Can a Drill Guide Improve the Coracoid Graft Placement During the Latarjet Procedure?

A Prospective Comparative Study With the Freehand Technique

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Background: One of the factors that can affect the success of the Latarjet procedure is accurate coracoid graft (CG) placement.

Hypothesis: The use of a guide can improve placement of the CG and screw positioning in the sagittal and axial planes as compared with the classic open ("freehand") technique.

Study Design: Cohort study; Level of evidence, 2.

Methods: A total of 49 patients who underwent a Latarjet procedure for the treatment of recurrent anterior shoulder instability were prospectively included; the procedure was performed with the freehand technique in 22 patients (group 1) and with use of a parallel drill guide during screw placement in 27 patients (group 2). All patients underwent a postoperative computed tomography scan with the same established protocol. The scans were used to evaluate and compare the position of the CG in the sagittal and axial planes, the direction of the screws (α angle), and overall contact of the graft with the anterior surface of the glenoid after the 2 surgical techniques.

Results: The CG was placed >60% below the native glenoid equator in 23 patients (85.2%) in group 2, compared with 14 patients (63.6%) in group 1 ($P = .004$). In the axial plane, the position of the CG in group 2 patients was more accurate (85.2% and 88.9% flush) at the inferior and middle quartiles of the glenoid surface ($P = .012$ and .009), respectively. Moreover, with the freehand technique (group 1), the graft was in a more lateral position in the inferior and middle quartiles ($P = .012$ and .009, respectively). No differences were found between groups 1 and 2 regarding the mean α angle of the superior ($9^\circ \pm 4.14^\circ$ vs $11^\circ \pm 6.3^\circ$, $P = .232$) and inferior ($9.5^\circ \pm 6^\circ$ vs $10^\circ \pm 7.5^\circ$, $P = .629$) screws. However, the mean contact angle (angle between the posterior coracoid and the anterior glenoid surface) with the freehand technique ($3.8^\circ \pm 6.8^\circ$) was better than that of the guide ($8.55^\circ \pm 8^\circ$) ($P = .05$).

Conclusion: Compared with the classic freehand operative technique, the parallel drill guide can ensure more accurate placement of the CG in the axial and sagittal planes, although with inferior bone contact.

Keywords: coracoid graft position; Latarjet; parallel drill guide; shoulder instability

In 1954, Latarjet[21] proposed the coracoid process transfer and its fixation to the anteroinferior portion of the glenoid rim in cases of recurrent anterior shoulder instability. Evaluating the classic open ("freehand") technique with the subscapularis muscle split, Patte and Debeyre[25] initially supported its triple-blocking stabilizing mechanism. Newer studies focused mainly on the importance of the dynamic interaction between the conjoined tendon and the inferior part of the capsule and the subscapularis muscle, producing an efficient sling effect at the mid- and end range of shoulder motion.[30]

However, one of the important factors that can also affect the success of this procedure is accurate coracoid bone block placement.[24] The initially described 1% recurrence rate[29] could be increased up to 83% if the coracoid is positioned >10 mm medially to the glenoid rim,[15] while its lateral placement predisposes patients to the development of postoperative osteoarthritis.[27] Furthermore, the direction and position of the screws anteriorly can lead to impingement and gradual wear of the humeral head while damaging the suprascapular nerve posteriorly.[20,22]

With older studies and newer publications showing good mid- and long-term clinical outcomes of the Latarjet procedure,[3,4,6,10] the overall interest in establishing its indications and developing the originally described technique

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has subsequently increased. However, in contrast with the French paradox where 72% of the surgeons prefer the Latarjet procedure as the first treatment option, the international tendency toward arthroscopic Bankart repair remains high (90% of cases).[28] This statement could be explained by the necessity of accuracy and the technical difficulties of the initially proposed freehand technique.[26] Therefore, guide-assisted operations simplifying the surgical steps have been proposed.[17,22]

Given the importance of the appropriate coracoid position, the purpose of this prospective study was to assess graft placement after the Latarjet procedure, comparing the classic freehand technique with the guide-assisted method. The hypothesis was that the guide application allows for more accurate graft placement and better contact with the anterior glenoid surface, providing improved reproducibility of the technique.

METHODS

Between March 2013 and April 2014, patients who were scheduled to undergo a Latarjet procedure for the treatment of recurrent anterior shoulder instability were informed for the purpose and the method of our study. Two trained surgeons (G.W., J.B.) from 2 orthopaedic centers performed the operations. One surgeon used only the classic freehand operative technique (group 1), while the second used a cannulated parallel drill guide for graft and screw placement (group 2). From the original 79 patients who underwent the procedure, 49 (22 freehand open and 27 guide assisted) gave their consent to undergo a postoperative computed tomography (CT) scan to evaluate the position of the transferred coracoid graft (CG) and screws. This study was approved by an institutional review board (CERC-VS-2016-02-1).

