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A guided surgical approach and novel fixation method for arthroscopic Latarjet

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Background: Most of the complications of the Latarjet procedure are related to the bone block positioning and use of screws. The purpose of this study was to evaluate if an arthroscopic Latarjet guiding system improves accuracy of bone block positioning and if suture button fixation could be an alternative to screw fixation in allowing bone block healing and avoiding complications.

Materials and methods: Seventy-six patients (mean age, 27 years) underwent an arthroscopic Latarjet procedure with a guided surgical approach and suture button fixation. Bone graft union and positioning accuracy were assessed by postoperative computed tomography imaging. Clinical examinations were performed at each visit.

Results: At a mean of 14 months (range, 6-24 months) postoperatively, 75 of 76 patients had a stable shoulder. No neurologic complications were observed; no patients have required further surgery. The coracoid graft was positioned strictly tangential to the glenoid surface in 96% of the cases and below the equator in 93%. The coracoid graft healed in 69 patients (91%).

Conclusions: A guided surgical approach optimizes graft positioning accuracy. Suture button fixation can be an alternative to screw fixation, obtaining an excellent rate of bone union. Neurologic and hardware complications, classically reported with screw fixation, have not been observed with this guided technique and novel fixation method.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Latarjet procedure; arthroscopic Latarjet; shoulder instability; glenoid bone loss; cortical button

Coracoid transfer to address anterior shoulder instability, first proposed by Michel Latarjet in 1954[31] and popularized by Gilles Walch,[46,47] is increasingly used in cases of glenoid deficiency and in revision anterior stabilization.[3,5,8,15,40,42,43] The technique has a 2-fold advantage: (1) it allows reconstruction of the glenoid bone loss (static bone effect), and (2) it reinforces the weak and stretched

The study was performed according to the medical ethical guidelines of our institution, and written, informed consent was obtained. (Approval Ref: Study 2015-9).

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inferior glenohumeral ligament by transferring the conjoint tendon closer to the joint and lowering the inferior part of the subscapularis (dynamic sling or seat-belt effect).[22,31,38,47] Together with the reattachment of the labrum and capsule, it allows "triple locking" of the shoulder.[13,36,38] The procedure yields good results with a low rate of recurrent instability, high rate of return to sports to preinjury levels, and high rate of patient satisfaction.[2,6,7,15,19,24,36,46]

With improvements in arthroscopic techniques, the arthroscopic Latarjet procedure is becoming increasingly popular.[9,11,13,29,30,37] However, on the basis of the literature and our experience, there are at least 3 drawbacks to the arthroscopic techniques.

First, arthroscopic positioning of the bone block flush and of the screws parallel to the glenoid surface is technically difficult. Many complications related to this procedure are attributed to graft malposition.[24,36,46,51] The obliquity of the scapula on the thorax makes it challenging to place the screws strictly parallel to the glenoid surface.[13,35] Excessive screw obliquity may cause impingement with the humeral head, leading to rapid-onset arthropathy.[36,42,46,50]

Second, although fixation of the graft with 2 bicortical metal screws is the recommended method of fixation,[2,36,46,48] it is also recognized as the main source of intraoperative and postoperative complications.[13,16,23,43,51,52] There are several potential disadvantages of the screw fixation: screw pullout or loosening, bending or breakage, bone block fracture, nonunion, resorption (3%-28%), and graft migration (4%-11%).[2,46] Some of these complications may be serious and symptomatic enough to warrant reoperation.[13,16,43,51,52]

Third, the proximity of the brachial plexus (especially axillary and musculocutaneous nerves) means that any drilling or screw insertion performed arthroscopically anteriorly is potentially dangerous.[10,11,20,51,52] Posteriorly, there is also a risk of suprascapular nerve injury if the drill and screws are too medially oriented.[28,32,35]

In an attempt to make the arthroscopic Latarjet procedure safer and to reduce complications associated with the traditional screw fixation, we have developed a novel surgical technique and fixation method involving a guided surgical approach for graft positioning and the use of specific suture buttons for fixation (Fig. 1). Herein, we describe the new technique and devices and evaluate its ability to obtain accurate graft positioning and healing in a prospective study with computed tomography (CT) assessment. We hypothesize that (1) use of a guiding system will allow more accurate positioning of the graft and (2) cortical button fixation will allow predictable and reproducible bone union and minimize complications reported with screw fixation.

Materials and methods

Latarjet guiding system

A number of instruments have been designed and developed to improve the safety and accuracy of the arthroscopic Latarjet procedure (Latarjet Guiding System; Smith & Nephew Inc., Andover, MA, USA).

1. **The glenoid drill guide** has 2 functions. First, it ensures that the cortical button suture tunnel is almost parallel (10° angulation) and 5 mm medial to the anterior glenoid rim. Second, it allows intra-articular drilling from posterior to anterior that is limited by a drill stop to avoid neurovascular injury.
2. **The coracoid drill guide** ensures that the cortical button suture tunnel is perpendicular to the coracoid, equidistant from its margins (5 mm), and at a fixed distance from its tip.
3. **Two purpose-designed 2.8-mm drill bits** (RCG Drill, Smith & Nephew) comprising an inner K-wire and outer sleeve.
4. **A pin puller** for removal of the K-wires.
5. **Two low-profile mechanical subscapularis spreaders.** First, these split the subscapularis muscle along its fibers. Second, they protect the axillary and musculocutaneous nerves at the time of coracoid transfer.
6. **An oscillating rasp** to create 2 opposing flat osseous surfaces of anterior glenoid and coracoid undersurfaces.
7. **An oscillating saw blade** for safe and rapid coracoid osteotomy.
8. **A pair of arthroscopic tissue retractors** to improve safety and visualization: the **curved (north) retractor** to elevate the upper part of the subscapularis, and the **straight (south) retractor** to protect the axillary and musculocutaneous nerves and pull down the inferior part of the subscapularis.
9. **A cannulated awl and a K-wire** can be used to create pilot holes and to insert a K-wire to improve visualization of the anterior glenoid neck (by lifting up the upper subscapularis).
10. **A suture tensioner** to obtain compression between the graft and the anterior glenoid.
11. **A coracoid grasper** to manipulate the bone block during fixation.
12. **Two half-pipe cannulas (long and short)** for atraumatic insertion of instruments: the **short half-pipe** is used to introduce intra-articular instruments; the **long half-pipe** is used to introduce instruments through the anteromedial transpectoral portal into the anterior subdeltoid space.

