Osseous Healing With Nonrigid Suture Fixation in the Arthroscopic Latarjet Procedure

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Background: The Latarjet procedure is a popular means to surgically address anterior glenohumeral joint instability. Although the Latarjet procedure is becoming increasingly common, challenges persist and include postoperative complications secondary to use of the conventional 2 bicortical fixation screws. Recently, a novel surgical technique using a guided surgical approach for graft positioning with nonrigid fixation via a suture suspensory system has been described.

Purpose: To evaluate healing rates and stability of the grafts in patients who underwent this new Latarjet technique.

Study Design: Case series; Level of evidence, 4.

Methods: We retrospectively gathered anonymized computed tomography (CT) data sets from a total of 107 patients who underwent nonrigid suture fixation using a cortical button fixation for anterior glenohumeral instability. Of the 107 patients, 45 had CT scans performed at 2 different time periods. The CT scans of each patient were compared by 2 fellowship-trained musculoskeletal radiologists. Data recorded included age, sex, date of scan, initial graft position on the glenoid, presence and degree of graft migration relative to the equator on follow-up scan, and percentage of osseous healing (as assessed by osseous bridging) on the follow-up scan. Descriptive statistics were calculated to evaluate the average migration and average percentage of healing at both time points.

Results: Our population (n = 45) consisted of 38 men (84.4%) and 7 women (15.6%). The mean age was 27.1 ± 1.1 years. The mean time between initial CT scan (2 weeks postoperatively) and follow-up CT scan was 26 ± 2 weeks. On follow-up scan, reviewer 1 found 75.6% of patients had greater than 75% healing, and reviewer 2 found 70.2% of patients had greater than 75% healing. The center of the graft was measured at or below the equator on follow-up examination in 43 of 45 (95.6%) patients by reviewer 1 and 44 of 45 (97.8%) patients by reviewer 2.

Conclusion: Based on these findings, nonrigid suture fixation using a cortical button device offers an effective alternative to traditional screw fixation for the Latarjet procedure with a high level of osseous healing and minimal graft migration.

Keywords: shoulder; instability; imaging; computed tomography; shoulder; general; Latarjet

The Latarjet procedure is an increasingly popular means to surgically address anterior glenohumeral instability.[10] The technique, performed through an open approach, was originally described by Michel Latarjet[18] in 1954. Typically, the procedure is indicated for young patients with recurrent anterior shoulder instability with significant glenoid bone loss (>20%) or with failed previous surgical stabilization attempts. The Latarjet procedure has reported success with low recurrent instability rates compared with soft tissue–alone procedures.[2,7,15]

Lafosse et al[16] introduced an arthroscopic version of the Latarjet procedure utilizing 2 metal screws for bone-block fixation. The goal was to translate the stability success of the Latarjet technique to a minimally invasive, arthroscopic technique. Additionally, an arthroscopic approach would allow the identification and treatment of concomitant pathology to be addressed simultaneously. Early results of the arthroscopic technique were favorable, with low rates of recurrent instability and favorable shoulder outcome scores.[11] Although the arthroscopic approach to the Latarjet technique is becoming increasingly common, challenges and concerns still persist and include (1) technical difficulty positioning the bone-block flush with the glenoid and the screws parallel to the glenoid surface; (2) postoperative complications secondary to the 2 bicortical screws including screw bending or pullout, causing injury to the cartilage of the humeral head; (3) risk of neurological injury; (4) a difficult learning curve; and (5) concerns of sequelae of subscapularis splitting with a radiofrequency device.[1-3,8,11-13,17]

