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Clinical and radiographic outcomes using standard length of cannulated screws for traditional Latarjet procedure

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Background: The purpose of this study was to evaluate the clinical and radiographic outcomes of open traditional Latarjet stabilization using 32-mm–long and 30-mm–long cannulated screws in males and females, respectively, with a minimum of 2 years of follow-up.

Methods: We retrospectively reviewed open Latarjet procedures using cannulated screws of standard length with a minimum of 2 years of follow-up. Functional evaluation was performed with postoperative Rowe and Walch score, visual analog scale for pain and return to sport. Graft healing was assessed with computed tomography scans at 4 to 6 months postoperatively. Patients were divided into 2 groups according to postoperative radiographic measurements: a bicortical or unicortical screw group. The α angle between the shaft of the screw and the glenoid subchondral bone was measured for superior and inferior screws. Level of significance was 0.05. The post hoc power analysis was 0.89.

Results: A total of 69 patients met the criteria for inclusion. Of these patients, 60 (87%) were available for final follow-up (n = 62 shoulders), with a mean age of 28.4 ± 9.5 years (range, 16-55 years) at the time of surgery. Fifty six males (93.3%) and 4 females (6.7%) were included. The mean final follow-up period was a mean of 38 months after the procedure (range, 25-48 months). Eight of 60 patients (13.3%) had persistent apprehension in abduction-external rotation position. One patient (1.7%) had a recurrence of shoulder subluxation. The mean Walch-Duplay score was 90 ± 11.6 points (range, 40-100 points), and the mean Rowe score was 93.4 ± 11 points (range, 50-100 points). The mean visual analog scale score for the evaluation of pain was 0.9 ± 1.3 (range, 0-4). The coracoid healed the glenoid neck in 87.1% (54/62) of the shoulders on the postoperative computed tomography scan. Lower alpha angle for inferior and superior screws had more rate of unicortical fixation ($P = .05$ and $P = .04$, respectively). Fourteen of 62 (22.6%) shoulders were found unicortical screws. Six bicortical cases and 2 cases of unicortical screws (25%) showed nonunion ($P = .86$). There were 2 complications, 1 patient had hematoma that required drainage and 1 case had transient axillary nerve palsy which resolved spontaneously. No complications associated with the hardware were found.

Conclusion: Open traditional Latarjet procedure using 32-mm–long and 30-mm–long cannulated screws in males and females, respectively, provided good outcomes with acceptable complication rates. Unicortical screws fixation does not have a higher rate of nonunion than bicortical screws.

The Latarjet procedure is a widely used surgical technique for patients with anterior shoulder instability.[10] This procedure offers low postoperative recurrence even in patients with glenoid bone defects,[9] failure with other surgical techniques,[12,16] and shoulder laxity.[1] According to published techniques, the coracoid, once osteotomized, could be fixed with 1 or 2 malleolar or cannulated screws. More recently, and especially for the arthroscopic technique, buttons have been used for fixation. Both techniques have comparable fixation stability,[30] although screws have been associated with complications.[17-19,37] Short screws can lead to failure due to loosening, while long screws can cause discomfort that requires removal for suprascapular nerve compression injuries.[18,22,25,35] Measuring the depth of the coracoid and glenoid at the time of graft placement is often difficult and there are no accurate measurement systems. Glenoid bone defects, gender, anatomical variations in glenoid and coracoid sizes, and the arc congruent or traditional surgical techniques may require different screw

The Institutional Review Board of Artro Center reviewed and allowed to perform this study. Each patient enrolled gave written informed consent for his or her participation in this study.

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lengths.[14,15] Mizuno et al[28] use a standard 35-mm long screw without reporting complications related to the length of the screws in traditional Latarjet technique. Some surgeons[27] use a depth gauge to determine the appropriate length of the second malleolar screw. Bath et al[3] suggest using 40-mm long screws and in small patients 35 mm in the first inferior screw and determine the length of the second malleolar screw with the depth gauge and if it is >5 mm to the first, the inferior screw could be replaced, but they did not need to replace any screw in their series. The authors noticed in their practice that after measuring the length of the screw, they very frequently used a single length for males and another for females so began to use this length as a standard.