Cortical button fixation device

On the basis of previous biomechanical and clinical studies, cortical button and suture-based suspension devices, such as the Endobutton, have been shown to be a good option for soft tissue graft fixation.[1,18,27,34,39] We hypothesized that such devices could also be used to obtain bone-to-bone healing. Therefore, 2 purpose-designed cortical button devices have been developed to allow coracoid graft fixation and healing (Bone-Link; Smith & Nephew). The fixation device consists of 2 circular metallic buttons, used with a No. 3-4 ultrahigh-molecular-weight polyethylene suture sling running through them (Fig. 1, *C*). The **coracoid**

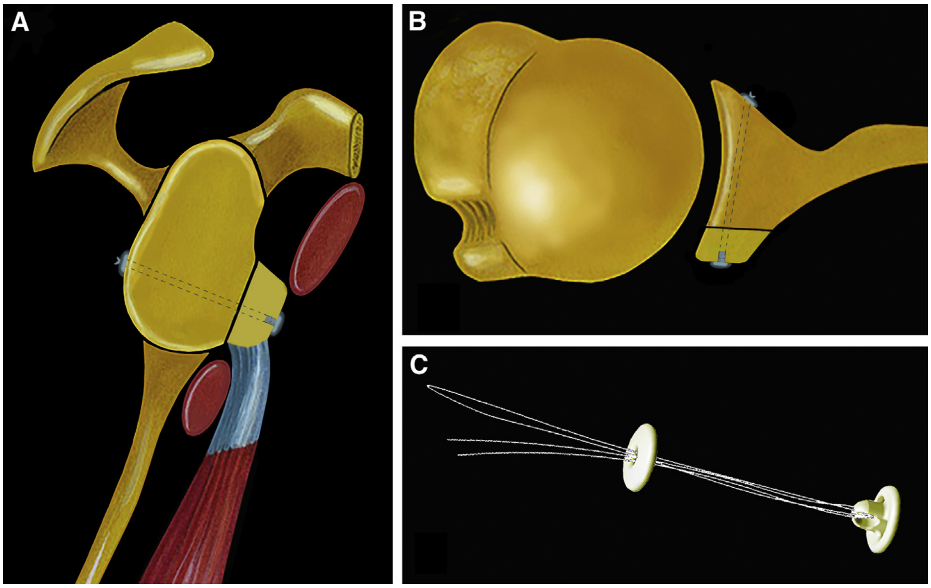

Figure 1 Arthroscopic Latarjet procedure with cortical button fixation. (**A**) The coracoid process is transferred, passed through the subscapularis, and fixed on the anterior neck of the scapula with 2 cortical buttons and a 4-strand suture (Bone-Link). (**B**) The anterior (coracoid) button has a pegged eyelet (to avoid cutting the bone with the suture) and is placed first; the posterior (glenoid) button has a single hole and is placed after having pulled the suture in the back of the shoulder. (**C**) A sliding knot (Nice-Knot) is tied posteriorly, and the suture is tensioned to obtain bone-to-bone compression; 3 additional surgeon's knots are tied to definitively lock the construct.

(anterior) button is convex (to adapt to the coracoid's shape) and pegged to prevent suture cut-through of the bone during the period before bone union. The **glenoid (posterior) button** has 1 hole allowing suture passage. A specific sliding knot (Nice knot) is tied posteriorly to obtain bone compression. Further bone compression is obtained with the help of the suture tensioner and 3 additional surgeon's knots to lock the construct.

Surgical technique

General anesthesia and interscalene block were used in all patients. Abduction of the arm is detrimental by bringing the axillary nerve in the operative field, and thus we recommend performing this procedure in the beach chair position. The arm is placed in a movable support (Spider Limb Positioner, Smith & Nephew) without traction. The shoulder is placed in 60° of flexion (to relax the anterior deltoid) and 30° of internal rotation (to increase the subcoracoid space and to relax the axillary nerve). The elbow is placed at 90° of flexion (to relax the conjoint tendon). Shoulder abduction is absolutely contraindicated as it brings the neurovascular structures laterally, in front of the scapular neck, putting them at risk. Shoulder extension is also contraindicated as it reduces the anterior subdeltoid space and puts the axillary nerve under tension.

Through a standard posterior portal, a systematic inspection of the joint is performed. The first anterior (north-west) portal is used for intra-articular work; it is located on the skin at the anterolateral corner of the acromion. Four additional anterior portals are created, on each side of the coracoid.[9,10] The north portal is 1 fingerbreadth proximal; the south portal is 2 fingerbreadths distal (in the axillary fold); the west portal is 2 fingerbreadths lateral; and the east portal (passing obliquely through the pectoralis major muscle) is 3 fingerbreadths medial to the tip of the coracoid (Fig. 2).

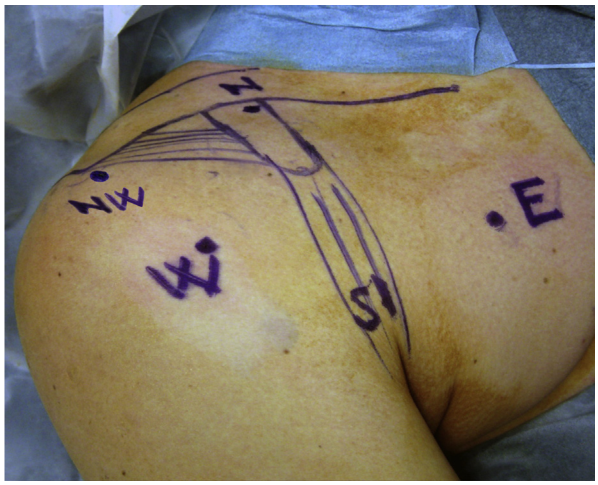

Figure 2 The 5 anterior arthroscopic portals needed to perform an arthroscopic Latarjet procedure, as shown in the right shoulder of a patient in the beach chair position: proximal (north), distal (south), lateral (west), and medial (east) to the coracoid process. The north-west portal (located at the anterolateral corner of the acromion) is the rotator interval portal used to work inside the joint; the other 4 portals are used to work mainly extra-articularly.