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Secondary to some of these concerns, a novel surgical technique, which uses a guided surgical approach for graft positioning with nonrigid fixation via a suture suspensory system, has been described.[6] With the traditional arthroscopic Latarjet procedure, the bone block should be positioned flush (to just a few millimeters medial) to the face of the glenoid, with screws ideally positioned parallel to the glenoid surface. There exists risk of hardware failure or complication with 2 bicortical screws including both screw bending and pullout. Athwal et al[3] reported a short-term complication rate of 24% using the arthroscopic Latarjet technique including 7% coracoid graft fracture, 3% screw backout or failure, and 4% hardware removal surgery. In the long term, a screw removal rate of 12.5% has been reported.[14] Additionally, the rigid screw fixation strength may lend itself to stress shielding and the associated concerns for superior graft resorption.[4,21] This technique has had good self-reported outcomes; however, minimal overall peer-reviewed data currently exist. Although a previous study has reported on the osseous healing after the arthroscopic Latarjet procedure using a nonrigid suture suspensory technique,[6] to our knowledge, imaging for assessment of healing, graft positioning, and migration has never been reviewed by independent musculoskeletal-trained radiologists. Additionally, there was no quantification of the percentage of radiologic healing but rather only assessment for union or nonunion.[6] The objective of this study was to retrospectively evaluate healing rates and stability, as determined by migration, of the coracoid graft in this more recently defined technique. The primary aim was to assess if the nonrigid suture fixation system is stable enough to allow the autograft bone to heal onto the native glenoid appropriately via measurement of osseous healing on computed tomography (CT) scans. The secondary outcome was assessment of the position of the coracoid graft on the glenoid and subsequent migration.

METHODS

Patient Selection

Patients who underwent an arthroscopic Latarjet procedure with nonrigid suture fixation using a cortical button fixation device through a subscapularis split in lieu of the traditional bicortical screws between 2012 and 2015 were selected for the study. The surgical technique used was described previously by Boileau et al.[5,6] All procedures were performed by a single surgeon who is independent of this manuscript. Anonymized Digital Imaging and Communications in Medicine CT data sets were retrospectively collected from these patients. Two different CT scans were collected from patients, 1 at 2 weeks postoperatively and 1 at a minimum of 3 months postoperatively. Patients who did not have at least 2 CT scans performed with sagittal reformats at 2 different time periods were excluded. The study was reviewed and marked for exemption for institutional review board approval at our institution.

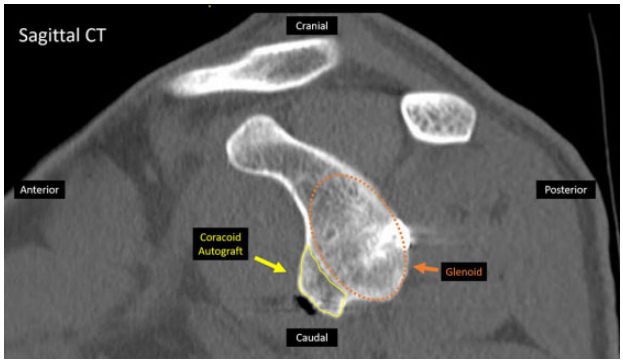

Figure 1. Sagittal computed tomography (CT) image at the level of the glenoid in an 18-year-old man demonstrates 100% osseous bridging at the autograft–native glenoid interface at 12 weeks postoperatively after nonrigid suture fixation using a cortical button device. No graft migration was seen in this patient.

Data Collection

Data collected included patient-specific characteristic data, such as age and sex, as well as the radiologic images. CT scan review was performed independently by 2 fellowship-trained musculoskeletal radiologists (V.K. and J.A.J.) on diagnostic workstations. Data gathered by the radiologists included (1) the initial graft position on the glenoid on the initial 2-week postoperative CT scan and (2) the presence and degree of graft migration relative to the equator with 3-o'clock position on the glenoid as the center and the percentage of osseous healing on the follow-up CT scan. The positioning relative to the equator was used based on previously identified and described positioning of the bone block during Latarjet procedures.[14] Osseous healing was determined as the percentage of osseous bridging visible on CT as assessed by the radiologists on sagittal reformatted images. Figure 1 shows a sample sagittal reconstructed CT image illustrating 100% osseous bridging

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Figure 2. Sagittal computed tomography (CT) image at the level of the glenoid demonstrates lack of osseous bridging at the autograft–native glenoid interface at 12 weeks postoperatively after nonrigid suture fixation using a cortical button device.

between the coracoid autograft and the native glenoid surface. Figure 2 illustrates a postoperative CT without evidence of osseous healing.

