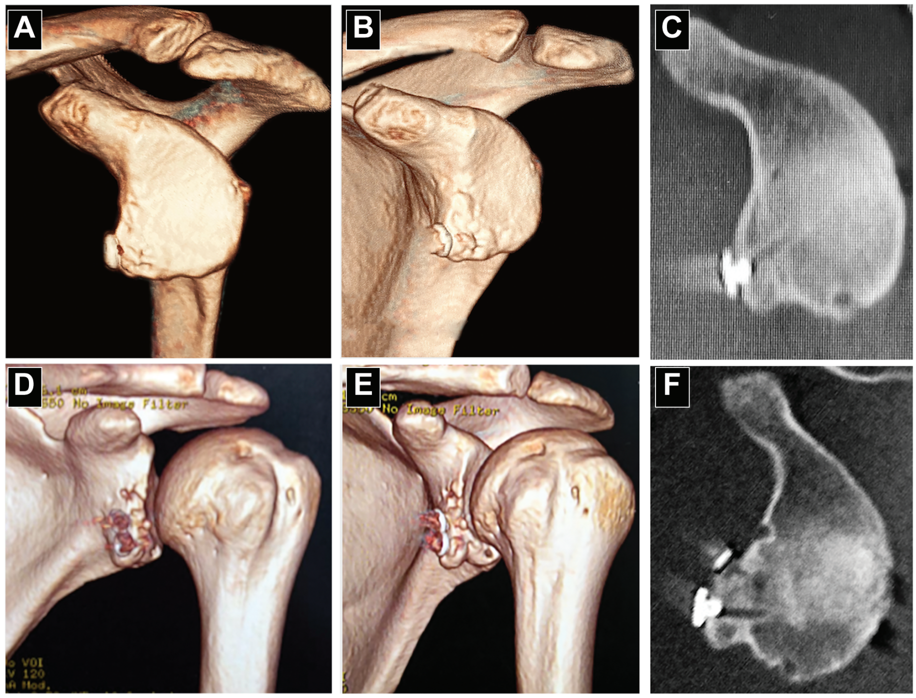

Figure 4. Postoperative 2- and 3-dimensional computed tomography scans performed 6 months after arthroscopic Latarjet demonstrating bone block healing and remodeling: after (A-C) 2-button and (D-F) 4-button fixation. In both cases, there is superior resorption of the coracoid graft with restoration of the pear shape of the glenoid.

TABLE 3
Computed Tomography Scan Analysis of Bone Block Resorption According to the Method of Di Giacomo[19,a]

	Total (N = 69)	Group 4B (n = 23)	Group 2B (n = 46)	*P* Value
Bone block resorption, %	25	28	23	.71
Proximal/superficial/lateral	29 (42)	14 (61)	15 (33)	.038
Proximal/superficial/medial	32 (46)	15 (65)	17 (37)	.04
Proximal/deep/lateral	22 (32)	9 (39)	13 (28)	.4
Proximal/deep/medial	24 (35)	10 (44)	14 (30)	.3
Distal/superficial/lateral	13 (19)	4 (17)	9 (20)	≥.99
Distal/superficial/medial	12 (17)	4 (17)	8 (17)	≥.99
Distal/deep/lateral	10 (14)	3 (13)	7 (15)	≥.99
Distal/deep/medial	5 (7)	2 (9)	3 (7)	≥.99

[a]Values are presented as No. (%) unless noted otherwise. The coracoid bone graft was divided into 8 parts to determine the location and amount of coracoid graft osteolysis.

They were treated nonoperatively using muscle strengthening under the supervision of a physical therapist. None of them required revision surgery at last follow-up.

Functional Outcomes. At the last follow-up, the functional results and range of motion were similar between the groups (Table 4).

Patient-Reported Outcomes. All patients were satisfied or very satisfied and would repeat surgery, except for the 3 patients who had a recurrence of instability. The Subjective Shoulder Value was 87% ± 11% for activities of daily living and 74% ± 17% for sports.

Return to Sports. At last follow-up, 96% of patients (66/69) had returned to their sports at the same or higher level as compared with their preinjury status with no difference between the groups.

Operating Time. The duration of the procedure was significantly longer in group 4B (95 ± 22 minutes; range, 75-118 minutes) than in group 2B (75 ± 26 minutes; range, 50-110 minutes) (*P* = .009). During the study period, there was no evidence of decreasing operative time between the first patient and the last for both techniques (Figure 5). The plateau curve in both groups indicated that the surgeon and team rapidly reached a plateau with no time improvements to be gained with increased surgical experience. In both groups, longer operative times (above the plateau) were related to more difficult revision cases for these patients.