We use a 70° scope (in preference to a 30° scope) for the procedure as it offers superior visualization of the anterior neck of the scapula. Furthermore, the advantage of viewing around ''acute angles'' with a 70° scope obviates the need for additional portals and thereby eliminates the problem of instrument crowding.[4]

The technique comprises **four steps**, all performed arthroscopically, in addition to the Bankart repair.

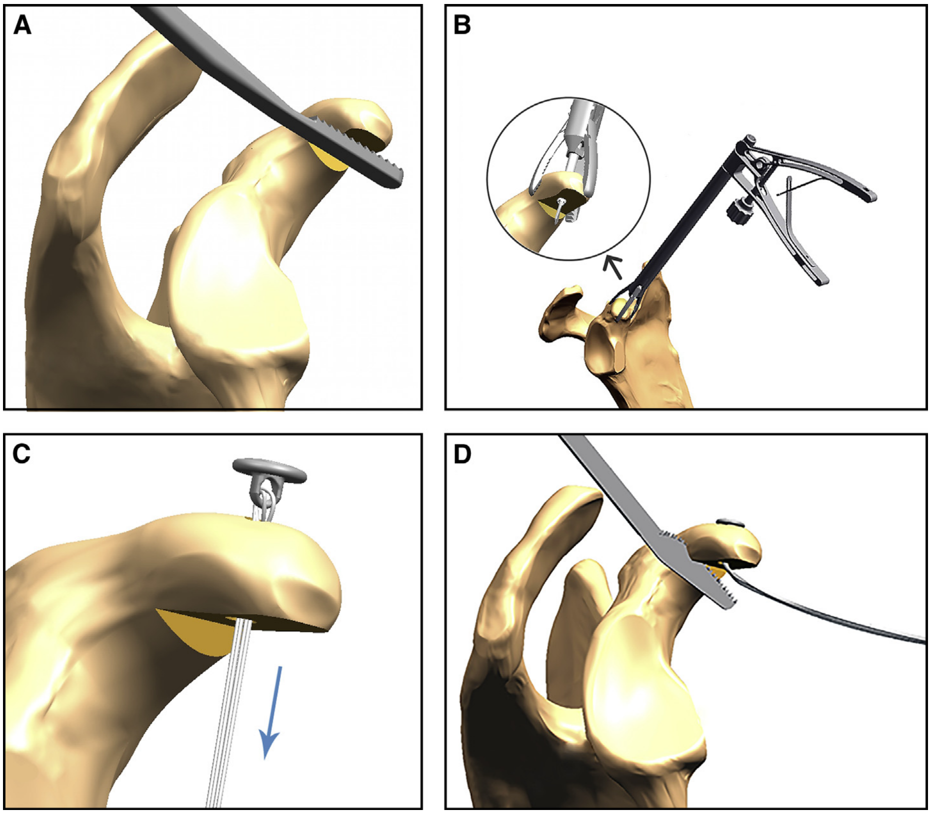

Figure 3 Coracoid preparation, drilling, and osteotomy. (**A**) The coracoid graft site is abraded with a motorized rasp introduced from the north-west portal. (**B**) The coracoid guide is introduced through the north portal and used to grasp the coracoid and to drill a 2.8-mm hole strictly perpendicular to the coracoid process. (**C**) The peg cortical button is placed over the coracoid using a shuttle suture. (**D**) The coracoid osteotomy is performed with a motorized saw introduced from the north-west portal.

Step 1: coracoid preparation, drilling, and osteotomy

The location of the posterior portal is crucial. It is located 1 cm inferior and medial to the posterior angle of the acromion. A spinal needle is used to make sure that the scope and instruments will be flush with the glenoid surface and at the level of the equator. With the arthroscope in the posterior portal, the first anterior (north-west) portal is created. A needle is used to ensure that instrumentation will be tangential to the anterior neck of the glenoid and to the undersurface of the coracoid. With use of electrocautery, the coracoid process is identified.

The 70° scope, being in the posterior portal, is pushed through the rotator. This allows release of the coracoacromial ligament from the lateral border of the acromion and identification of the conjoint tendon. Using a hook, a suture is placed around the conjoint tendon to retract distally the tendon and the coracoid after its osteotomy. The north portal is then created (medial to the coracoid process) with the help of the spinal needle. This allows release of the pectoralis minor from the medial border of the coracoid. The undersurface of the coracoid process is abraded with the motorized rasp (introduced through the north-west portal) to create a flat surface (Fig. 3, *A*).[10] The coracoid guide is introduced to grasp the coracoid perpendicular to its surface. This means that it must be tilted 45° medially (Fig. 3, *B*). A first drill-tipped K-wire housed inside an outer sleeve is advanced through the guide and drilled until it exits the inferior surface of the coracoid. The hole is placed 5 mm from coracoid margins (Fig. 3, *B*). The coracoid K-wire is replaced with a polydioxanone (PDS) suture, which is passed through the sleeve and the coracoid hole. The PDS suture is retrieved through the west portal. The coracoid guide and the sleeve are removed. The coracoid peg button (with the 4-strand suture) is pulled into place using the PDS suture as a shuttle (Fig. 3, *C*). The coracoid is osteotomized with a motorized saw (introduced through the north-west portal), harvesting about 15 to 20 mm of bone (Fig. 3, *D*). The north portal is closed with a clip to avoid losing water outside the shoulder.