Operative Techniques

Freehand Technique. The surgical steps of the classic open (freehand) technique have already been extensively described.[13,26] However, it is important to highlight some steps that differ between the compared techniques. Through a limited deltopectoral approach and after preservation of 1.5 cm of the coracoacromial ligament, the osteotomy of the coracoid was performed, aiming to harvest a graft of 2.5 to 3 cm in length. The soft tissue from the coracoid undersurface was carefully removed and then decorticated with a straight saw, providing a broad, flat cancellous bed. Without any guide assistance, two 3.2-mm approximately centered drill holes were made.

The subscapularis muscle's split was made at the junction of the superior two-thirds and the inferior one-third. After meticulous exposure, the capsule was identified and incised vertically at the level of the joint line. The labral-periosteal flap (Bankart lesion) was elevated and the anterior glenoid surface also decorticated, creating a bleeding flat surface to facilitate coracoid placement.

With a 3.2-mm drill bit placed approximately 7 mm medial to the glenoid surface (depending on the coracoid size), the first glenoid hole was created at the level of 5 o'clock (right shoulder) and directed parallel to the joint line.

The coracoid was then placed at the anterior glenoid margin and fixed with a 4.5-mm partially threaded malleolar screw passed through the inferior drill hole into the glenoid hole. A 35-mm-long screw was used unless the patient was very small (30 mm) or large (40 mm). Ensuring the "flush" position of the graft, the second glenoid drill was created through the superior coracoid hole with, again, a 3.2-mm drill bit. With a depth gauge, the appropriate length of the second malleolar screw was determined. In cases with >5-mm difference between the 2 screws, the inferior one was replaced; however, in our study population, no change was made. A "2-finger" technique was used to tighten both screws, and the final position of the coracoid was checked. During every step of the coracoid fixation, its position or rotation could be confirmed and changed by removing 1 screw, loosening the other, or drilling in a slight different direction. Finally, the capsule was sutured to the coracoacromial ligament stump with an absorbable suture, with the arm in full adduction and external rotation.

Mini-Open Guide-Assisted Technique. The guide-assisted technique was performed with a Latarjet guide system (Arthrex Inc). The surgical exposure was exactly the same. The coracoid preparation was performed with a special grasper-coracoid drill guide, which allows the surgeon to drill 2 parallel 4-mm holes through the graft. Care was taken to ensure that, before drilling, the guide was positioned perpendicular and at the center of the prepared coracoid surface.

Additionally, during the final placement and fixation of the CG, a parallel drill guide (Arthrex Inc) was used without the locating offset finger (Figure 1A). The pegs of this guide fit to the predrilled holes on the CG, allowing easy control of the coracoid–conjoint tendon complex. The CG was guided under direct visual control and placed on the anterior glenoid surface to obtain a flush position. Thereafter, two 1.6-mm nonthreaded guide wires were used to provisionally stabilize the graft (Figure 1B). By using a 2.75-mm cannulated drill through the already placed wires, the glenoid was drilled (beginning with the inferior hole), and two 4-mm titanium low-profile partially threaded

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Ethical approval for this study was obtained from the Vivalto Santé Institutional Review Board (CERC-VS-2016-02-1).

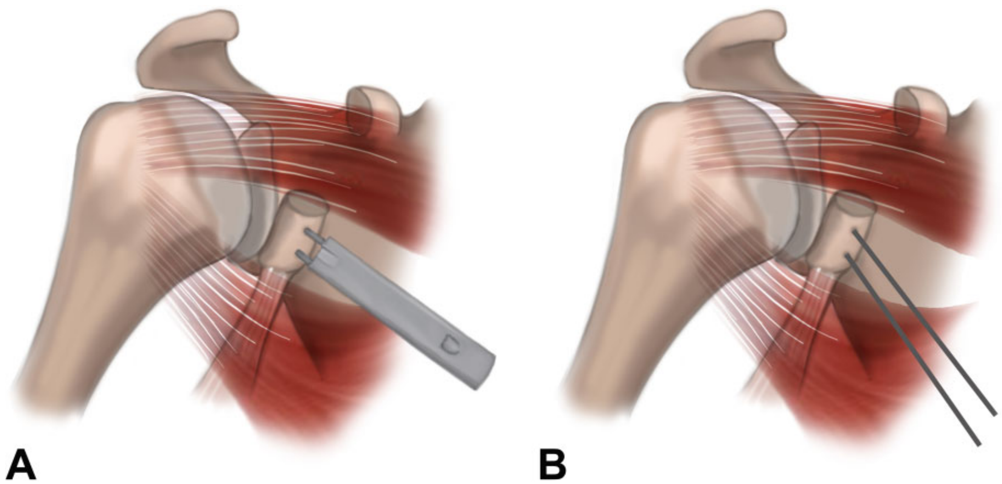

Figure 1. (A) Coracoid graft placement with the parallel drill guide (Arthrex Inc). (B) Provisional stabilization of the graft with two 1.6-mm guide wires.

screws of appropriate length were inserted to secure the coracoid. During drilling, screw placement, and final screw tightening, it is very important to firmly hold the coracoid, with a small periosteal elevator, against the glenoid to obtain direct compression of the CG during screw placement and to avoid graft breakage. The screw length was determined in the same way as in the freehand technique, and the final capsular reconstruction was performed in the same manner as the freehand technique.

