Arthroscopic Latarjet procedure with double-button fixation: short-term complications and learning curve analysis

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Background: The arthroscopic Latarjet with double-button fixation is a guided procedure recently proposed to treat anterior shoulder instability with glenoid bone loss. The goal of this study was to report intraoperative and early postoperative complications and to analyze the learning curve.
Methods: This was a prospective, nonrandomized study that included 88 patients. Intraoperative or postoperative complications as well as adverse events and operative time were recorded. Clinical outcomes were evaluated at 2 weeks, 1.5 months, and at the last follow-up. Radiologic analysis was based on an immediate postoperative computed tomography scan.
Results: The intraoperative complications or adverse events rate was 3.3%: 1 conversion to open surgery, 1 bone block fracture, and 1 instrumentation problem. The postoperative complication rate was 6.8%: 4 coracoid migrations, and 2 subluxations. None of these complications occurred beyond the 10th case performed. The average operative time significantly decreased with surgical experience ($r = -0.8426$; 95% confidence interval, −0.9074 to −0.7384; $P < .0001$) to reach 76 ± 12 minutes (range, 62-95 minutes) at 30 cases. Radiologically, 90% of the bone blocks were flush and subequatorial beyond the 30th case. At a mean follow-up of 12.6 months (range, 6-24 months), Walch-Duplay and Rowe scores were 80 and 81 points, respectively.
Conclusions: At short-term follow-up, the arthroscopic Latarjet procedure with double-button fixation exhibited a low complication rate. Operative time significantly improved with surgical experience and was optimized after 30 cases. Early clinical results confirmed that this procedure can be safe and reliable.

The Hôpitaux de Toulouse Ethics Committee for Research on Human Subjects approved this study (No. 01-526).

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

Keywords: Arthroscopic Latarjet; double button; complications; learning curve; bone block; anterior shoulder instability

The Latarjet procedure is indicated to treat anterior shoulder instability with significant glenoid bone loss: the coracoid transfer provides an adequate bone reconstruction and the conjoint tendon contributes a sling effect in abduction-external rotation.[16,20,26] With an associated Bankart repair, obtaining a "triple locking" effect with an extra-articular bone block position is possible.[8] Despite a low rate of recurrence after open Latarjet of approximately 5%, the complication rate could reach 25% in the literature.[8,10-12,23,25,26]

Arthroscopic techniques have been recently developed to reduce this complication rate and improve the bone graft position.[6,7,15] Lafosse et al[15] described a procedure in which the screw fixation of the coracoid was similar to the original Latarjet technique. However, some concerns related to screws (position, length, impingement with soft tissue, placement) were reported.[1] In contrast, Boileau et al[6] proposed an innovative double-button fixation method and a guided approach to transfer the coracoid through the subscapularis muscle. The procedure remains demanding, and to our knowledge, no other center has reported clinical and radiologic outcomes for this new surgical technique.

The objective of our study was to report early intraoperative and postoperative complications or adverse events of this new surgical technique and to analyze the learning curve of this innovative operation. We hypothesized that the complication rate with this arthroscopic technique would not exceed the reported rates with the open Latarjet procedure.

Materials and methods

This was a prospective nonrandomized multicenter study conducted from April 2015 to October 2016. We included (1) patients with an anterior shoulder instability associated with glenoid bone loss, (2) treated with an arthroscopic Latarjet procedure with double-button bone block fixation, and (3) evaluated with a minimum follow-up of 6 months. Revision operations were excluded. Patients gave their consent for the use of their clinical and radiologic data. Of the 90 patients who fulfilled the criteria for inclusion, 2 were excluded because of revision surgery; therefore, a cohort of 88 patients was available for statistical analysis.

Surgical technique

The 4 surgeons who participated in this study were specialized in shoulder surgery for a mean of 5.5 years (range, 3-9 years) and a mean of 343 cases yearly (range, 255-462 cases yearly). They were educated through a specific training program dedicated to this technique, including demonstration step by step by the designer of the technique and cadaveric laboratory assisted procedures.[6]

A 70° scope and specifically designed instruments (Latarjet Guiding System; Smith & Nephew Inc., Andover, MA, USA) were used. The procedure involved 5 arthroscopic anterior portals (North, West, South, East, and Northwest) and 5 successive steps according to Boileau et al[6] summarized as follows:

1. Coracoid preparation and osteotomy: pectoralis minor and coracoacromial ligament release, abrasion and flattening of the under face, positioning of the peg button, and osteotomy at approximately 1.5 cm from the tip of the coracoid (Fig. 1).
2. Glenoid preparation: abrasion and flattening of the neck of the scapula, insertion of an anchor at 3 o'clock, and positioning of a posterior-anterior pin with the glenoid drill guide (Fig. 2).
3. Subscapularis split: use of an intra-articular spreader transfixing the subscapularis muscle and opening a "safe window" by protecting the visible axillary nerve in front. A second spreader is placed from the east portal to extend the split (Fig. 3).
4. Bone block fixation: transfer of the coracoid through the subscapularis split with shuttle suture and definitive fixation with a posterior cortical button fixation (compression controlled at 100 N) by a Nice knot[5] (Fig. 4).
5. Bankart lesion repair with the previously positioned anchor and 1 or 2 sutures.

Postoperatively, an immobilization in internal or neutral rotation was established for 4 weeks. Pendular exercises were initiated in week 2 and active mobilization from week 4 by protecting external rotation up to the week 6. No sports that would place the shoulder at risk were authorized before 3 months.

Intraoperative and postoperative assessment

The learning curve was analyzed through the operative time (from the cutaneous incision to its closure), accuracy of bone block position, and intraoperative complications or adverse events. Postoperative complications with clinical or radiologic effect were also recorded.

Clinical monitoring was performed prospectively at 2 weeks, 1.5 months, and every 3 months. Active mobilities were assessed in forward elevation, in external rotation with the elbow at side and in abduction, and in internal rotation (vertebral level reached by the thumb). The functional objective assessment was based on the Rowe and Walch-Duplay scores.[22,24]

The preoperative radiologic analysis was based on anteroposterior and Bernageau views.[4] A computed tomography (CT) scan or arthro-CT scan clarified the presence of a Hill-Sachs lesion and the amount of glenoid bone loss.

Postoperatively, an anteroposterior view was assessed at each clinical appointment, and an early CT scan (<15 days) was dedicated to analyze the position of the bone graft. OsiriX (Pixmeo, Geneva, Switzerland) imaging software allowed for the multiplanar reconstruction from the native data.[14,21] The bone block overhang was measured in the axial plane according to the technique tangent to the subchondral bone over 2 sections (equatorial and lower one-fourth of the glenoid

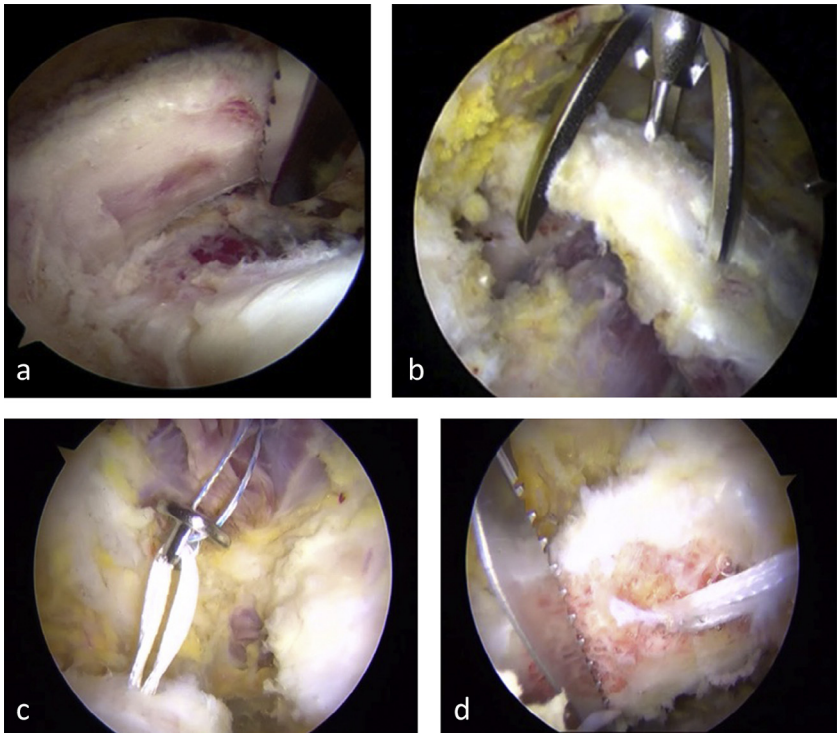

Figure 1 First step. Posterior viewing portal of a right shoulder. (**A**) The coracoid process is flattened and abraded with a motorized rasp, (**B**) a coracoid guide places a Kirschner wire housed inside an outer sleeve, (**C**) the peg button is positioned over the coracoid with a shuttle suture, and (**D**) the coracoid is osteotomized with a motorized saw.