Step 2: glenoid preparation and drilling

The anterior labrum is completely detached (but preserved) to visualize the glenoid bone defect. A suture is passed through the labrum at the 5-o'clock position and retrieved through the west portal, allowing the labrum to be pulled away from the glenoid neck. The glenoid neck is abraded to a flat bed by use of the motorized rasp (Fig. 4, *A*). A glenoid anchor hole is drilled at 3 o'clock (through the west portal), and a suture anchor (SUTUREFIX, Smith & Nephew) is inserted; it will be used later for the labrum repair.

Using switching sticks, the scope is transferred to the north-west portal while a short half-pipe cannula is placed through the posterior portal. The glenoid drill guide is introduced inside the joint along the cannula. The guide is placed flush to the glenoid surface, at the 5-o'clock position, with the tip of the hook of the guide 5 mm medial to the glenoid rim (Fig. 4, *B*). A switching stick is introduced through the west portal to retract the labrum

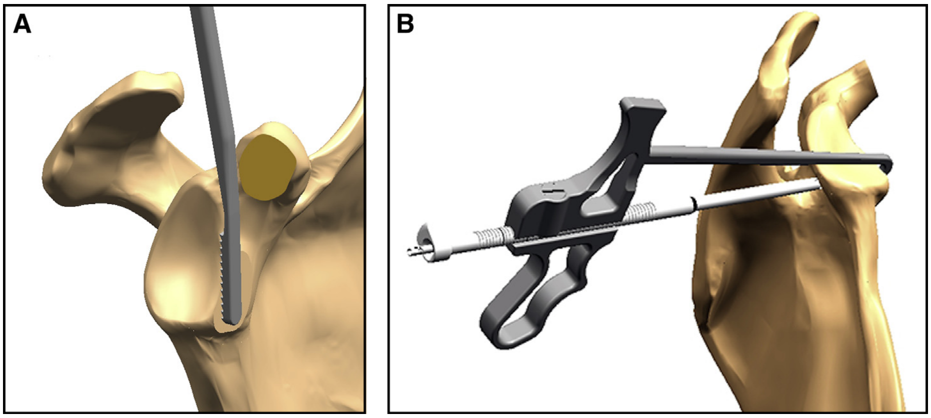

Figure 4 Glenoid preparation and drilling. (**A**) The glenoid neck is abraded with a motorized rasp. (**B**) The glenoid guide (10° angulated) is introduced inside the shoulder with the help of a half-pipe cannula. It allows drilling of a 2.8-mm hole almost parallel to the glenoid surface, below the equator (at the 5-o'clock position) and 5 mm medial to the anterior glenoid rim.

and subscapularis. The second drill-tipped K-wire housed inside an outer sleeve is drilled from posterior to anterior through the guide. The hole in the glenoid must be located at the 5-o'clock position (in a right shoulder) and 5 mm medial to the glenoid rim.

The glenoid guide is removed, leaving the sleeve in place. The subscapularis spreader is inserted inside the joint and pushed through the subscapularis muscle (at 5 o'clock) to act as a landmark for the split.

Step 3: subscapularis splitting and axillary nerve protection

With the arthroscope in the west portal and the shoulder in slight internal rotation, the axillary and musculocutaneous nerves must be clearly and systematically identified and protected. Following the anterior axillary vessels (the so-called 3 sisters) medially allows us to identify the 2 nerves (the so-called 2 brothers); hence our saying, "The 3 sisters guide the surgeon to the 2 brothers." The straight blunt retractor, introduced through the south portal, is used to separate the conjoint tendon from the subscapularis muscle and to protect the nerves.

With the arm by the side and slightly externally rotated, the subscapularis muscle is fully exposed. The posterior spreader is gently pushed farther through the muscle in a lateral direction (Fig. 5, *A* and *B*). The muscle belly is divided parallel with its fibers, at the superior $^2/_3$ −inferior $^1/_3$ junction.[21,33,47,49] While the spreader is opened, the cauterizing instrument is used to incise 1 cm longitudinally into the superficial tendon of the subscapularis; great care is taken to incise only the tendon and not the underlying capsule (used later for Bankart repair).

The anterior spreader is then introduced through the east portal and opened to visualize the abraded anterior neck of the scapula. Both spreaders create a "safe window" through the subscapularis muscle (Fig. 5, *C* and *D*), giving access to the anterior neck of the glenoid, which should now be completely exposed, and the correct position of the K-wire is confirmed.

Step 4: coracoid transfer and fixation

A suture retriever (passing from posterior to anterior through the outer sleeve of the glenoid drill piece) is used to catch the coracoid PDS suture, which is then retrieved posteriorly (Fig. 6, *A*). The drill piece in the glenoid is retrieved, and the PDS suture is used to shuttle the suture of the cortical button and to transfer the graft with the conjoint tendon onto the glenoid neck. The 4 strands of suture are passed through the hole of the second (glenoid) cortical button, and a sliding-locking knot (Nice knot) is then tied.[12] The suture tensioner is put in place in the back of the shoulder, and a temporary compression of 25 N is first obtained. The scope is reintroduced inside the joint to control placement and rotation of the bone graft. The positioning and rotation of the coracoid graft are controlled with the help of the coracoid grasper, ensuring no lateral overhang. Further compression of 100 N of the bone graft against the anterior glenoid neck is obtained by use of the suture tensioner (Fig. 6, *B*). The suture tensioner is removed. It is followed by 3 square knots tied to definitively lock the construct. Combined use of the glenoid and coracoid guides allows matching of the articular surface of the coracoid graft to the glenoid rim, thus virtually eliminating the possibility of an articular step (Fig. 7).

Step 5: Bankart repair

Visualization from the posterior portal and palpation with a probe confirm the absence of overhanging of the coracoid bone block and the stiffness of the construct (Fig. 8, *A*).The remaining capsule and labrum are now reattached to the glenoid rim, placing the graft in an extra-articular position. The previously placed suture anchor (placed at 3 o'clock) is used to repair the labrum (Fig. 8, *B*). Additional sutures can be placed to perform an anteroinferior capsulorrhaphy.[17] The dynamic sling effect of the block can now be visualized by placing the scope in the anterior subdeltoid space.

