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Does the presence of glenoid bone loss influence coracoid bone graft osteolysis after the Latarjet procedure? A computed tomography scan study in 2 groups of patients with and without glenoid bone loss

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Background: Coracoid bone graft osteolysis and fibrous union are the principal causes of failure in patients treated with the Latarjet procedure. This study aims to investigate the hypothesis that coracoid bone graft osteolysis is more pronounced in cases without glenoid bone loss, which may be due to a diminished mechanotransduction effect at the bone healing site.
Methods: We prospectively followed up 34 patients, treated with a mini-plate Latarjet procedure, divided into 2 groups (group A patients had glenoid bone loss >15% and group B patients had no glenoid bone loss). A computed tomography scan evaluation with 3-dimensional reconstruction was then performed on all patients to evaluate coracoid bone graft osteolysis according to our coracoid bone graft osteolysis classification.
Results: The computed tomography scan analysis showed a different distribution of osteolysis between group A and group B. The statistical analysis showed a significant difference ($P < .01$, Bonferroni test) between groups A and B for the following sections: proximal/lateral/superficial, proximal/medial/deep, distal/lateral/superficial, and distal/lateral/deep. On average, the coracoid grafts in group A patients showed less osteolysis than the coracoid grafts in group B patients (39.6% vs 65.1%).
Discussion: The coracoid bone graft underwent much less osteolysis in patients with significant glenoid bone loss (>15%) than in those without it. Because factors of blood supply, compression, and surgical technique were the same for both groups, we believe that the mechanotransduction effect from the humeral head on the graft influences its remodeling.
Conclusion: The results of this study suggest that the bone graft part of the Latarjet procedure plays a role in patients with significant coracoid bone loss but much less so when there is no bone loss.

Approved by the Concordia Hospital Ethical Committee (study No. 2/2012).

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Level of evidence: Level II, Prospective Cohort Treatment Study.

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Coracoid bone graft osteolysis and fibrous nonunion are considered the principal causes of failure (recurrent dislocation, subtle instability, pain, and stiffness) in patients treated with the Latarjet procedure for anteroinferior shoulder instability.[1,5-7,13-15,17,26]

Osteolysis is influenced by biological and biomechanical factors. Biological factors include bone contact between the coracoid bone graft and the glenoid bone bed in the lateral region, influenced by the shape of the glenoid neck and the graft, as well as blood supply to the graft from the bleeding surface of the decorticated glenoid neck and coracoid graft and from the conjoined tendon to the distal part of the coracoid graft. Infection may also induce osteolysis. Biomechanical factors are related to stability at the bone contact area and mechanical cues that remodel bone. Wolff's law states that bone in a healthy person or animal will adapt to the loads under which it is placed. If loading on a particular bone increases, the bone will remodel itself over time to become stronger to resist that sort of loading. The inverse is true as well: if the loading on a bone decreases, the bone will become weaker because of turnover, it is less metabolically costly to maintain, and there is no stimulus for continued remodeling that is required to maintain bone mass. In particular, the coracoid bone graft will be subjected to bending forces from the conjoined tendon in its inferior part and by shearing forces from the humeral head in its lateral part.[4]

With the aim of better understanding these factors, we have been quantifying and localizing osteolysis of coracoid bone grafts. An initial study showed that the superficial part of the proximal coracoid bone graft underwent the greatest amount of osteolysis.[9] In a subsequent study, we tried to influence one of the biological factors by increasing contact and compression between the coracoid graft and the glenoid neck through the use of a wedged profile plate; however, this did not seem to reduce the amount of coracoid bone graft osteolysis.[8]

This study aims to investigate our hypothesis that coracoid bone graft osteolysis is more pronounced in cases without glenoid bone loss, which may be due to a diminished mechanotransduction effect at the bone healing site because the shearing forces of the humeral head would then be less on the more superficial and superior sections of the graft.

Materials and methods

The database for this study consisted of 191 patients who underwent the Latarjet procedure with a mini-plate fixation technique for anteroinferior dislocation with or without ligamentous hyperlaxity by the same surgeon (G.D.G.) from April 2009 to September 2012. The main criterion for the procedure was an instability severity index score[2] of at least 6 points. Except for 4 patients who underwent surgery after their first dislocation, all patients had recurrent dislocations. The exclusion criteria were concomitant rotator cuff lesions, previous surgery for recurrent anteroinferior dislocation, and multidirectional instability. High-risk sports and activities were not exclusion criteria.

All patients were operated on by the same technique with the modified Latarjet procedure. The coracoid bone graft was laid lengthwise below the equator and no less than 2 mm from the glenoid cartilage. Both the neck and the graft were decorticated to bleeding cancellous bone. In our modification, fixation of the coracoid bone graft is performed with 2 bicortical cannulated screws that are partially threaded (diameter, 4 mm) through a custom-made mini-plate.[8,9,16,18]

All patients underwent preoperative computed tomography (CT) scans to quantify glenoid bone loss according to the Pico method.[3] A CT scan evaluation with 3-dimensional reconstruction was then performed on all patients to evaluate the coracoid bone graft 3 days after surgery. On the basis of the CT scan, we prospectively included 25 patients with bone loss greater than 15% (group A) and 25 patients with no bone loss (group B) who consented to undergo another CT scan at a follow-up of greater than 1 year. The method for determining and statistically analyzing coracoid graft osteolysis was the same as that used in the previous studies.[8,9]

The postoperative and follow-up CT scans were performed on a latest-generation 64-slice Siemens Somatom dual-source scanner (200 mA, 120 kV [peak], and slice thickness of 1 mm) (Siemens, Erlangen, Germany). The graft was divided into 8 sections with the glenoid apex as a reference point to ensure reproducible measurements between both CT scans. The 8 sections were defined by 3 planes on an axial slice: (1) 2 regions, respectively, through the mid portion over the superior screw (4 proximal sections) and under the inferior screw (4 distal sections); (2) superficial and deep in relation to contact with the glenoid; and (3) medial and lateral (Fig. 1). All 8 sections were measured by use of a semiautomated edge detection module (Adobe Photoshop, version 7.0; Adobe Systems, San Jose, CA, USA), according to the method described by Puri et al[20] and Whang et al.[23] All CT scans measurements were performed by an independent radiologist not involved in the study.

Two independent groups were defined by the amount of glenoid bone loss, age, number of dislocations, and percentage of reabsorption of the 8 coracoid sections. To normalize the data expressed by the percentage, the values (v) were scaled into angular values (φ), from 0° to 90°, by the following formula: $\varphi = \arcsin \sqrt{v}$. This trigonometric transformation causes magnification of the differences at the scale ends (around 0% and 100% of reabsorption). Because this transformation brings the variance