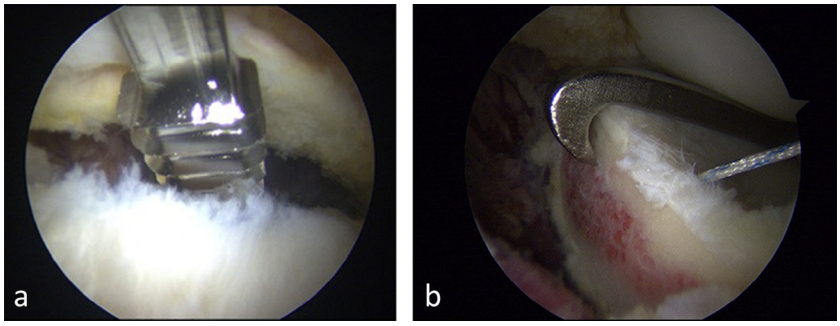

Figure 2 Second step. Posterior viewing portal of a right shoulder. (**A**) The glenoid neck is abraded with a motorized rasp. (**B**) After an anchor is placed at the 3 o'clock position, a glenoid guide helps to drill the glenoid from posterior to anterior at 5 mm from the rim.

cavity). The bone block was thus considered as flush when no medialization or overhang was observed on the 2 levels of analysis. The subequatorial coronal position of the bone block was assessed by the coracoid subequatorial length/coracoid total length ratio.

The complication rate and radiologic analysis was assessed by subgroups of 10 successive cases of each surgeon (case 0 to case10, case 11 to case 20, etc) to assess the influence of the surgical experience on these parameters.

Statistical analysis

Statistical tests used SAS 9.3 software (SAS Institute, Inc., Cary, NC, USA). Quantitative variables are described by as average, standard deviation, and maximum and minimum values. The Agostino-Pearson test was used to determine whether the data were normally distributed. Qualitative variables are described by sample size and percentages. Qualitative variables were compared using the χ^2 or Fisher exact test. Quantitative variables were compared using the Student *t* test or the Mann-Whitney test, depending on whether the variable was normally distributed. The Spearman correlation test was used to determine the relationship between 2 variables. The significance threshold was set at 0.05.

Results

Study population

The average age was 25 ± 7 years (range, 16-60 years), and 86% were men. The dominant side was involved in 57%. Of

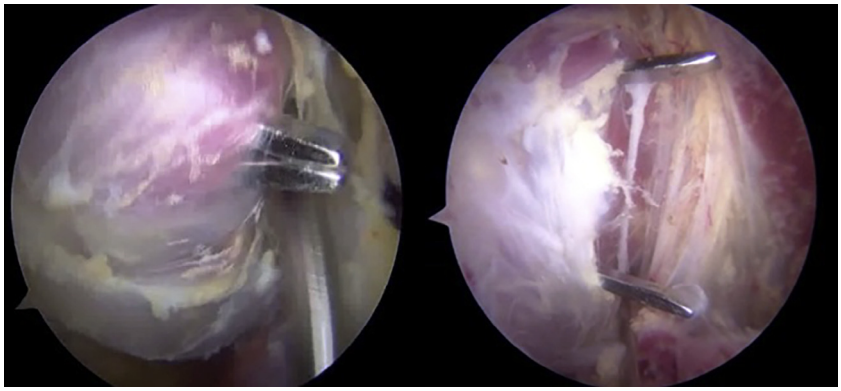

Figure 3 Third step. West (anterior subdeltoid space) viewing portal of a right shoulder. The spreader splits the subscapularis muscle and protect the axillary nerve.