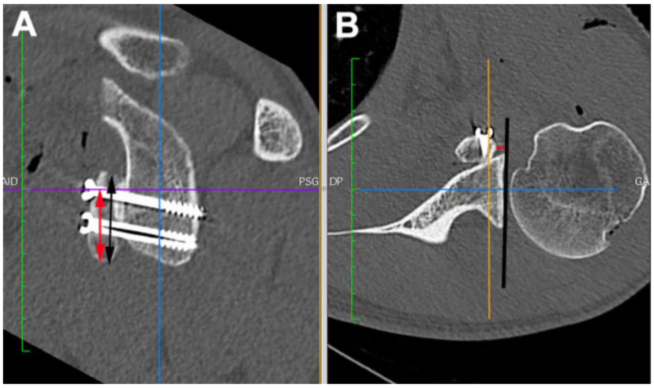

Figure 2. Evaluation of the coracoid graft in (A) the sagittal plane in relation to the equator of the native glenoid and (B) the axial plane (mediolateral position). In (A), the black arrow indicates the whole length of the coracoid graft (CG) while the red arrow shows the part of the graft sitting below the glenoid equator. In (B), the black line is tangent to the subchondral bone of the glenoid while the red line indicates the distance between the black line and the most lateral aspect of the CG.

CT Scan Evaluation

All the patients who consented to participate in the study underwent a CT scan 1 to 6 weeks postoperatively, based on the same protocol (64-slice CT scanner, slice thickness set at 0.5 mm, bone filter; Toshiba).

All the acquired DICOM format images were exported and further processed with the Macintosh-based Osirix software (Pixmeo). The image analysis protocol used was developed during a multicenter study regarding the position of the CG after the Latarjet procedure[2] and was established according to previously published studies.[18,19] All measurements were made by 2 highly experienced orthopaedic surgeons (J.B., L.N.) who had participated in the development of the imaging-processing protocol.

Images in all 3 planes (coronal, sagittal, axial) were simultaneously displayed in the same screen window. The following 4 measurements were then made for each patient: (1) the position of the CG in the sagittal plane, (2) the position of the CG in the axial plane, (3) the direction of the screws used (α angle), and (4) the contact angle[2] (Figures 2 and 3).

The position of the CG in the sagittal plane was defined as the percentage of the CG sitting below the equator of the glenoid. We divided the results into 4 groups: A (80%-100% below the equator), B (60%-79%), C (40%-59%), and D (<40%). In the axial plane, the CG was considered flush when the lateral edge of the graft was $\leq$1 mm lateral to $\leq$4 mm medial to the joint line; "medially placed" when it was >4 mm medial to the joint line; and "prominent" when it was >1 mm lateral to the joint line. The α angle was defined as the angle between the shaft of the screw and the glenoid subchondral bone. Finally, the contact angle was the angle between the posterior surface of the CG (measured between the 2 screws) and the anterior neck of the glenoid. Contact was considered complete if the angle was $\leq 4^\circ$ and incomplete when $>4^\circ$. If the space between the CG and the glenoid was >1 mm, we assumed that no contact existed.[2]

Statistical Analysis

The sample size of the study was calculated as follows with the GPower software (v 3.1; Heinrich-Heine-Universität). According to previous radiologic studies, after several methods of the Latarjet procedure, the angle of the screws