Postoperative management

Postoperative radiographs are taken to confirm the correct graft position (Fig. 9, *A*). The patient is discharged from the hospital the same day or the day after surgery. The arm is strictly immobilized for 2 weeks in a neutral rotation sling; this allows healing of the conjoint tendon in the muscular part of the subscapularis muscle and avoids postoperative loss of external rotation. Pendulum exercises start after 2 weeks (5 times a day, 5 minutes each session). After 4 weeks, the sling is removed and formal rehabilitation with a physiotherapist is started. Swimming pool therapy is

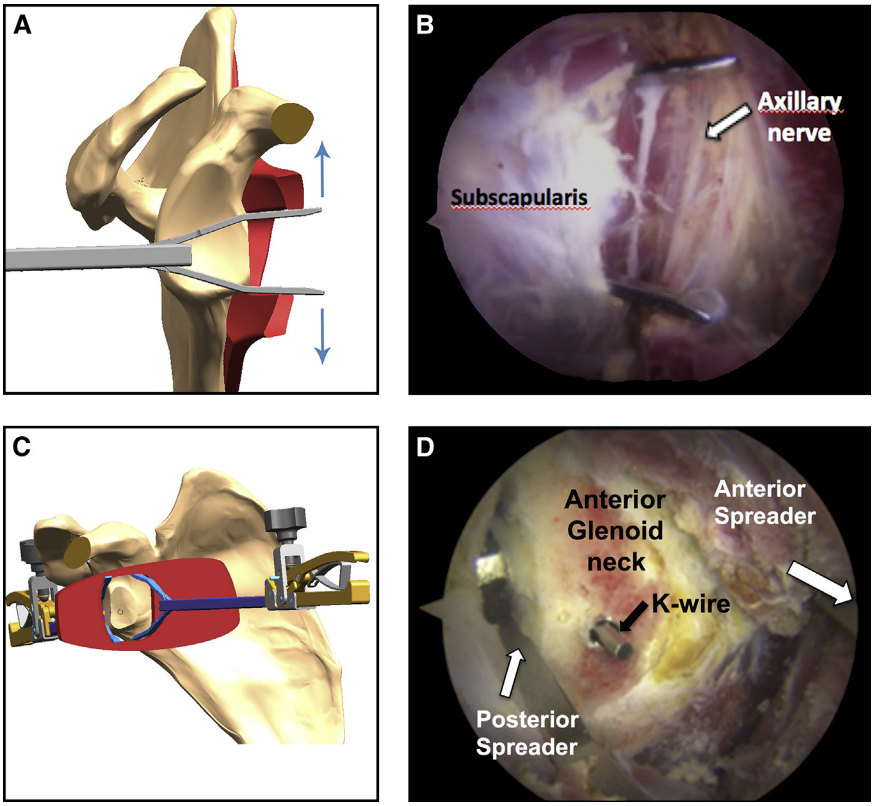

Figure 5 Subscapularis split. After the axillary and musculocutaneous nerves have been located and protected with a retractor, the first (posterior) spreader is gently pushed through the subscapularis muscle (from posterior to anterior), staying lateral to the nerves, and opened (**A** and **B**). The second (anterior) spreader is placed in the split and opened. This allows the creation of a "safe window" through the muscle and protects the axillary and musculocutaneous nerves. The outer sleeve of the drill is seen and will be used to shuttle the suture in the back of the shoulder (**C** and **D**).

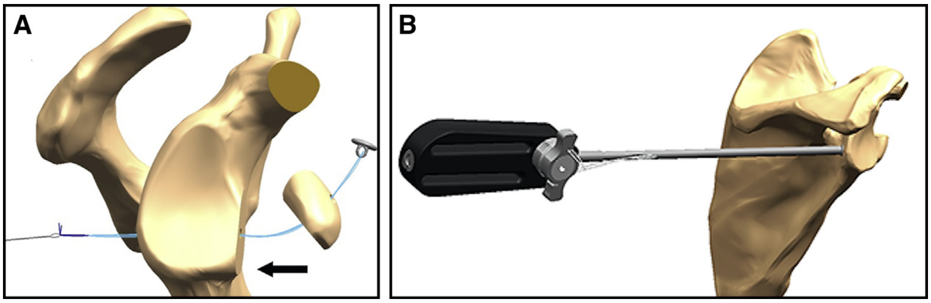

Figure 6 Coracoid transfer and fixation. (**A**) The 4-strand suture is shuttled through the glenoid, which brings the coracoid graft onto the anterior neck of the scapula. (**B**) After rotation of the bone block has been controlled, a suture tensioner is used to put compression (100 N) between the transferred coracoid bone block and the glenoid neck.

encouraged. No heavy lifting is allowed for the first 12 weeks. Return to all types of sports activities, including collision and contact-overhead sports, is allowed between 3 and 6 months postoperatively.

Study design

To evaluate the value of this novel arthroscopic procedure in obtaining satisfactory graft positioning and healing, we performed a prospective clinical and CT scan study. The criteria for inclusion were (1) traumatic recurrent anterior shoulder instability and (2) glenoid bone deficiency involving >20% of the glenoid surface, as measured on preoperative 3-dimensional CT scan or during diagnostic arthroscopy.[15,41,44] Patients with previous failed shoulder stabilization and glenoid bone deficiency were accepted for enrollment. We excluded patients with no or minimal glenoid deficiency and those with isolated labral or isolated Hill-Sachs lesions.

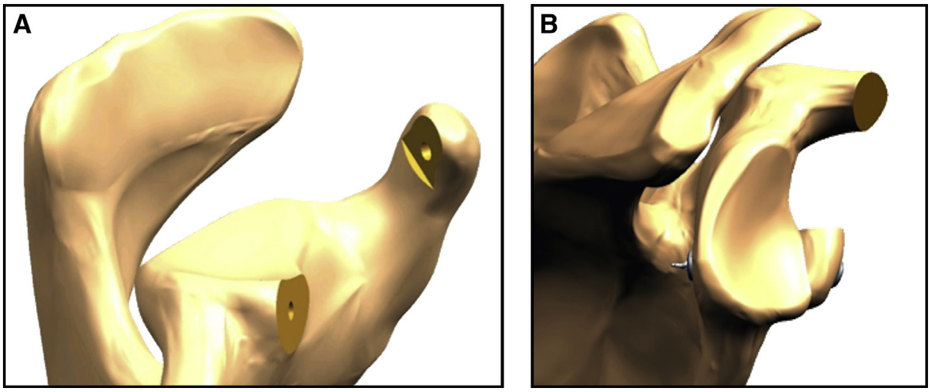

Figure 7 The guided arthroscopic approach (**A**) improves graft positioning (reducing the risk of excessive medialization or lateralization), while the cortical button fixation provides strong fixation (**B**).