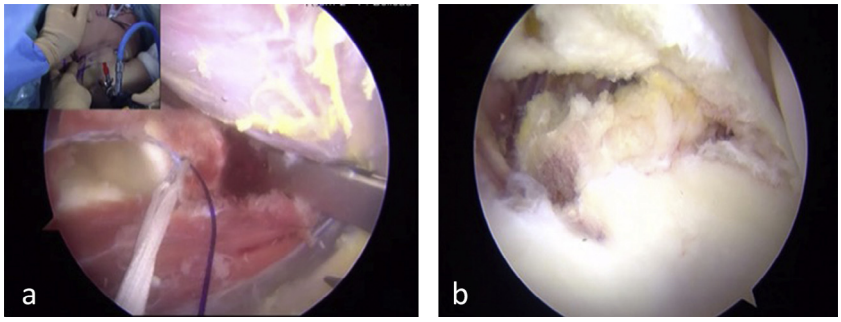

Figure 4 Fourth step. West (anterior subdeltoid space) viewing portal of a right shoulder. (**A**) A shuttle suture through the glenoid sleeve is used to pull the bone block through the subscapularis split. (**B**) The bone block is positioned parallel to the glenoid rim as flush as possible with an intra-articular view.

the patient population, 89% participated in sports: 40% in a pure contact sport, 29% in an overhead-contact sport, 16% in a pure overhead sport, and 15% in a sport without a specific risk to the shoulder.

The average instability severity index score was 5 ± 1.6 points (range, 3-9 points).[2] Glenoid bone loss occurred in 100% of cases and a Hill-Sachs lesion in 95%.

Complications

Three (3.3%) complications or adverse events occurred during the procedure: 1 conversion to open surgery because of diffuse soft tissue bleeding despite a controlled low blood pressure, 1 bone block fracture in a 60-year-old patient requiring an additional stabilization with a Hill-Sachs remplissage procedure, and 1 inconsequential glenoid guide pin failure during the step of glenoid drilling. All of these complications or adverse events occurred before the 10th case, regardless of the surgeon. No intraoperative neurologic or vascular lesion was reported.

Six (6.8%) postoperative complications were observed in 5 patients: 2 recurrent subluxations and 4 early bone block migrations (<3 months). The first recurrence was at 2.5 months after the operation while the patient slept on the operated-on shoulder in maximum abduction position. A CT scan showed the coracoid transfer was nonunited and migrated. The second occurred at 6 months during a contact with another player after resumption of soccer in a young hyperlax patient. The bone graft was united with a slightly too high position on the glenoid rim.

To date, none of these patients required surgical revision and were asked to follow a proprioceptive rehabilitation program. These complications were not observed beyond the 20th case.

No postoperative infectious or neurologic or vascular complications were identified in the entire series at the last follow-up.

Surgical time analysis

The average operative time of the entire series was 107 ± 30 minutes (range, 62-192 minutes). A significant inverse correlation was found between the operative time and surgical experience noted as number of cases performed ($r = –0.8426$; 95% confidence interval, –0.9074 to –0.7384; $P < .0001$). The time decreased by at least 10% every 10 cases, to reach 76 ± 12 minutes (range, 62-95 minutes) beyond the 30th case (Fig. 5). No significant difference was found among the 4 surgeons regarding the operative time improvement at any point ($P = .3$).

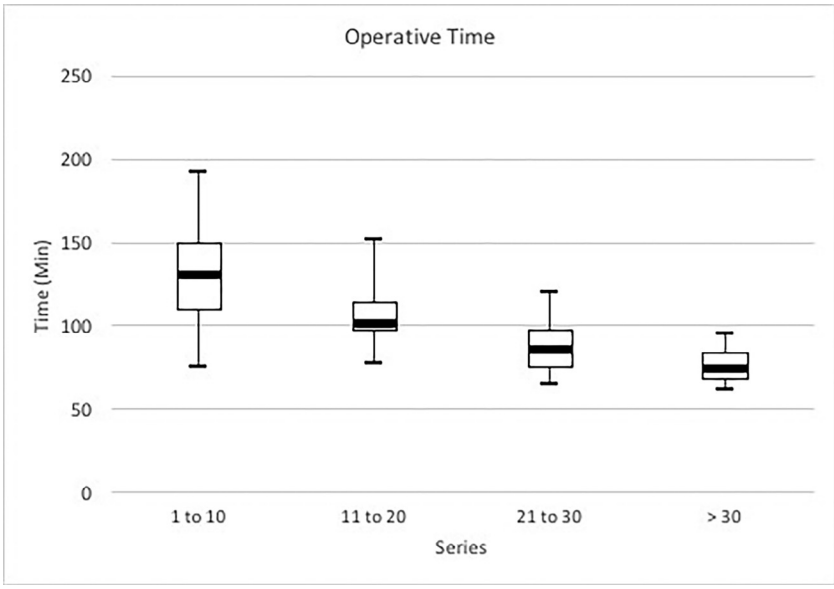

Figure 5 Box-and-whisker plots indicate the surgical time evolution in chronological cohorts of 10 cases. The *horizontal line* in the middle of each box indicates the median, the *top and bottom borders* of the box mark the 75th and 25th percentiles, respectively, and the *whiskers* mark the maximum and minimum of all the data.