The purpose of this retrospective study was to evaluate the clinical and radiographic outcomes of patients with recurrent anterior shoulder instability who underwent open traditional Latarjet stabilization using 32-mm and 30-mm long cannulated screws in males and females, respectively, with a minimum of 2 years of follow-up.

We hypothesized that the Latarjet procedure using standard length would provide a low rate of recurrent instability and complications with acceptable radiological results even in cases with unicortical screws.

Materials and methods

We retrospectively reviewed Latarjet procedures performed by a single surgeon (J. L. O.) between 2016 and 2019. Indications for Latarjet reconstruction were recurrent traumatic anterior instability with off-track lesion, glenoid bone loss more than 15%, failed soft tissue repair procedure or collision athletes. Contraindications included multidirectional instability, chronic locked anterior shoulder dislocation, ipsilateral neurological deficit, complete rotator cuff tear, and epilepsy. All patients were studied before surgery with magnetic resonance imaging, and computed tomography (CT) with 3-dimensional (3D) reconstruction. The exclusion criteria for our study were incomplete functional outcome and radiological data.

Surgical technique

A limited deltopectoral approach was used. The skin incision was vertical from the tip of the coracoid extending 4-7 cm toward the axillary fold. The cephalic vein was taken laterally with the deltoid.

Hohmann retractor was placed over coracoid process, on the coraco-clavicular ligaments origin. The coracohumeral ligament and minor pectoral were released close to the bone. A 90° oscillating saw was used to create a medial to lateral osteotomy. The graft was prepared on the inferior surface, removing soft tissue and the inferior cortex of the coracoid graft was removed with a saw to create a flat bone surface. The caudal hole was made using a 2.75-mm drill bit at 5 mm to the coracoid tip.

With the shoulder in slight external rotation, the superior and inferior borders of the subscapularis muscle were identified, and a horizontal split was made in the muscle at approximately the midportion of the muscle using electrocautery. Capsule was identificated and vertical incision was made at the level of the joint line, allowing placement of a Fukuda retractor into the glenohumeral joint. The anteroinferior labrum and periosteum were excised with electrocautery and a curved osteotome was used to elevate this labral-periosteal flap from the glenoid in a lateral to medial direction. A straight oscillating saw is used to decorticate the anterior surface of the glenoid to create a flat cancellous bone bed. The inferior 2.75-mm hole was drilled into the glenoid approximately 6 mm from the subchondral bone line and 10 mm to caudal glenoid rim. The coracoid was fixed with a single inferior screw flush with the glenoid line using a pin and cannulated drill. The first pin was retained in the first screw. Definitive fixation was achieved by inserting a second pin into the cephalic portion of the coracoid and through the glenoid and parallel to the first. The coracoid segment was drilled, and the second screw was inserted into the glenoid segment using the self-drilling technique. In all cases, 2 partially threaded cannulated screws (3.75 mm diameter) of 32 mm in length (South American implants) were used in males and 30 mm were used in females. In the cases of laterally protruding grafts, the protruding bone was osteotomized flush with the joint using an oscillating saw. Neither the capsule nor the subscapularis muscular fibers were sutured.

The arm was immobilized in a sling for 1 month and patients were allowed to begin active gentle flexion of elbow on the second postoperative day. Passive and active movements of the shoulder were allowed in the second month. At the third postoperative month, patients begin to perform shoulder strength activities if the range of motion (ROM) is mostly normal. In the fourth month, the patients are allowed to return to full sports.

