Distal Clavicle Autograft Augmentation for Glenoid Bone Loss: An Anatomic Cadaveric Study

Luis Gustavo Prata Nascimento, Luiz Giglio, Vitor La Banca[1], Ana Vigano, Roberto Ikemoto[2], Joel Murachovsky
[1]La Banca - Clínica De Ortopedia, [2]Abc Med School

INTRODUCTION: The distal clavicle (DC) is considered a promising graft option for addressing glenoid bone loss due to its autologous and osteochondral nature, eliminating the risk of antigenicity, and minimizing donor site morbidity. Despite these advantages, there remains a debate concerning the morphological characteristics of the DC and its correlation with glenoid anatomy. This study aims to examine and compare the morphological dimensions of the DC with those of the glenoid, evaluating cartilage thickness, DC format, and its potential to effectively cover anterior glenoid defects.

METHODS: We dissected 20 shoulders from ten fresh cadavers with mean age of 57.6 ± 3.6 years using an extended deltopectoral approach to access the glenoid and acromioclavicular (AC) joint. We classified the distal clavicle (DC) morphology as flat, curved, or oblique. The DC was resected with a 1 cm medial osteotomy to the AC joint, and the glenoid was resected at the scapular neck level. Superoinferior and anteroposterior measurements of the DC and glenoid were conducted. A vertical osteotomy on the anterior glenoid rim simulated bony lesions seen in recurrent anterior shoulder instability, facilitating cartilage thickness assessment. The DC was manually attached to the osteotomized glenoid surface to evaluate positioning and compare radii of curvature. Additionally, the DC was osteotomized to measure its cartilage thickness.

RESULTS: The mean age was 57.6 ± 3.6 years, ranging from 30 to 88 years. There were 8 male and 2 female specimens. None of the cadavers had any prior surgery on the shoulder or anatomic deformity that could preclude evaluation.

Main Results:

The mean ApG was 29.57 ± 0.42 mm, ranging from 26.3 to 33.31 mm. Mean SiCl was 13.94 ± 0.75 mm, varying from 7.3 to 22 mm, and mean ApCl was 23.67 ± 0.98 mm, ranging from 13.3 to 31.1 mm. The ratios of SiCl/ApG and ApG/ApCl measurements were 47.08% and 80%, respectively.

Our average glenoid cartilage thickness was 2.63 ± 0.20 mm, ranging from 0.96 mm to 4 mm. The DC cartilage was 2.18 ± 0.17 mm, varying from 0.54 mm to 4 mm. The thickness of the clavicular cartilage corresponded in average to 73.87% of that of the glenoid.

Regarding the morphology of the AC joint, 40% (8) was flat, 30% (6) curved, and 30% (6) oblique, according to the classification proposed by Colegate-Stone et al.

Measurements obtained from each subject are depicted in Table 1.

DISCUSSION AND CONCLUSION: Our findings suggest that the distal clavicle (DC), used as a graft possibly covers nearly half (47.08%) of the total anteroposterior length of the glenoid, and its cartilage thickness closely matches that of the glenoid (73.87%). These results indicate the potential of the DC as an autologous graft option for patients with substantial glenoid bone loss, offering the advantage of a cartilaginous surface.Our findings suggest that the distal clavicle, when utilized to reconstruct an eroded glenoid, may have the potential to cover a significant portion of the defect. The morphological results for SiCl and ApCl found in this study are in accordance with the literature. Tokish et al. reported an average of 13 mm and 19 mm, respectively, and Larouche et al. presented an average of 11 mm and 18 mm, respectively. So, when analyzing the capacity of the DC to restore the glenoid surface, we found similar results when comparing to those of Tokish et al.(47,08% vs 44%). On the other hand, the evaluation done by Larouche et al.demonstrated that the DC could restore only 22% of the glenoid surface and recommended this graft to be used on small to moderate glenoid bone loss, those differences could be explained by different measurement methods and tools employed as well as different populations.

We chose to measure the largest anterior to posterior glenoid distance in this study, as the mean orientation of glenoid defects points towards the 3 o'clock position for right shoulders and 9 o'clock position for left shoulders. Mallon et al.found an average value of 24 mm (range 16-29.5 mm) and Bueno et al.3 26.38mm (range 20.03-32.35mm), which were approximately similar to our findings.

The contact area between the DC and glenoid is essential for better fixation and bone healing. Then, positioning the DC with the SiCl distance to fill a glenoid bone loss will be able to cover the glenoid defect up to 47,08%, with a contact area, on average, of 23.67 mm (ApCl average). Thus, allowing two anchors, two buttons, or even two screws fixation. Moreover, comparing the SiCl dimensions observed in this study with the coracoid measurements previously reported by Bueno et al., corroborate with the validity of the DC as a graft source.

Regarding the visual morphological analysis of DC, we used the classification proposed by Colegate-Stone et al. These authors found an incidence of 5.1% of the curved-shape DC, while we observed an incidence of 30% in our evaluation. Also, Larouche et al. presented 14% curved shape DC in tomographic evaluation, but visually it corresponded to 11%. Nevertheless, we understand that the curved shape, as it has a convex articular surface, is incongruent with the concave articular surface of the glenoid. Therefore, when considering the DC as a graft option, it's important to consider the shape

during the positioning in the glenoid bone lesion. With a curved DC type, it might be necessary to slightly medialize it to align its apex to the glenoid surface and make it congruent.

Despite the significance of our findings, this study is limited by the relatively small number of specimens. Additionally, the mean age of the specimens is slightly older than the typical population affected by anterior shoulder instability. However, as we excluded subjects with significant arthritis, we believe the impact of age is minimal. It's important to note that this study relied solely on manual measurements, and bone density analysis was not incorporated, a limitation that should be acknowledged. Nonetheless, the measurements obtained aligns with previously reported studies Furthermore, while our study shares similarities with others on this subject, it distinguishes itself by assessing a diverse population with a mix of racial backgrounds.