Statistical Analysis

Statistical analysis was conducted using SPSS Version 25.0 (IBM Corp). Descriptive statistics included simple counts, percentages, and measures of central tendency to include means and SDs. Average migration relative to the equator and average percentage of healing were calculated using the measurements of each radiologist. Interrater agreement was determined by evaluating Cohen κ values for categorical data and intrarater correlation coefficients for continuous data.

RESULTS

Patient Population

In total, data from 107 patients who underwent the Latarjet procedure with nonrigid suture fixation using cortical button fixation were available. Of the 107 patients, only 45 had at least 2 CT scans performed with sagittal reformats at 2 different time periods at least 3 months apart. These 45 patients were included in the analysis. The population was 84.4% male (38/45 patients) and 15.6% female (7/45 patients). The mean age was 27.1 ± 1.1 years. The mean time period between initial CT scan (performed at 2 weeks postoperatively) and follow-up CT scan to assess for healing and migration was 26 ± 2 weeks. Age and sex distribution in the final cohort were similar to that in the patients who did not meet inclusion criteria (mean age of patients not meeting criteria, 27.3 ± 1.2 years; 81.4% male, 18.6% female), thus showing no characteristic biases for age and sex in patients meeting inclusion criteria.

TABLE 1
Evaluation of Osseous Healing and Graft Migration[a]

	Reviewer 1	Reviewer 2
Average osseous healing, %	74.0	68.9
Percentage of patients with at least 75% healing	75.6	70.2
Percentage of patients with at least 90% healing	60.0	57.8
Center of graft at or below equator (first scan), %	95.6	97.8
Center of graft at or below equator (second scan), %	93.3	97.8

[a]Graft migration evaluated by percentage of patients with center of graft at or below equator.

Osseous Healing

Radiologic evidence of substantial osseous healing was found in the majority of coracoid grafts. Reviewer 1 calculated an average osseous healing of 74.0%, with 34 of 45 patients (75.6%) demonstrating at least 75% healing on CT and 27 of 45 patients (60.0%) with at least 90% osseous healing on CT (Table 1). Reviewer 2 calculated an average osseous healing of 68.9%, with 31 of 45 patients (70.2%) demonstrating at least 75% healing on CT and 26 of 45 patients (57.8%) with at least 90% healing on CT. There was a very good agreement between the reviewers in terms of measurement of osseous healing, with an intraclass correlation coefficient of 0.887 (95% CI, 0.794-0.938).

Graft Position and Migration

The coracoid graft was found to be positioned appropriately with minimal graft migration between follow-up CT scans. Reviewer 1 determined the graft was at or below the equator in 43 of 45 patients (95.6%) at the first follow-up CT scan. Minimal migration was noted in the graft position at the second follow-up CT scan, with the graft position at or below the equator in 42 of 45 patients (93.3%). Reviewer 2 recorded the position of the graft at or below the equator in 44 of 45 patients (97.8%) at both the first and second follow-up CT scans, indicating no significant migration. There was good agreement between reviewers for both the first (κ, 0.656; 95% CI, 0.337-0.975) and second postoperative scans (κ, 0.483; 95% CI, 0.177-0.786).

DISCUSSION

Our study provides further evidence that nonrigid suture fixation using a cortical button device offers an effective alternative to traditional screw fixation for the Latarjet procedure. Concerns have been raised that a nonrigid suture fixation system may not be strong enough to withstand forces to allow osseous healing. Furthermore, there have been concerns that this longer suture lever arm may be more susceptible to graft migration. In our study, we found that, through a nonrigid fixation system, osseous

healing of the graft can be achieved in a high percentage of patients. Position of the graft on follow-up was measured at or below the equator in 93.3% to 97.8% of patients, indicating appropriate positioning on follow-up in most patients with minimal migration. We used the 3-o'clock position relative to the equator, as this has been used previously to describe positioning of the bone block during Latarjet procedures.[14] Furthermore, Nourissat et al[19] reported that the graft centered at the 4-o'clock position is biomechanically advantageous. This is the first study to assess the radiologic outcomes of this technique utilizing the imaging expertise of independent musculoskeletal radiologists.