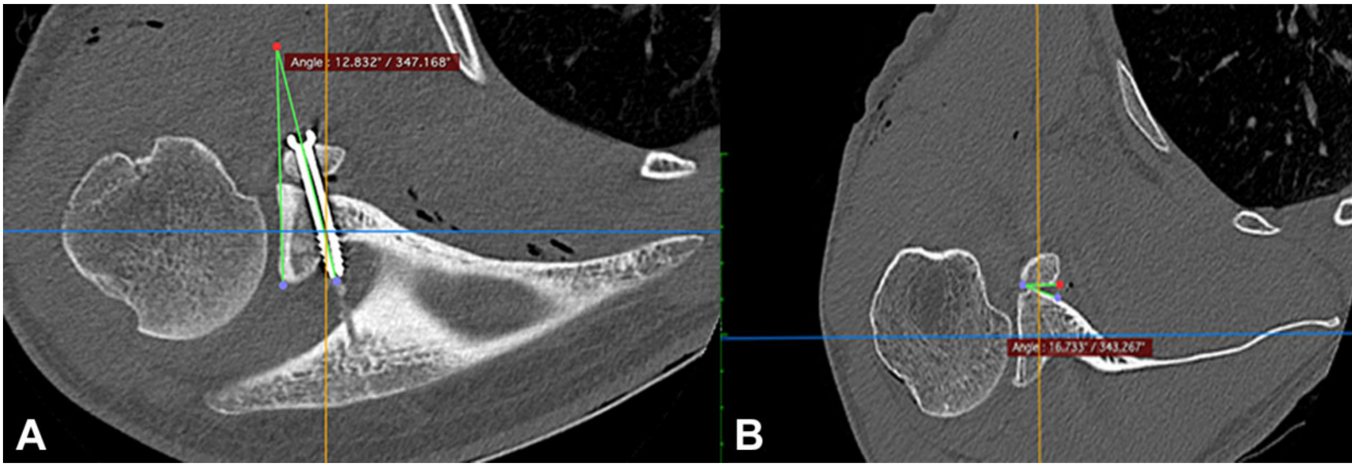

Figure 3. (A) Calculation of screw direction (α angle). The red dot indicates the α angle formed from the shaft of the screw and the glenoid subchondral bone (green lines). (B) Evaluation of the coracoid graft contact with the anterior glenoid surface. The contact angle is defined from the posterior surface of the coracoid graft (green line between the red and blue dots) and the anterior neck of the glenoid (green line between the 2 blue dots).

can vary from 21° to 6° and the mediolateral position of the CG from –8 to 10 mm.[7,11,16] To find the differences between the 2 independent groups (freehand vs guide-assisted technique) and obtain a power of 0.95 and an alpha value of 0.05, a minimum of 26 patients (13 patients in each group) was necessary.

Based on the most reliable Shapiro-Wilk test, major deviations from normality were revealed. Thereafter, continuous variables were compared with the nonparametric Spearman correlation or the Mann-Whitney *U* test, and categorical variables were compared with the chi-square test. Finally, despite the limit of 49 patients, a binary multivariate analysis was performed to find possible predisposing factors leading to better graft contact. Statistical significance was set at $P < .05$, and the analysis was performed with SPSS (v 22.0; IBM Corp).

RESULTS

Regarding the position of the CG in the sagittal plane, the CT scan analysis revealed that use of the parallel drill guide resulted in better and more reproducible placement of the graft below the native equator (Figure 4). In 23 cases (85.2%) operated with the guide-assisted technique, >60% of the CG was placed below the equator, while only 14 grafts (63.6%) were similarly fixed in the sagittal plane by the freehand technique ($P = .004$).

In the axial plane, the use of the parallel drill guide ensured a more accurate CG position in relation to the glenoid articular surface. Specifically, at the inferior quartile of the glenoid, the CGs were positioned flush in 85.2% (23 cases) in group 2, compared with 72.7% (16 cases) in group 1 ($P = .012$). Similarly, at the middle of the glenoid, 88.9% (24 cases) were ideally positioned in group 2 versus 68.2% (15 cases) in group 1 ($P = .009$). Moreover, the freehand technique (group 1) predisposed to a lateralized

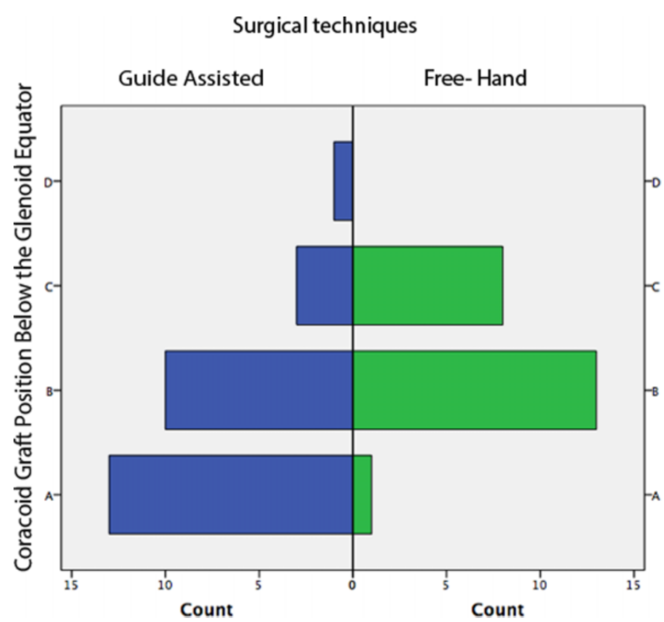

Figure 4. The parallel drill guide resulted in better and more reproducible placement of the graft below the native equator. A = 100%-80% below the equator, B = 79%-60%, C = 59%-40%, D <40%.

position of the graft at the inferior quartile of the glenoid in 27.3% (6 patients) versus 3.7% (1 patient) in group 2 ($P = .012$) and at the middle quartile of the glenoid in 31.8% (7 patients) versus 3.7% (1 patient) ($P = .009$).