Radiological assessment

Preoperative CT scans were downloaded as DICOM (Digital Imaging and Communications in Medicine, Danville, CA, USA) format reconstructed as 3D models by the 3D medical image processing software 3D Slicer (version 4.10.2; 3D Slicer, Earth, TX, USA). A glenoid on-face view was acquired with the humeral head subtracted according to the method described by Sugaya et al.[40] The preoperative glenoid bone loss was measured using the unilateral 3D glenoid method[29] and it was considered "critical" defect more than 15%.[38]

Graft healing was assessed at least 4 months postoperatively with postoperative CT scans that we routinely ask at 4-6 months, when patients return to sports activity, to evaluate final position of the graft and screws. Bone fusion was defined as trabeculation or ossified density crossing the glenoid/bone block space over a minimum length of 5 mm on 2D CT scans.[7] Osteolysis or graft resorption was considered nonunions. Bone block positioning was evaluated using postoperative 3D CT on-face view. The ideal position was defined when the coracoid tip was below the glenoid equator (in the vertical plane), above the infraglenoid tubercle. In the axial plane, the bone block was medial if the most lateral aspect was 2 mm medial, or lateral if it was 2 mm lateral to the tangent line.[7] The distance from the posterior cortex of the scapula and the screw tip were recorded in axial plane on CT scan (Fig. 1, *A*); unicortical screws were registered in with negative number. The angulation of the screws was also recorded as the alpha angle formed between the line tangent to the anterior and posterior margins of the glenoid and the line drawn along the length of the screw[3] (Fig. 2, *B*). The subsequent radiographs and CT scans were also examined for bone block migration, fracture or lysis, hardware migration or losing, or breakage.

Clinical assessment

Patients were contacted via e-mail or WhatsApp at the latest follow-up and asked to complete a customized postoperative assessment questionnaire.[13] If there was no response from the patient, the message was repeated once.

The questionnaire included self-assessment of stability, activity, and visual analog scale score for pain. We asked the patient to send photographs in 3 positions: in forward elevation, in external rotation with the elbow at the side, and in 90° of abduction and internal rotation with the elbow abducted at 90° to the thorax with the subject supine on the examination, on the bed or on the floor. A validated on-

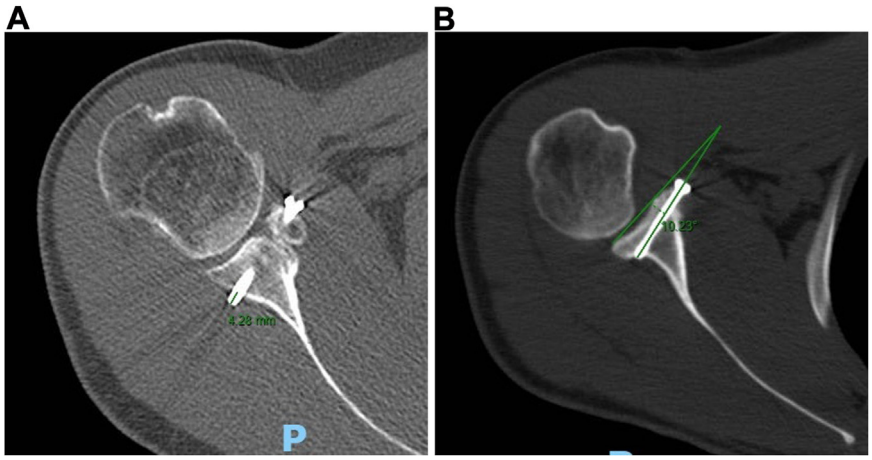

Figure 1 (**A**) Measurement of the distance from the posterior cortex of the scapula and the tip of the screw (—). (**B**) Axial view of the right shoulder in a postoperative CT scan. Example of α angle measurement (—): the line tangent to the anterior and posterior margins of the glenoid and the line drawn along the length of the screw. *CT*, computed tomography.