For these reasons, Boileau et al[6] described a novel arthroscopic technique using a suture-button nonrigid fixation system as an alternative to traditional screw fixation. The goal of this technique was to avoid the potential complications of screw fixation while obtaining bone graft union. Boileau et al[6] recently reported favorable functional results and 93% rate of return to sports. Additionally, the authors reported a low complication rate, with only 2.5% rate of recurrent subluxation and 2.5% rate of revision surgery. There were no reported neurologic injuries or hardware-related complications in 121 patients. Bone-block osseous healing was reported in 95% of patients at follow-up, with appropriate graft position in 92.5% of patients. However, these results were reported by authors who were involved in development of the system and not independently reviewed by musculoskeletal radiologists. Furthermore, they only assessed for union or nonunion, which was defined as a visible radiolucent line but in our study would be defined as 0% osseous healing. They did not substratify based on the percentage of bony healing.

A key strength of our study is the detailed and independent review of postoperative CT scans by 2 independent musculoskeletal-trained radiologists. A radiologist review allows for an accurate, objective analysis of osseous bridging formation as well as extent of graft migration on follow-up CT scans. This eliminates the potential bias in the assessment of objective radiologic outcomes. The 71% to 74% osseous healing rate on CT scan observed in our study compares similarly with that observed in a previous CT scan analysis of the arthroscopic Latarjet technique using screw fixation ($\sim$78%).[9] Open Latarjet techniques have been found to have up to 28% nonunion rates, with graft migration up to 10%.[8,20] Thus, the results of our study compare favorably with those reported for both of these techniques.

Limitations of our study include the lack of a control group in this retrospective review of previously collected data. In addition, all surgeries were performed by a single surgeon and thus may not have universal applicability. Given that performing nonrigid suture fixation using a cortical button device has a high learning curve and is technically demanding, our reported results may be related to surgeon experience and comfort with the technique. Additionally, our study is limited to radiologic findings and cannot be correlated with clinical findings, given the anonymized data. The postoperative follow-up CT scan time points are not standardized, which limits the ability to make a generalized estimate of graft migration over time. Futher long-term radiologic data would also be beneficial, as we were limited to $\sim$28 weeks postoperatively. Of the 107 patients who received this procedure, only 45 had the second CT scan, thus introducing potential bias. This cohort of patients was included in previously published data for outcomes and complications with the technique, with only 2.5% rate of recurrent subluxation, 2.5% rate of revision surgery, and no reported neurologic injuries or hardware-related complications.[6] The characteristics were reported in the Results section, which show no significant difference between the study and the exclusion groups.

Future studies should focus on comparison of the multiple different procedures for anterior stabilization in patients with significant glenoid bone loss. A randomized controlled trial comparing the open Latarjet procedure, arthroscopic Latarjet procedure with screw fixation, and arthroscopic Latarjet procedure with nonrigid suture button fixation would be the ideal method of study. However, the feasibility of a quality randomized controlled trial would be questionable, particularly given the high learning curve for the arthroscopic Latarjet procedure. Additionally, comparison of alternative techniques or adjunct procedures, such as utilization of the long head of the biceps for patients with moderate glenoid bone loss and the need for an isolated soft tissue repair versus a Latarjet procedure, would be informative.

CONCLUSION

Our study results demonstrate that postoperative CT scans in patients who have undergone nonrigid suture fixation for arthroscopic Latarjet procedures show high rates of osseous healing and minimal graft migration. This study provides additional radiologic data that this technique modification for arthroscopic Latarjet may be a reliable alternative to the traditional screw fixation.

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