Table I Preoperative and postoperative clinical assessments

Variable	Preoperative	Follow-up	*P* value
Rowe score (100 points total)	30 ± 12 (20-60)	81 ± 13 (50-100)	<.001
Duplay score (100 points total)	33 ± 14 (10-70)	80 ± 12 (50-100)	<.001
Active anterior elevation, °	179 ± 9 (150-180)	170 ± 11 (140-180)	.29
External rotation, °			
Elbow at the side	63 ± 19 (30-90)	66 ± 18 (30-90)	.90
In abduction	84 ± 13 (70-100)	88 ± 6 (70-100)	.85
Internal rotation, spine level	T8 (T3-T12)	T12 (L1-T7)	.83

Data are presented as mean ± standard deviation (range).
T, thoracic; *L*, lumbar.

Postoperative clinical assessment

For an average follow-up rate of 12.6 months (range, 6-24 months), Walch-Duplay and Rowe scores were 80 ± 12 points (range, 50-100 points) and 81 ± 13 points (range, 50-100 points), respectively. The average active mobility was 170° ± 11° (range, 140°-180°) in forward elevation, 66° ± 18° (range, 30°-90°) in external rotation with elbow at side, 88° ± 6° (range, 70°-100°) in external rotation in abduction, and T12 (range, L1-T7) in internal rotation (Table I). No apprehension in 90° of abduction/90° of external rotation was found in 80 patients (90%).

Radiologic assessment

Position of the bone block in the coronal plane

The bone block was flush in 81% of cases, medial in 15%, and lateral in 4%. In the lateral position, the average overhang was 3.6 ± 1.5 mm (range, 1.2-5 mm). The improved bone block position was significant beyond the 20th case with a flush bone block up to 90% (Fig. 6).

Position of the bone block in the sagittal plane

The average length of the bone block was 17.3 ± 2.8 mm (range, 12-25.4 mm). On average, 87% ± 18% (range, 33%-100%) of the bone block length was subequatorial. No bone block was fully above the equator. The surgical experience allowed for a significant improvement of subequatorial positioning of the bone block beyond the 30th case (Fig. 6).

Discussion

This study confirmed our initial hypothesis: the intraoperative and immediately postoperative complication rate for the arthroscopic Latarjet procedure with double-button fixation remains low, at approximately 10%, and did not exceed open Latarjet.[8,10-12,23,25,26] No major vascular or neurologic

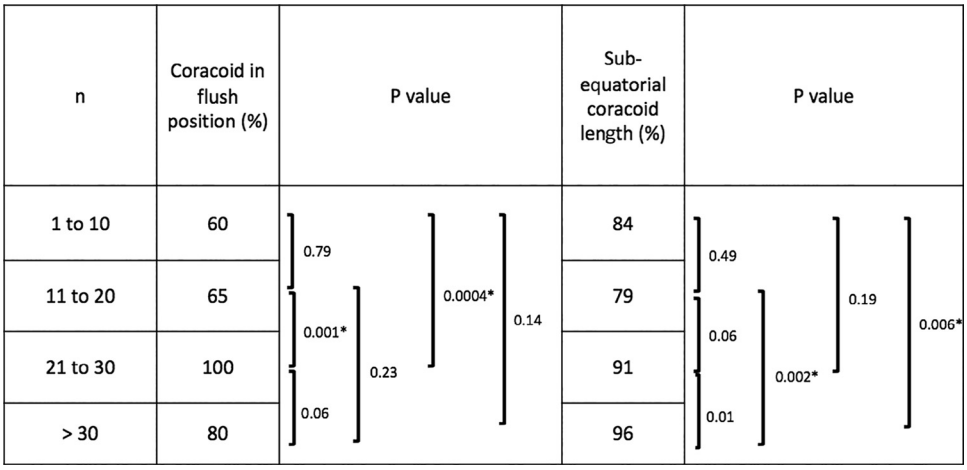

Figure 6 Analysis of the bone graft position (coronal and sagittal plan) in chronological cohorts of 10 cases.

complications were identified. Moreover, the learning curve analysis demonstrated that the operative time and bone block position significantly improved with surgical experience.