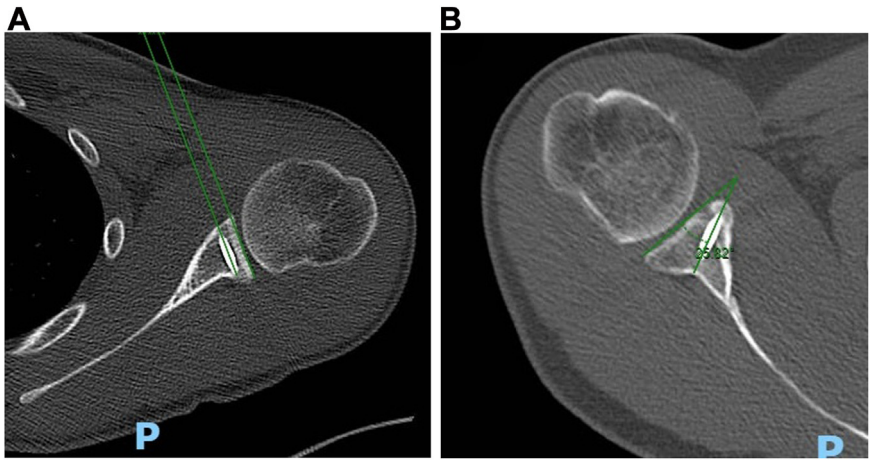

Figure 2 (**A**) Axial view of the right shoulder in a postoperative CT scan showing unicortical screw and 0° α angle (parallel to subchondral bone glenoid). (**B**) Axial view of the right shoulder in a postoperative CT scan showing bicortical 25.8° α angle screw toward the glenoid vault. *CT*, computed tomography.

screen application to measure shoulder ROM was used.[34] This questionnaire and ROM were used to calculate the postoperative Rowe score[31] and Walch-Duplay score.[42] Patients were asked if they returned to their preinjury level of sport. Postoperative dislocation or subjective subluxation was considered a failure.

Statistical analysis

Categorical variables are presented as numbers and percentages, whereas continuous data are expressed as mean ± standard deviation. Patients were divided into 2 groups according to postoperative radiographic measurements: a bicortical screw group if the superior and/or inferior screws reached to pierce the posterior cortex of the glenoid, otherwise a unicortical screw group. Differences between groups of continuous data were analyzed using the Student's *t*-test, and if the data distribution was not normal, the Mann-Whitney U test was used. A Fisher's exact test was used to compare the 2 groups for categorical data. A post hoc power analysis was calculated using G-Power software and indicated that the study had a power of 0.89 to detect a significant difference in the observed bony union rates of the 2 groups. Statistical analysis was performed using Epidat 3.1 (EpiData, Buenos Aires, Argentina) software with a significance level of 0.05.

Results

After applying the inclusion and exclusion criteria, a total of 69 patients met the inclusion criteria. Of these patients, 65 (94.2%) were available for final follow-up. Five patients were excluded due to incomplete postoperative imaging, leaving 60 patients (n = 62 shoulders) with a mean age of 28.4 ± 9.5 years (range, 16-55 years) at the time of surgery (Table I). All patients were of Caucasian ethnicity. There were 56 males (93.3%). Fourteen of 62 shoulders (22.6%) were revision arthroscopic Bankart repairs. Five of 60 (10%) patients were smokers. There were no intraoperative complications. One patient had hematoma that required drainage 2 hours after surgery. One patient had transient axillary nerve palsy which resolved spontaneously in the second postoperative week. No complications associated with the hardware were found. A total of 21 (35%) patients had participated in contact sports. The dominant arm was involved in 35 (56.5%) shoulders (Table I).

Functional results

The mean final follow-up was 38 months after surgery (range, 25-48 months). Eight patients (13.3%) had persistent apprehension in abduction-external rotation position. One patient (1.7%) had a

Table I
Patient characteristics.

Variables	Shoulders N = 62
Male	56 (92.9%)
Female	4 (7.1%)
Age at surgery (yr)	28.4 ± 9.5
Dominant side	35 (56.5%)
Critical glenoid bone defect	32 (51.6%)
Sport participation	44 (73.3%)
Collision sport	21 (33.9%)
Prior failed surgery stabilization	14 (22.6%)
Smokers	6 (10%)

Table II
Comparison of unicortical and bicortical screws.