No statistical differences were found between groups 1 and 2 regarding the mean α angle for the superior (9° ± 4.14° vs 11° ± 6.3°, $P = .232$) and inferior (9.5° ± 6° vs 10° ± 7.5°, $P = .629$) screws (Figure 5). Additionally, overangulated (α angle >25°) screws occurred in only 2 cases (n = 1 for each technique).[5] However, further statistical analysis

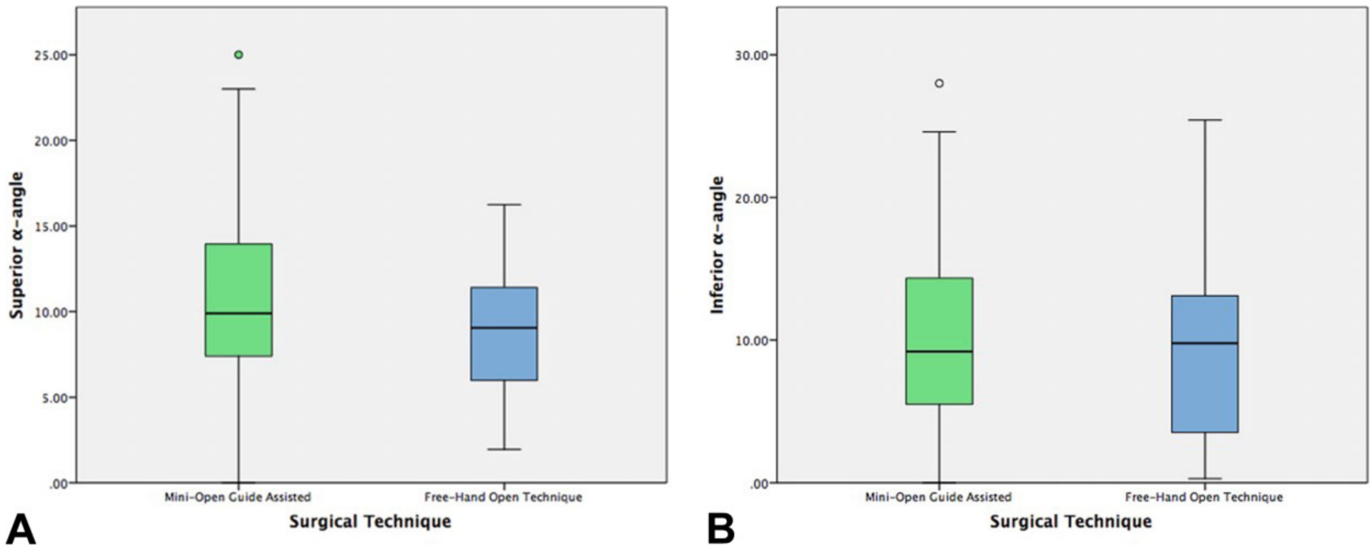

Figure 5. No statistical differences were found regarding the mean α angle in the (A) superior or (B) inferior screws. The box indicates the interquartile range; the error bars indicate the 95% CI; and the circle indicates an outlier.

revealed a very strong positive correlation in the α angle between inferior and superior screws when a guide was used ($r_s = 0.936$, $P < .001$). The same was not found in the freehand approach ($r_s = 0.532$, $P = .01$).

Finally, despite the higher and more lateral position of the CG in the sagittal and axial planes, respectively, the contact with the freehand technique was better. With the freehand technique, the mean contact angle was 3.8° ± 6.8°, compared with the 8.55° ± 8° with the guide ($P = .05$). In 15 cases of group 1 (68.2%), the contact was perfect (<4°) and in 7 cases (31.8%) it was partial (>4°). In 11 cases (40.7%) of group 2, the contact was characterized perfect and it was partial in the rest (n = 16, 59.3%). The differences were statistically significant ($P = .05$). Further binary multivariate analysis showed that apart from the surgical technique, no other factor (position of the CG in the sagittal or axial plane, direction of the screws) predisposed to a better or worse contact of the graft ($P = .9$). Finally, there were no cases of noncontact between the CG and the glenoid in either group (Figure 6).

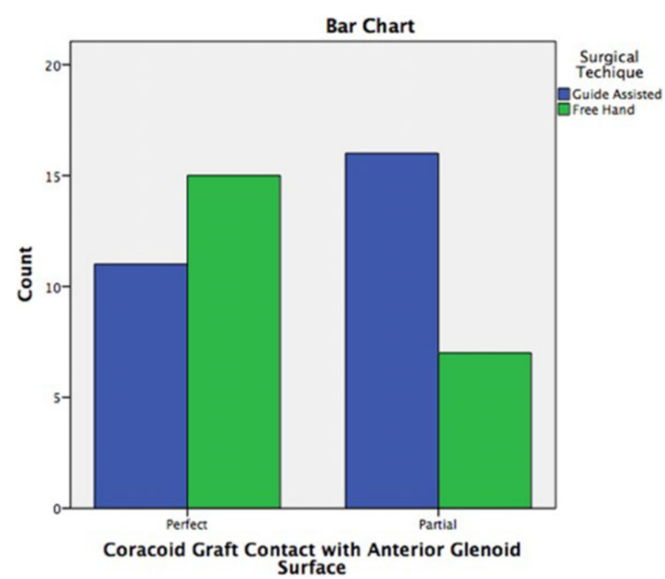

Figure 6. The freehand technique resulted in statistically significantly better contact of the coracoid graft with the glenoid ($P = .05$).