Athwal et al[1] reported the North American experience for the first 83 cases using the arthroscopic Latarjet procedure in 5 centers specialized in shoulder surgery. They described 24% adverse events or complications, including neurologic (1%) or vascular (1%) injuries. The fixation of the coracoid transfer with 2 screws was potentially involved in the occurrence of some complications[15]: 7% of graft fractures, 3% of screw backouts, bending or failures, and 4% of revision operations for removal of screws.

Studies from the European experience for this same surgical technique reported lower complication rates, however. Kany et al[13] described 1% neurologic complications and 3% surgical revisions for coracoid fracture or improper screw positions. A recent multicenter study of the French Arthroscopic Society reported by Métais et al[18] included 222 patients. Each center that participated was rather experienced in arthroscopic Latarjet with more than 100 cases already performed before the study. None included their first cases. The immediate postoperative complication rate was 4.5% (n = 10), and the revision rate for screw removal was 3% (n = 6).

The device used for graft fixation was not an issue in the double-button technique. Indeed, the device is low profile and adjustable to the patient's anatomic parameters without impingement with surrounding tissue. However, due to its mechanical characteristics in compression, this fixation method does not shield from a bone block fracture in case of decreased bone density, and we observed 1 intraoperative coracoid fracture in this series.[3]

Properly positioning the bone graft on the margin of the glenoid cavity is one of the keys of Latarjet procedure. In a position too lateral, residual pain and long-term degenerative arthritis of glenohumeral joint was reported, whereas too medial, the failure rate with recurrent shoulder instability increased.[17,20,26] In a previous report, after the arthroscopic Latarjet with screws fixation, Kany et al[13] noted a bone block in flush position in 68% and too lateralized in 24%, among their 95 first cases. However, according to a similar surgical technique, Casabianca et al[9] reported only 32% of bone blocks flush after 19 procedures. In our study, the flush position was obtained in more than 80% of cases, increasing to 90% beyond the 20th case. Because this had already been proposed in open techniques, the use of a glenoid drill guide seemed to optimize the theoretical position of the bone block and minimized the effects of a learning curve.[2,6,19]

Thus, the guided approach of arthroscopic Latarjet with double-button fixation offered a double security: a reproducible bone graft position in the coronal plane and a controlled subscapularis split. Indeed, the 2 spreaders protected the axillary nerve and avoided any kind of injury during the positioning of the coracoid on the refreshed scapula. This explained why we did not encounter neurologic issues in our series. Not using these specific instruments would increase intraoperative difficulties, expose the patient to potential complications, and affect clinical outcomes.

Four early coracoid migrations were observed in our series. One was attributed to the recurrence of instability in a noncompliant patient at less than 3 months postoperatively. The healing of the bone graft was in progress but was insufficient to support the direct constraints of the humeral head and the pullout strain of the conjoint tendon involved in abduction-external rotation. The 3 migrations would be probably conditioned by technical errors when the posterior button was locked with the sliding-locking knot.[11] Because no migrations were observed beyond the 20th case, we believe that we improved our skills.

This study has some limitations due to its multicenter design. However, we did not identify any significant differences between the surgical time and the rate of complications. In addition, the short-term follow-up constitutes a limit to properly evaluate clinical outcomes, and a minimum of 24 months would be necessary to precisely assess the reliability of this technique. Finally, the rate of nonunion was not reported because it would require further CT scanning.

Conclusions

The arthroscopic Latarjet procedure with double-button fixation exhibits a low rate of intraoperative and postoperative complications (approximately 10%), including the process of learning the technique. No major neurologic or vascular complications were reported in this series. Thirty cases seem to be necessary to reach a surgical time close to the open procedure and to optimize bone block position, especially in the sagittal plane. Finally, early clinical assessment confirms that the arthroscopic Latarjet procedure with double-button fixation can be a safe and reliable technique.

Disclaimer

Nicolas Bonnevialle, Charles-Edouard Thélu, Jérome Vogels, and Yves Bouju are paid consultants for Smith & Nephew. The other authors, their immediate families, and any research foundations with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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