	Unicortical screws N = 28	Bicortical screws N = 96	*P* value
Female/male	0/21	4/37	.29
Age at surgery (yr)	25.7 (± 9.5)	29.2 (± 9)	.23
Glenoid bone loss (%)	16.1 (± 8.4)	14.5 (± 9.1)	.52
Superior angle (°)	9.3 (± 8.8)	14.3 (± 8.8)	.04
Inferior angle (°)	9 (± 7.2)	13.9 (± 9)	.05
Previus surgery (shoulders)	2	12	.73
Graft nonunion (shoulders)	2	6	.86

recurrence of shoulder subluxation after a fall while skating and was treated conservatively because it was an isolated episode. Forty four patients (73.3%) reported that they participated in sports preoperatively. Forty two patients (95.5%) returned to sports activities after surgery. At the final follow-up, 38 patients (86.4%) were able to return to sports at the same level or better. The mean Walch-Duplay score was 90 ± 11.6 points (range, 40-100 points), and the mean Rowe score was 93.4 ± 11 points (range, 50-100 points). The mean visual analog scale pain score was 0.9 ± 1.3 (range, 0-4).

Radiologic evaluation

Critical glenoid bone defect was present in 32 of 62 (51.6%) shoulders on preoperative CT scan.

In all shoulders, the tip of the coracoid was below the glenoid equator and above the infraglenoid tubercle (from en-face view in CT 3D reconstruction). There were no cases of bone graft malposition in the axial view. The mean angle of inclination between the screw and the glenoid surface was 11 ± 8 degrees (range, 0-30) for the inferior screw and 13 ± 9 degrees (range, 0-30) for the superior screw. The inferior screw was bicortical in 49 (79%) and the tip of the screw was a mean of 1 ± 2.2 mm (range, −3 to 5) to the posterior scapular cortex. The superior screw was bicortical in 41 (66%) shoulders, and the average screw tip was 0.6 ± 2.9 mm (range, −7 to 7) to the posterior scapular cortex. The coracoid healed to the glenoid neck in 87.1% (54/62) of the shoulders. Fourteen of 62 (22.6%) shoulders were found unicortical screws. Six bicortical cases and 2 cases of unicortical screws (25%) showed nonunion ($P = .86$) (Table II). Comparison between unicortical and bicortical screws showed that unicortical screws have had a low alpha angle (Fig. 2).

Discussion

The present study shows the outcomes and complications of traditional Latarjet technique using the 32-mm long screws for males and 30-mm long screws for females. In our series, 1 of 62 (1.6%) patients had a recurrence episode with a low rate of complication and good clinical outcomes comparable to published studies.

Shah et al[37] determined the appropriate screw length by adding the depth measurements made in the drill hole in the glenoid and the coracoid with 8% of recurrence at 6 months. Mizuno et al[28] reported postoperative recurrence in 4 of 68 shoulders (5.9%) using standard 35-mm long malleolar screws and no hardware complications were reported. Boileau et al[6] described an arthroscopic Bankart Bristow Latarjet procedure in which a 4-mm cannulated screw was inserted along the axis of the coracoid process; the length of the screw was determined by adding the length of the coracoid graft to the previously measured glenoid drilling depth and adding 2 mm to ensure that the posterior cortex would be engaged (36-40 mm in length). In their study, no patient had any recurrence of instability; however, they did show nonunions or fibrous unions have been found in 17% of the series and it was related to the use of a screw that was too short and unicortical. Although in their series they have used the Bristow technique with a single screw, which has been associated with a greater risk of nonunion and reabsorption.[41]

The association between unicortical screws and increased risk of nonunion remains controversial; biomechanical evidence shows greater fixation with bicortical screws.[36] Jassim et al[21] have not found to compromise bony union in Latarjet procedure using unicortical screws. In our study, we found 12.9% of cases without bone consolidation in the postoperative CT, although this was not associated with instability, nor it was associated with cases of unicortical screws. These differences found in the literature could be related to the pull-out forces of the hardware or to the surgical technique used. In our series, to improve the anchorage, we do not use a drill in the glenoid for the second upper screw since these are self-drilling screws.