TABLE 4
Clinical and Patient-Reported Outcomes[a]

Parameter	Total (N = 69)	Group 4B (n = 23)	Group 2B (n = 46)	*P* Value
VAS pain, out of 10	0.82 ± 1.3	1.04 ± 1.3	0.65 ± 1.4	.7
Adjusted Constant-Murley score, %	90 ± 9	89 ± 10	91 ± 9	.81
Subjective Shoulder Value, %				
Activities of daily living	87 ± 11	85 ± 8	88 ± 11	.45
Sports	74 ± 17	71 ± 13	76 ± 19	.3
Score, out of 100				
Walch-Duplay	85 ± 18	80 ± 23	87 ± 14	.21
Rowe	86 ± 17	82 ± 21	88 ± 14	.23
Recurrence of instability	3	2	1	.25
Apprehension	3	2	1	.25
Range of motion, deg				
Active forward elevation	172 (140-180)	170 (150-180)	173 (140-180)	.362
Abduction	169 (130-180)	167 (140-180)	170 (130-180)	.45
External rotation 1	62 (20-90)	63 (20-90)	61 (30-90)	.67
External rotation 2	88 (60-90)	85 (70-90)	89 (70-90)	.49
Internal rotation (spine level)	T10	T12	T7	.5

[a]Data are reported as mean ± SD, mean (range), or No unless noted otherwise. VAS, visual analog scale.

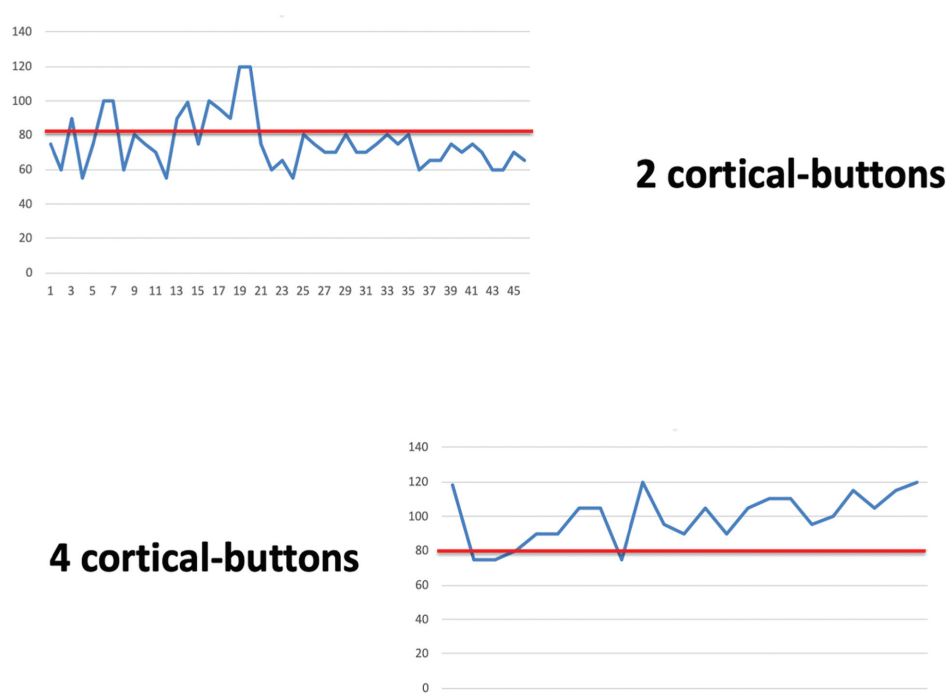

Figure 5. Chronological analysis of the operating time between the first patient and the last for the 2- and 4-button fixation techniques. The operative time remained constant within each technique group, mostly <80 minutes for the 2-button procedure and between 80 and 120 minutes for the 4-button technique.

DISCUSSION

The key finding of the present study is that 4-button fixation has no additional benefit on the measured outcomes when compared with 2-button fixation for the arthroscopic Latarjet procedure. The data of our case-control paired comparative study show that 2-button fixation equals the performance of 4-button fixation in terms of initial and final bone block positioning, rates of bone block healing, frequency of recurrent instability, return to sports, and patient satisfaction. Overall, 3 patients (4%) had a recurrence of instability: 1 in group 2B and 2 in group 4B (however, 1 of them had epilepsy and had a subluxation related to a seizure that occurred 10 months after surgery). Our recurrence rate compares favorably with that of other series using screws[26] or suture buttons[43,44] for bone block fixation, in which rates varied between 2.5% and 7%. Our data confirm that cortical buttons are a safe and reliable alternative to screw fixation, providing high rates of bone block healing and avoiding the complications reported with screws.