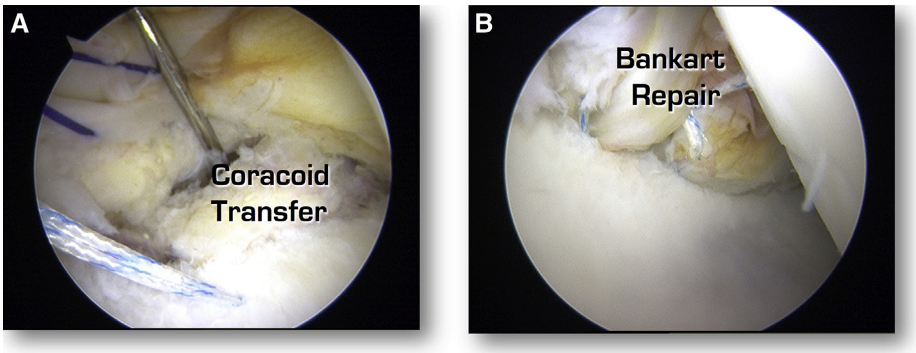

Figure 8 Arthroscopic final view. Intra-articular views show (**A**) perfect positioning of the coracoid bone block and (**B**) capsulolabral repair producing the bumper effect (and placing the bone block in an extra-articular position).

Clinical assessment

Patients were prospectively observed and examined clinically at 2 weeks, 3 months, 6 months, and 12 months postoperatively and annually thereafter. Any postoperative dislocation or subjective complaint of occasional to frequent subluxation was considered a failure. Functional assessment was performed with the Rowe and Walch-Duplay scores.[14,25,46]

Computed tomography scan assessment

Graft positioning was evaluated with radiographs and CT scans obtained at 2 weeks (Figs. 9, *B* and 10). The ideal position was defined as below the glenoid equator (in the vertical plane) and flush to the glenoid rim (in the horizontal plane).[13,25,46] The bone block was judged to be too lateral if a step was visible beyond the level of the glenoid rim and too medial if it was ≥5 mm medial to the rim. Graft healing was assessed by the same imaging studies performed at 6 months postoperatively (Fig. 9, *C*).

Statistical analysis

To evaluate risk factors for nonunion, we used the Fisher variance test, with multivariate analysis. The level of significance was set at $P < .05$. Analysis was performed with StatView 5.0 (SAS Institute, Inc., Cary, NC, USA).

Results

Patient population

Between December 2012 and May 2014, 78 surgical patients met the inclusion criteria. Two patients could not come for the 6-month follow-up, leaving 76 patients (10 women and 66 men) with a mean age of 27 years (range, 15-58 years). The dominant arm was involved in 64% of the patients. The average number of instability episodes was 15 (range, 3-300). All patients were involved in sports before injury. Fifty-three patients (70%) played at a competitive or recreational level. Nine patients (12%) had a history of unsuccessful prior shoulder stabilization (1 open Bankart repair, 6 arthroscopic Bankart repairs, and 2 arthroscopic Hill-Sachs remplissage plus Bankart repair). Two patients had associated pathologic processes (1 superior labral anterior-posterior type III lesion and 1 partial-thickness supraspinatus tear) that were treated during the same procedure.