Two types of complications associated with the use of screws in Latarjet surgery have been reported in the literature. One commonly reported complication is postoperative anterior pain due to soft tissue impingement; this complication has been associated with threaded stainless steel malleolar screws with relatively large heads.[18] Another complication of screw use is posterior overhang into the spinoglenoid notch. Although the use of a standard screw length has a potential risk of overhang and nerve compression, suprascapular nerve palsy due to long screws has been rarely reported.[26,35] This nerve injury has not been related to the length of the screw, but rather to the angle at which it was placed.[22,39]

Shishido and Kikuchi[39] measured the angle of insertion from the anterior glenoid rim to the suprascapular nerve using a Kirschner wire. They found that the insertion angle toward the bifurcation of the infraspinatus motor branch averaged 27.7° in the sagittal plane; however, the entry points of the screws on the anterior glenoid surface during the Latarjet procedure are usually only 6 to 7 mm[43] from the corner of the glenoid, not the rim. In a cadaveric study, Lädermann et al[22] concluded that the screws were not in contact with the suprascapular nerve when the angle to the glenoid in the Latarjet procedure was less than or equal to 10° in the sagittal plane.

In our study, we found that the superior and inferior screw α angles in bicortical screws were 13.9 and 9.3, respectively; we did not find complications of suprascapular nerve palsy in our series. This finding may be because the overhanded screws were not enough to cause nerve injury. We have also found that larger α angles have a greater possibility of passing through the posterior cortex of the glenoid and invading the spinoglenoid vault. According to anatomical and tomographic size studies, both the glenoid and coracoid may vary according to sex or race.[2,8,11,15,23,33] The glenoid can significantly decrease its width due to the bone defect, each 10% of bone loss it can decrease mean 2.5 mm over its width.[2,4]

In our study, more than half of the patients had significant bone defects; we did not find significant differences between unicortical and bicortical groups. This could be related to the fact that the measurement of the bone defect is performed on the glenoid surface and the screws are placed 6 mm medially.[26] On the other hand, the decortication of the anterior glenoid rim and the inferior surface of the coracoid alter the original distances in each patient.

Regarding gender, the diameter of the coracoid as well as the anterior-posterior width of the glenoid[32] could be approximately 2 millimeters less in female patients.

Hovelius et al[20] suggest smaller diameter screws in female patients, although we have not found the recommended length in the literature.[24] Female patients tend to have fewer glenoid bone defects in anterior shoulder instability than males, according to tomographic studies.[14] In our study, we empirically chose a screw length of 30 mm in female patients without finding significant complications in this group.

One of the limitations of the study is that, being retrospective, the tomographic control was performed in different centers, although the DICOM images were all processed with the same software by the same trainer observer and poor-quality CTs were excluded. Additionally, the physical examination and questionnaires were not in person. Other authors have used a similar telehealth protocol for postoperative evaluation for patients living far from the institution. This validated method allowed us to have few lost cases of follow-up and like strength, all patients were evaluated with the same validated protocol.[34]

Another limitation is the paucity of female cases in the sample, although this is to be expected given the total number of cases; future studies or meta-analyses may be necessary to determine whether the length of screws used is the correct one. Finally, because it was a retrospective study, we have not collected information on the height and weight of the patients, although a recent study found no relationship between the height and width of the glenoid and the body mass index.[5]

Conclusion

The open traditional Latarjet procedure with standard 32-mm and 30-mm cannulated screws in male and female patients, respectively, provided good results with acceptable complication rates. Unicortical screw fixation does not have a higher rate of nonunion than bicortical screw fixation.

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