Although mechanical studies have shown that the button construct is less rigid than the screw construct,[3,34] our data demonstrate that the button construct is stable enough to allow high rates of bone block consolidation, with no difference between 2- and 4-button fixation. While the screw construct provides anterior fixation of the bone block on the glenoid neck, the button construct provides anteroposterior fixation, which is paramount to resist the pullout loads exerted by the conjoint tendon. Our observations using arthroscopy at the end of the Latarjet procedure have shown us that, owing to the volume of the inferior part of the subscapularis under the transferred coracoid bone block, the force of traction of the conjoint tendon on the tip of the coracoid is directed horizontally and not vertically. Furthermore, the more the arm is placed in external rotation, the more volume of subscapularis muscle is placed under the transferred bone block, and the more horizontal pullout strengths are exerted on the coracoid. As shown by our data, the anteroposterior fixation provided by the 2-button construct is perfectly adapted to resist these horizontal pullout loads. Our high rates of bone block healing with 2 or 4 buttons and the absence of bone block migration confirm the value of this means of fixation.

The only difference found between the techniques was operative time, which was significantly longer by an average of 20 minutes for the 4-button procedure. All surgical procedures were performed by an experienced senior shoulder surgeon, and all surgical steps were similar for the 2 fixation techniques, except for the glenoid and coracoid drilling where a double-barrel guide was used in the 4-button technique. The increased operating time (95 vs 75 minutes; $P = .009$) with the 4–suture button procedure shows that this type of construct makes surgery even more complex. Intraoperative difficulties in the 4-button procedure included tangling of sutures and increased difficulty in passing the bone block through the subscapularis. Interestingly, the operative time with both techniques did not decrease with the surgeon's experience but remained relatively constant, meaning that the surgeon and team reached their peak performance quickly with the 2- and 4-button procedures. Postoperatively, we observed increased shoulder swelling attributed to the increased operating time.

On postoperative CT scans performed 2 weeks after surgery, the bone block was accurately and "ideally" positioned (below the equator and flush to the glenoid surface) in 95% of patients, regardless of the fixation technique. These data confirm that the use of drill guides allows for accurate and reproducible graft placement during arthroscopic Latarjet with button fixation.[6-9] Furthermore, the arthroscopically guided Latarjet procedure virtually eliminates the possibility of neurological complications,[6] as glenoid drilling is made from posterior to anterior and remains intra-articular (away from the anterior neurovascular structures).[8-10] There were no neurological, vascular, infectious, or hardware complications, and no revision surgery has been required for patients in either group.

The assumption that a 4-button fixation technique would be superior to a 2-button fixation technique is counteracted by the results of the present study. In both groups, we did not observe any secondary rotational displacement or migration of the transferred coracoid bone block, and the rates of graft healing were high and equivalent in both groups. Smoking was found to be a risk factor for graft nonunion independently of the fixation technique (2 or 4 buttons). This finding has been shown in previous studies using screw[13] or button[8-10] fixation.

A common belief is that the suture button suspensory system is a "nonrigid fixation system."[21,32] The use of the tensioning device rigidifies the suture fixation construct and eliminates micromotion. This tensioner allows for transforming of the flexible suture button construct into a bolt (or a rivet), providing a rigid fixation with intraoperative bone block compression. The high rate of bone block healing and absence of secondary displacement found in our study (with 2 or 4 buttons) confirm that the use of this tensioning device is a key factor to prevent any rotational movement and improve the chances of bone graft healing via cortical button fixation.[6,9,23] The absence of graft migration in our series confirms that the suture material used (No. 3-4 ultra-high molecular weight polyethylene) is strong enough to withstand the shearing and bending forces applied on the coracoid bone block.

The risk of iatrogenic fracture of the coracoid bone block is not rare when using a 2-screw fixation technique.[16,19] A recent multicenter study of arthroscopic Latarjet procedures using screw fixation, as performed by high-volume surgeons, reported a 4.1% rate of coracoid graft fracture.[40] In our study, no intra- or postoperative coracoid fractures were encountered. The risk of graft fracture is related to the size of the coracoid, the degree of osteopenia, the diameter and number of drilled holes (1 or 2), and overcompression via screws.[1,6,27,34] A clear advantage of the cortical button fixation is that the drilling hole diameter required for the suture passage (2.8 mm) is smaller than the one needed for screw passage (3.2 mm).[6,27,34] In female patients with small coracoids and in older patients (age, >40 years), we prefer to drill only 1 hole through the coracoid and use a 2-button fixation procedure.[1,27,34] Our procedurally designed anterior button has a round and flat shape, which provides uniform distribution of the pressure, and a peg eyelet, which prevents sawing of the suture through the bone block when applying bone compression via the suture tensioner.[8,23]