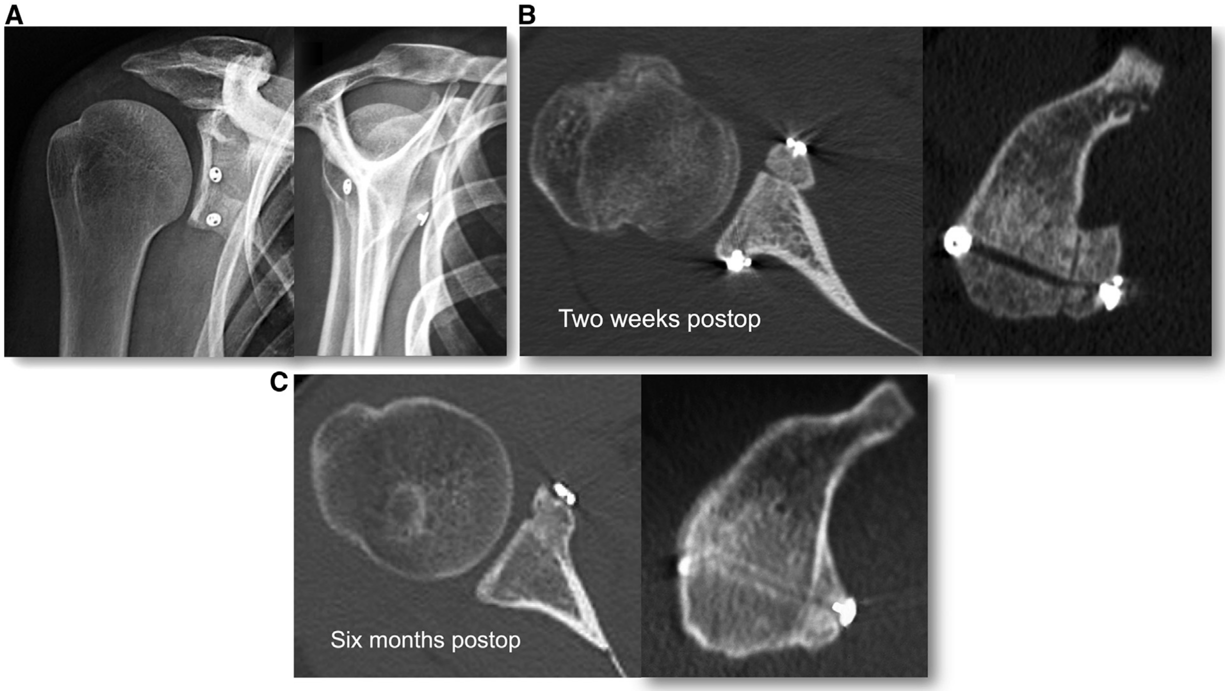

Figure 9 Example of coracoid bone block positioning and healing after guided arthroscopic Latarjet procedure and fixation with suture and cortical buttons. (**A**) Anteroposterior and lateral radiographs at 2 weeks. (**B**) Two-dimensional CT images at 2 weeks demonstrate perfect coracoid positioning (below the equator and flush to the glenoid surface). (**C**) Two-dimensional CT images at 6 months demonstrate coracoid bone block healing and remodeling.

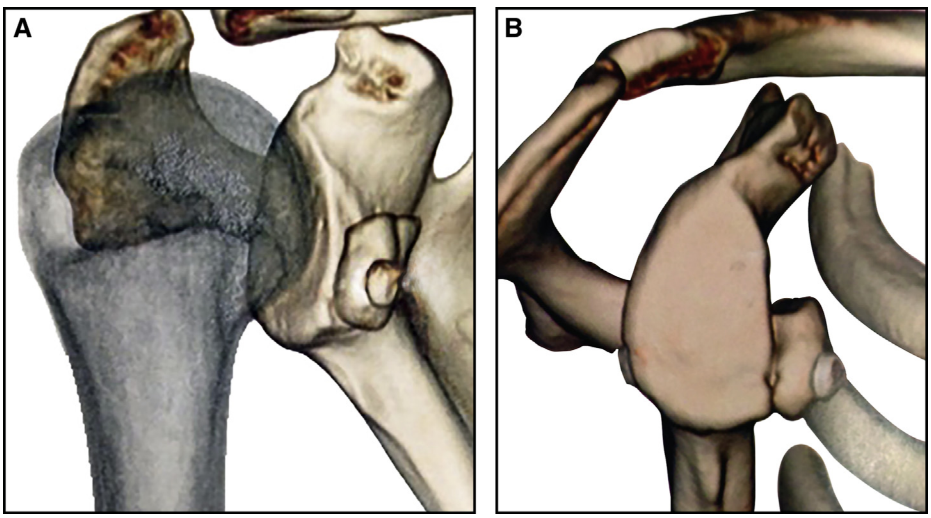

Figure 10 Three-dimensional CT images performed at 2 weeks after arthroscopic Latarjet procedure showing perfect bone block positioning, which is flush to the articular surface (**A**) and below the equator (**B**).

Clinical results

At a mean follow-up of 14 months (range, 6-24 months), no patient had redislocated; however, 1 rugby player experienced a traumatic subluxation after a forced abduction–external rotation movement while playing 5 months after surgery. CT scan analysis showed that the graft had failed to unite. At latest follow-up, the mean Rowe and Walch-Duplay scores were 95 (range, 84-100) and 96 (range, 86-100), respectively, and 93% had returned to their preinjury level of sports. The neurologic examination findings were normal in all patients. No patient underwent further surgery.

Table I Coracoid bone graft position in relation to the glenoid evaluated on postoperative CT scans performed 2 weeks after surgery

Coracoid bone graft positioning	No. of shoulders (N = 76)	%
Horizontal position		
Too medial (>5 mm medial to the glenoid rim)	0	0
Too lateral (>5 mm lateral to the glenoid rim)	3	4
Flush to the glenoid surface (correct graft position)	73	96
Vertical position		
Over the equator (>50% of bone block over equator line)	1	2
At the equator (>25% of bone block over equator line)	4	5
Under the equator (correct graft position)	71	93

Coracoid bone graft positioning

The results of the CT evaluation for bone block positioning are reported in Table I. Overall, 96% of the grafts were placed congruent with the glenoid articular surface, with only 3 grafts demonstrating slight lateral placement (Fig. 10). No secondary rotation of the graft was observed.

Coracoid bone graft healing

On the basis of CT evaluation performed 6 months after surgery, the graft had united in 69 patients (91%) (Fig. 9, *C*) and failed to unite (fibrous union) in 7 patients (9%). Partial graft osteolysis was seen in 2 patients. No hardware failures and no graft migration were observed.

Risk factors for nonunion

When comparing the 69 patients whose graft had healed with the 7 patients with nonunion, we found that smoking ($P < .05$) was the only significant risk factor found for nonunion. Age, gender, glenoid bone loss, and previous history of shoulder surgery were not found to be significant.

Discussion

Performing the arthroscopic Latarjet procedure ought to be approached with caution. It is not only technically challenging (especially with respect to graft and screw positioning) but also potentially dangerous (because of the proximity of the neurovascular structures), and it can be associated with complications related to the use of screws as already stated.[13,16,20,28,32,43,51,52] In an attempt to make the procedure more reproducible and safer, we have developed a guided surgical approach and a suture button fixation technique. The study hypotheses were confirmed. Our results show that (1) a guided surgical approach for the arthroscopic Latarjet procedure improves graft positioning, with reduced risk of excessive medialization or lateralization; (2) suture button fixation is an alternative to screw fixation with respect to union rates; and (3) neurologic and hardware complications classically reported with screw fixation are not observed.

The study has several key strengths. First, it is a prospective case series; only 2 patients (3%) have been lost to follow-up. Second, standardized postoperative imaging was performed on all by CT, which is significantly superior to plain radiography in assessing graft positioning and healing.[44] Third, our minimum 6-month follow-up was sufficient to evaluate healing of the graft because the critical period for the performance of a fixation device is between postoperative weeks 6 and 12.[26,44,46] Study weaknesses include the absence of a control group (classic screw fixation technique) and its relatively short follow-up. A randomized, controlled study was not performed, as this is the development of a new technique. We do acknowledge that longer follow-up and further studies will be needed to definitively confirm the reliability of the procedure and to allow comparison with the traditional method.