DISCUSSION

One main finding of our study was that the use of the parallel drill guide during the Latarjet procedure ensured a statistically significant better CG placement in the sagittal and axial planes compared with the freehand technique. The guide with its pegs fits into the predrilled holes of the coracoid and allows better control of the coracoid–conjoint tendon complex during its final placement. Regardless of the length, width, and shape of the coracoid, the surgeon can always verify and modify the superoinferior and mediolateral positions of the CG before any pin placement, ensuring an ideal position. No such modifications can be easily made with the freehand technique, where the correct placement of the first inferior drill hole on the anterior surface of the glenoid is more demanding and depends mainly on the surgeon's experience. Therefore, in approximately 85% of the study patients who underwent the guide-assisted procedure, >60% of the CG was placed below the native equator of the glenoid, and a flush position was achieved in 85% to 89% of cases, minimizing the risk of a prominent osseous graft. However, an important finding was that the use of the guide did not result in better contact angle values when compared with the freehand technique (8.55° ± 8° vs 3.8° ± 6.8°, $P = .05$). The contact was perfect in 68.2% of the cases operated without any guide and in 40.7% with the aid of it ($P = .05$)

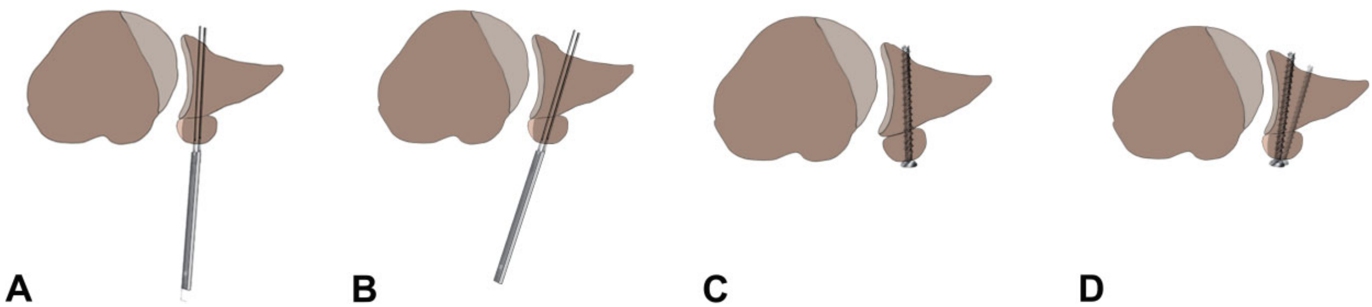

Figure 7. (A-C) With the drill guide, the applied pins and, consequently, the screws are always parallel, following the same "bad or good" direction. (D) The same does not happen with the freehand technique, where the surgeon can always change the direction, and the screws could be divergent.

The importance of our findings has been well understood since the early 1980s, when Hovelius et al[14] reported approximately 63% malpositioned CGs in a series of 111 patients and Allain et al[1] later confirmed a similar percentage of 53% associated with high rates (60%) of central glenohumeral arthritis with the freehand procedure. In accordance with our results regarding the freehand technique, Mizuno et al[23] also recently observed inaccurate graft position in 20.6% of the cases (13.2% lateralized and 7.5% medially placed).

Despite the clinical importance of these results, the findings of the aforementioned studies were based on plain radiographs, which, according to more recent studies, cannot provide an accurate analysis of the CG position or the bone-to-bone contact.[9] In the effort to accurately evaluate the position of the transferred coracoid and the direction of the hardware used, Doursounian et al[12] showed the superiority and accuracy of postoperative CT scans compared with plain radiographs. Therefore, several CT scan–based clinical or cadaveric studies attempted to evaluate CG position after Latarjet procedure.[7,8,17-19,22] The use of a parallel drill guide (customized or not) has been shown to provide good graft placement in the axial and sagittal planes of the glenoid.[7,18,19] However, no clear comparison with the classic open technique had ever been performed.

Furthermore, despite the diversity of the CT imaging-processing protocols used, careful interpretation of the already published data shows that a guide can probably lead to higher values of the α angle and, possibly, to worse contact of the bone block.[7,18,19] Also in our study, even with the guide, the radiologic results were not always excellent. It is obvious that whether an ancillary drill guide is used or not, the direct visual control of the glenoid surface and the particular exposure of the area remain the most difficult and important surgical steps. Furthermore, according to our results, it is important to notice that with a drill guide, both screws of the CGs always had the same "good or bad" direction, with their α angles showing a strong positive correlation ($r_s = 0.936$, $P < .001$). This finding can be explained by the fact that with the guide, the surgeon is always obliged to follow the direction of the first screw. This enhances the importance of the appropriate first pin-screw placement to avoid complications, such as suprascapular nerve damage or impingement with the humeral head.[20,22] The same does not happen with the freehand technique, where the surgeon can change the angle direction of each screw (especially the second), possibly resulting in better compression and contact of the graft with the anterior glenoid surface (Figure 7). Theoretically, another factor that can affect the final pin-screw direction and, consequently, the contact of the CG is the direction of the initial 4- or 3.2-mm holes made to the graft with the aid of the grasper guide or by the freehand technique, respectively. With both methods, the surgeon should attempt to create these pilot holes perpendicularly to the bone.

