Pathological or Physiological? An Analysis of the Glenoid Bone Graft Resorption following Arthroscopic Anatomic Glenoid Reconstruction Using a Distal Tibia Allograft

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INTRODUCTION: Bone graft resorption is a common consequence of bone graft augmentation procedures, including Arthroscopic Anatomic Glenoid Reconstruction (AAGR). There is significant concern that the large amount of bone graft resorption may be pathological and lead to failure of the graft over time. Interestingly, resorption has been shown to plateau at a certain point following AAGR. This suggests that the significant glenoid graft resorption that occurs in many cases of AAGR may not be pathological and instead could be attributed to physiological bone remodeling following Wolff's Law, where the graft is remodeled to the native architecture of the glenoid. A strong correlation exists between glenoid width (W) and glenoid height (H) and is described by equation $\mathbf{W_{(mm)} = 2.53_{(mm)} + 0.71*H_{(mm)}}$. The purpose of this study was to apply this equation to 3D reconstructed glenoid models generated from postoperative CT scans to determine if bone graft resorption follows Wolff's Law after AAGR.

METHODS: This study is a retrospective analysis of prospectively collected data. The study group included 185 patients who underwent AAGR for anterior shoulder instability between 2012 and 2020 who have completed postoperative follow ups for a minimum of two years with 3D CT reconstruction images at minimum one-year postoperative. De-identified glenoid images were reviewed using 3D models generated using the Horos and Meshmixer software to measure glenoid width (W) and height (H). The 3D models were oriented to obtain an *en face* view of the glenoid to measure glenoid width and height. The height was defined as the maximal distance obtained from the superior pole of the glenoid at the level of the base of coracoid to the inferior pole. The width was the maximum length possible recorded between the anterior and posterior glenoid rims in an orthogonal orientation to the previously measured height (Figure 1). The measured glenoid width was compared to the predicted glenoid width based on height using equation $W_{(mm)} = 2.53_{(mm)} + 0.71*H_{(mm)}$, and the difference between the two measures was calculated.

RESULTS: The average glenoid width at minimum one-year postoperative was 29.94±3.25mm. Using equation $W_{(mm)} = 2.53_{(mm)} + 0.71*H_{(mm)}$, the average estimated glenoid width of these patients was 29.88±2.21mm. There was no significant difference between the measured and estimated glenoid width (mean difference 0.58±3.58mm, p value = 0.959).

DISCUSSION AND CONCLUSION: The estimated glenoid width did not differ significantly from the measured glenoid width in patients who had undergone AAGR with distal tibia allograft at minimum one-year follow up. These findings support the hypothesis that bone graft resorption follows Wolff's Law after AAGR and the glenoid remodels to its native architecture. The results of this study help explain why significant postoperative bone graft resorption frequently occurs following AAGR and will help direct size of distal tibia allograft bone blocks used in AAGR in the future to limit postoperative complications and optimize patient outcomes.

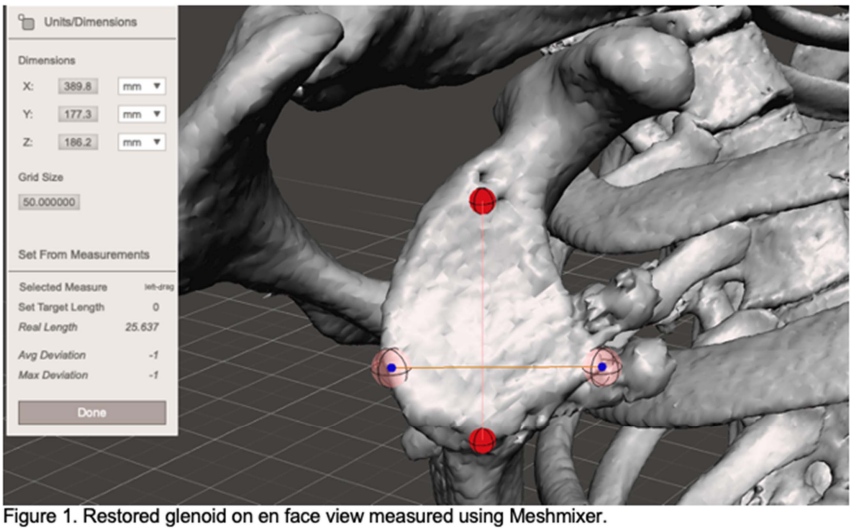

Figure 1. Restored glenoid on en face view measured using Meshmixer.