The success of the Latarjet procedure is largely dependent on accurate placement of the graft relative to the glenoid margin.[2,16,25,35,42,43,46,51,52] Malpositioning can lead to major complications, including recurrent instability (when it is placed too medial or too high or low) or pain and subsequent rapid-onset osteoarthritis if it is positioned too lateral.[25,36,46] In our guided technique, the use of glenoid and coracoid guides allows matching of the articular surface of the graft to the glenoid rim, thus virtually eliminating the possibility of an articular step. Moreover, the flexible nature of the suture button construct eliminates any possibility of coracoid obliquity. In our series, the graft was flush to the glenoid surface in 96% of patients. This rate is far higher than that reported with open or arthroscopic Latarjet techniques.[2,12,16,29,30,43,46,51]

Graft healing is another key factor for the success of the Latarjet procedure. In the traditional Latarjet technique (open or arthroscopic), fixation of the transferred bone block is achieved with 2 (4.5-mm-diameter) bicortical screws.[2,15,19,30,36,46] Butt and Charalambous,[16] in a recent review of 30 studies (1658 cases), found the mean rate of graft nonunion or graft migration with screw fixation to be 10.1% ± 1.6%. Our results (91% union) suggest that suture button fixation at least equals the performance of screw fixation. Knowing that the results reported in the literature are based on radiographic analysis (which is known to be inferior to CT analysis), our results compare favorably.

To our knowledge, it is the first time that a suture button fixation device has demonstrated the ability to achieve bone-to-bone healing. In addition to providing a rigid construct, the suture button technique both preserves bone and maximizes the cancellous bone contact area between the coracoid and the glenoid neck; only a single 2.8-mm hole is required to pass the suture through the coracoid and glenoid, whereas the screw technique uses two 3.2-mm holes.[46,48,50] In our series, smoking was found to be a significant pejorative factor for bone nonunion. Our high rate of bone healing with cortical button fixation of the transferred bone block is not surprising. A recent biomechanical evaluation has shown that the median ultimate load to failure of 2 bicortical malleolar screws is 202 N (range, 95-300 N).[48] In contrast, it has been demonstrated that a cortical fixation device, such as the Endobutton, provides a repair construct with load to failure of up to 440 N for distal biceps fixation and up to 800 N for anterior cruciate ligament graft fixation.[1,26,34,39] These values are considerably higher than the value obtained with screw fixation in the traditional Latarjet procedure.[18,27,34,45]

Another pertinent finding of the present study is that the use of suture button fixation avoids hardware complications reported with screw fixation. For many surgeons, a substantial barrier to adoption of the Latarjet procedure is the high rate of complications and unplanned reoperations (30% and 7%, respectively, according to the recent systematic analysis of 45 studies by Griesser et al[23]). With screw fixation, the most commonly encountered complication is symptomatic hardware, occurring in 6.5% of cases according to Butt and Charalambous.[16] These complications include hardware failure (screw migration, loosening, or breakage in 3.8%) and hardware irritation (including joint penetration, soft tissue irritation, and impingement in 2.7%); they may be severe enough to lead to further surgery in a young and active population.[16,23] Using the suture button fixation, we observed no hardware failure or implant migration, and none of our patients have required further surgery so far.

Many authors have emphasized the risk of neurologic injuries, mainly in patients with prior surgical procedures (seen in up to 10%).[16,20,28,32,35,43,51,52] In our series, we did not observe any neurologic complication, despite 8 of our patients (12%) having had previous failed surgical procedures to stabilize their shoulder. Screw manipulation and drilling close to the anterior neurovascular structures are dangerous parts of the traditional (open or arthroscopic) Latarjet procedure. With our arthroscopic guided technique, the risk of injury to the anterior neurologic structures is almost eliminated as glenoid drilling is made from posterior to anterior and remains inside the glenohumeral joint (with a stop for the K-wire). Posteriorly, the risk of iatrogenic injury to the suprascapular nerve is totally eliminated because our glenoid guide allows drilling and placement of the implant away from the nerve, within the posterior "safe zone" defined by Lädermann.[28] Furthermore, given the low profile and flexible nature of the suture button construct, placement under arthroscopy is easier and safer.

Finally, the benefits of completing the surgery arthroscopically and performing a Bankart repair (in addition to the Latarjet) may be questionable. In our opinion, the main benefit of completing the surgery arthroscopically (in addition to decreased bleeding, less postoperative pain, better cosmesis, and earlier return to sport) is the improved intra-articular and extra-articular visualization, allowing (1) possible treatment of associated pathologic processes (superior labral anterior-posterior lesions, labrum tears, rotator cuff tears), (2) control of accurate graft placement, (3) improved safety of the procedure because of permanent visual control of the neurovascular structures, and (4) ability to perform an associated Bankart repair, placing the coracoid graft in an extracapsular position. The main benefits of keeping the capsule and labrum are the following: (1) it protects the humeral head from contact with the graft (which should theoretically result in a reduced incidence of arthritis); (2) it adds shoulder stability (by keeping the bumper effect); (3) it preserves proprioception (essential in sportsmen); and (4) there is no hardware inside the glenohumeral joint, which reduces the risk of reoperation for symptomatic hardware failure.

Conclusion

The most important finding of the present study is that a suture button fixation device can be used to obtain bone union of the coracoid with the glenoid neck in the arthroscopic Latarjet procedure. Both the guided surgical approach and the suture button fixation method developed for the arthroscopic Latarjet procedure allow reproducibly accurate positioning, fixation, and healing of the graft. In addition, neurologic and hardware complications reported with screw fixation have not been observed with this novel fixation method and guided technique. In the senior author's hands, and in similar fashion to the evolution of anterior cruciate ligament reconstruction, the utilization of targeting drill guides, passing pins, and cortical suspension fixation devices has reduced intraoperative challenges and brought simplicity, reproducibility, and safety to the Latarjet procedure performed arthroscopically.

A video of the technique is available upon request to the corresponding author.

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