The parallel drill guide used in our study is available with an additional locating offset finger of 6 or 8 mm. Theoretically, this could ensure a flush position of the CG in relation to the glenoid articular surface. However, we did not use this offset because it was designed for the modified Latarjet procedure, where the CG is rotated 90° and its inferior surface lines up with the glenoid surface.[6] With the coracoid rotated in this "sitting" position, its mediolateral width is smaller, and the locating offset of 6 or 8 mm could be more easily adapted. The same does not happen when the graft is fixed in the "lying" position, as described in the original Latarjet technique that we used.[21,26] Therefore, the locating finger cannot always fit to the shape and width of the coracoid. Furthermore, because of its relative bulky size, we found it difficult to obtain direct visualization of the glenoid surface through the already limited exposure.

Our study is the first prospective comparison between the classic open and guide-assisted techniques with a detailed imaging-processing protocol. Its main strengths are the prospective design, the number of participating patients (power of the study), the comparison of the techniques between 2 centers, each dedicated to a single method, and the evaluation of the CG's position in the axial and sagittal planes. We also attempted to measure the α angle of the screws placed and, sequentially, the contact of the coracoid with the anterior glenoid. However, we should mention that we performed only immediate postoperative CT evaluation; as such, we cannot comment on whether there are differences in rates of bony union, graft osteolysis, recurrent instability, or development of arthritis between the techniques. Another limitation of our study was that, although it was based on 2 surgeons, each technique was performed exclusively by 1 surgeon. Therefore, the difference that we saw may be a result of differences between the surgeons and not the technique, despite both surgeons being highly experienced with shoulder surgery. Also, the interpretation of the CT images was not blinded to the technique, owing to the different types of screws used. Finally, no comparison was made with the newer techniques that utilize suture buttons for graft fixation.

CONCLUSION

The use of a parallel drill guide during the Latarjet procedure can lead to more accurate placement of the CG in the axial and sagittal planes as compared with the freehand technique. However, the guide technique had a negative effect on the CG-to-glenoid contact. This can be explained by the fact that the surgeon is unable to change the angle direction of the screws (especially the second), thus enhancing the importance of good surgical exposure and appropriate first pin-screw placement.