Bone block remodeling, with partial resorption of the upper part of the transferred coracoid, was observed on CT scans performed at an average of 8 ± 2 months after surgery, regardless of the type of fixation (2 or 4 buttons). Such bone block remodeling has already been reported with screw[1,16,19,25,28] and button[9,43,44] fixation. This postoperative physiological remodeling of the graft is related to biological factors (the blood supply is decreasing farther from the conjoint tendon distally) and mechanical ones (according to Wolff law, the superior portion of the grafted bone with less loading underwent relatively greater osteolytic changes).[1,16,19,25,28] Kee et al[28] showed that this process of remodeling was almost completed at approximately 8 months postoperatively with no changes thereafter. The percentage of graft resorption was similar between the groups (28% in group 4B vs 23% in group 2B), which raises the following questions: Why use 4 buttons when we know that osteolysis of the upper part of the transferred coracoid does occur? Why risk leaving the upper button floating free and rubbing against the subscapularis tendon, causing irritation or inflammation, after the upper part of the bone block has resorbed? This bony resorption of the superior part of the coracoid is, for us, another argument in favor of a 2-button fixation for the Latarjet procedure.

The excellent anatomic and clinical results reported here with both techniques were obtained using a guided arthroscopic technique, a tensioning device, and specific titanium buttons.[6,8,9] Our results cannot be transposed for other modified Latarjet techniques using currently available standard EndoButtons or designed for soft tissue fixation (anterior cruciate ligament reconstruction,[31] distal biceps repair,[38] and acromioclavicular reconstruction)[35] and techniques that do not use a tensioner to rigidify the suture button construct. Furthermore, in our technique, the coracoid bone block was fixed in the "lying" position (classic Latarjet procedure); therefore, our results cannot be transposed for other modified Latarjet procedures[37] with the bone block in the "standing" position (Bristow)[11] or "sitting" position (congruent arc technique),[13] where the surface area for bone contact is smaller.

Limitations

The main limitation of this study is that it is retrospective and not randomized, although data were collected prospectively for both groups. Another weakness is that we did not perform any intra- or interobserver analysis for CT scan analysis, although assessment of the scans was performed by 2 senior observers. Furthermore, the intraoperative choice between the groups was arbitrary. We have logically tended to place 4 suture buttons in patients with a big size and a large coracoid. The arthroscopic Latarjet is known to be a technically difficult procedure with a long learning curve.[22,40] All patients underwent surgery by 1 senior surgeon, who has broad experience in shoulder arthroscopy and has mastered the arthroscopic Latarjet procedure utilizing cortical button fixation for many years. Some less experienced surgeons may not be able to reproduce the excellent results reported here. This is still a difficult procedure, and a less experienced surgeon may need more time even with a single double button.[12] The main strength of our case-control comparative study is that most potential biases were eliminated. Initially, the 2 groups were paired for age at surgery, sex, and follow-up, leaving all other variables possibly different. However, as shown in Table 1, patients in both groups were similar for many parameters, including the number of instability episodes before surgery, dominant side, work-related injuries, smoking, hyperlaxity, Instability Severity Index Score, and glenoid and humeral lesions. This similarity between groups reinforces our conclusion: there is no clinical or anatomic advantage of the 4-button technique over the 2-button technique.

CONCLUSION

Our data demonstrate that a 2–suture button construct is sufficient for achieving reliable coracoid bone block positioning, high rates of bone healing, and excellent functional and subjective results. The 4-button fixation technique does not provide any anatomic or clinical advantages when compared with the 2-button fixation technique, while making the procedure more complex and lengthening the operative time by an average of 20 minutes. The rates of recurrence of instability, return to sports, patient satisfaction, and complications were similar between the groups. The 2-button fixation technique combined with a suture-tensioning device is biomechanically equivalent to a rigid bolt (or rivet). Such a rigid fixation system with 2 points of fixation (1 anterior and 1 posterior) provides rotational stability and achieves graft compression. In an environment of rapidly growing health care costs, the increased cost of using 4 implants (instead of 2) and the increased operative time of the 4-button procedure are important considerations to be taken into account. The results of the present study have encouraged us to continue using the 2–suture button technique in arthroscopic Latarjet for recurrent anterior shoulder instability. The 2-button fixation method is simple and safe and may be used for the arthroscopic and open Latarjet procedures, avoiding the complications seen with screws.

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