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REFERENCES

1. Allain J, Goutallier D, Glorion C. Long-term results of the Latarjet procedure for the treatment of anterior instability of the shoulder. *J Bone Joint Surg Am*. 1998;80(6):841-852.
2. Barth J, Neyton L, Métais P, et al. Is the two-dimensional computed tomography scan analysis reliable for coracoid graft positioning in Latarjet procedures [published online March 31, 2017]? *J Shoulder Elbow Surg*. doi:10.1016/j.jse.2016.12.067
3. Beranger JS, Klouche S, Bauer T, Demoures T, Hardy P. Anterior shoulder stabilization by Bristow-Latarjet procedure in athletes: return-to-sport and functional outcomes at minimum 2-year follow-up. *Eur J Orthop Surg Traumatol*. 2016;26(3):277-282.
4. Bhatia S, Frank RM, Ghodadra NS, et al. The outcomes and surgical techniques of the Latarjet procedure. *Arthroscopy*. 2014;30(2): 227-235.
5. Boileau P, Thélu C-É, Mercier N, et al. Arthroscopic Bristow-Latarjet combined with bankart repair restores shoulder stability in patients with glenoid bone loss. *Clin Orthop Relat Res*. 2014;472(8): 2413-2424.
6. Burkhart SS, De Beer JF, Barth JRH, Criswell T, Roberts C, Richards DP. Results of modified Latarjet reconstruction in patients with anteroinferior instability and significant bone loss. *Arthroscopy*. 2007; 23(10):1033-1041.
7. Casabianca L, Gerometta A, Massein A, et al. Graft position and fusion rate following arthroscopic Latarjet. *Knee Surg Sports Traumatol Arthrosc*. 2015;24(2):507-512.
8. Cassagnaud X, Maynou C, Mestdagh H. Clinical and computed tomography results of 106 Latarjet-Patte procedures at mean 7.5 year follow-up [in French]. *Rev Chir Orthopédique Réparatrice Appar Mot*. 2003;89(8):683-692.
9. Clavert P, Koch G, Neyton L, et al. Is anterior glenoid bone block position reliably assessed by standard radiography? A cadaver study. *Orthop Traumatol Surg Res OTSR*. 2016;102(8):S281-S285.
10. Cowling PD, Akhtar MA, Liow RYL. What is a Bristow-Latarjet procedure? *Bone Joint J*. 2016;98-B(9):1208-1214.
11. Cunningham G, Benchouk S, Kherad O, Lädermann A. Comparison of arthroscopic and open Latarjet with a learning curve analysis. *Knee Surg Sports Traumatol Arthrosc*. 2015;24(2):540-545.
12. Doursounian L, Debet-Mejean A, Chetboun A, Nourissat G. Bristow-Latarjet procedure with specific instrumentation: study of 34 cases. *Int Orthop*. 2009;33(4):1031-1036.
13. Edwards TB, Walch G. The Latarjet procedure for recurrent anterior shoulder instability: rationale and technique. *Oper Tech Sports Med*. 2012;20(1):57-64.
14. Hovelius L, Albrektsson B, Berg E, et al. Bristow-Latarjet procedure for recurrent anterior dislocation of the shoulder: a 2-5 year follow-up study on the results of 112 cases. *Acta Orthop Scand*. 1983;54(2): 284-290.
15. Hovelius L, Sandström B, Olofsson A, Svensson O, Rahme H. The effect of capsular repair, bone block healing, and position on the results of the Bristow-Latarjet procedure (study III): long-term follow-up in 319 shoulders. *J Shoulder Elbow Surg*. 2012;21(5):647-660.
16. Kany J, Flamand O, Grimberg J, et al. Arthroscopic Latarjet procedure: is optimal positioning of the bone block and screws possible? A prospective computed tomography scan analysis. *J Shoulder Elbow Surg*. 2016;25(1):69-77.
17. Klatte TO, Hartel MJ, Weiser L, et al. Accuracy of Latarjet graft and screw position after using novel drill guide [published online July 4, 2016]. *Eur J Trauma Emerg Surg*. doi:10.1007/s00068-016-0703-4
18. Kraus TM, Graveleau N, Bohu Y, Pansard E, Klouche S, Hardy P. Coracoid graft positioning in the Latarjet procedure. *Knee Surg Sports Traumatol Arthrosc*. 2013;24(2):496-501.
19. Kraus TM, Martetschläger F, Graveleau N, et al. CT-based quantitative assessment of the surface size and en-face position of the coracoid block post-Latarjet procedure. *Arch Orthop Trauma Surg*. 2013; 133(11):1543-1548.
20. Lädermann A, Denard PJ, Burkhart SS. Injury of the suprascapular nerve during Latarjet procedure: an anatomic study. *Arthroscopy*. 2012;28(3):316-321.
21. Latarjet M. Treatment of recurrent dislocation of the shoulder. *Lyon Chir*. 1954;49(8):994-997.
22. Meyer DC, Moor BK, Gerber C, Ek ETH. Accurate coracoid graft placement through use of a drill guide for the Latarjet procedure. *J Shoulder Elbow Surg*. 2013;22(5):701-708.
23. Mizuno N, Denard PJ, Raiss P, Melis B, Walch G. Long-term results of the Latarjet procedure for anterior instability of the shoulder. *J Shoulder Elbow Surg*. 2014;23(11):1691-1699.
24. Nourissat G, Delaroche C, Bouillet B, Doursounian L, Aim F. Optimization of bone-block positioning in the Bristow-Latarjet procedure: a biomechanical study. *Orthop Traumatol Surg Res*. 2014;100(5): 509-513.
25. Patte D, Debeyre J. Luxations récidivantes de l'épaule. *Encycl Med Chir Paris-Tech Chir*. 1980;44265:4.
26. Plancher KD, Petterson SC, Walch G. Open Latarjet: a reliable, successful method to prevent recurrence in the presence of bony defects. *Oper Tech Sports Med*. 2013;21(4):238-245.
27. Schmid SL, Farshad M, Catanzaro S, Gerber C. The Latarjet procedure for the treatment of recurrence of anterior instability of the shoulder after operative repair: a retrospective case series of forty-nine consecutive patients. *J Bone Joint Surg Am*. 2012;94(11):e75.
28. Thomazeau H, Courage O, Barth J, et al. Can we improve the indication for Bankart arthroscopic repair? A preliminary clinical study using the ISIS score. *Orthop Traumatol Surg Res*. 2010;96(8): S77-S83.
29. Walch G, Boileau P. Latarjet-Bristow procedure for recurrent anterior instability. *Techniques in Shoulder and Elbow Surgery*. http://journals.lww.com/shoulderelbowsurgery/Fulltext/2000/01040/Latarjet_Bristow_Procedure_for_Recurrent_Anterior.8.aspx. Accessed May 11, 2016.
30. Yamamoto N, Muraki T, An K-N, et al. The stabilizing mechanism of the Latarjet procedure: a cadaveric study. *J Bone Joint Surg Am*. 2013;95(15):1390-1397.