Patient-Specific Glenoid Reconstruction: The Importance of Understanding Anatomic Variations of the Scapula

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INTRODUCTION: Many surgeons are interested in learning how to reconstruct the glenoid for shoulder instability using an arthroscopic, anatomic approach. The acromion and coracoid have anatomic variations that impact arthroscopy for glenoid reconstruction. The acromion is used to identify the posterior portal, described to be 2cm inferior and 2cm medial to the posterolateral corner. This portal is essential for the proper creation of the far medial (Halifax) portal, allowing for the bone graft to pass from the anterior shoulder, lateral to conjoin, superior to subscapularis, and parallel to the glenoid. However, the posterolateral corner has more anatomic variability than previously thought. In addition, while the size and shape of the coracoid has been extensively studied as a graft for the Latarjet, the morphology has not been examined regarding interference with the fixation of a bone graft arthroscopically. Authors have found variations in these two anatomical structures to be common and are the leading cause of difficulties with the arthroscopic glenoid reconstruction and mal-positioning of the graft. With advancements in augmented reality and 3D printing, these could be useful tools to provide patient-specific surgery to accommodate for these variations. At this time there is not enough understanding of the variations in the anatomy of the scapula to properly utilize this. The purpose of this study was to determine the amount of variation in the anatomy of the acromion and coracoid using 3D models and measurements on a Hololens to support the use of virtual reality and patient-specific glenoid reconstruction.

METHODS: The CT scans of 100 patients requiring an arthroscopic glenoid reconstruction were analyzed for acromion and portal placement variability. The 3D CT scans of scapula were used to upload 3D models onto a Hololens virtual reality headset. We then used the virtual reality headset to measure the height and width of the glenoid. A 0.5 cm pointer was placed on the surface of the glenoid to simulate the ideal position of the scope from the posterior portal. From this we measured the superior to inferior and medial to lateral distances of the acromion and coracoid. Also, the angle between the face of the glenoid and the anterolateral acromion. Measurements were in cm to the first decimal place.

RESULTS: There was significant variation in the position of the posterolateral corner, making the standard 2cm inferior and 2cm medial landmarks rarely the ideal position for the posterior portal. The mean superior to inferior distance of the acromion was 0.42 cm with a standard deviation of 0.65. The mean medial to lateral distance was 0.87 with a standard deviation of 0.61. There was less variation in the position of the coracoid. There was also wide variation in the angle between the anterior rim of the glenoid and anterolateral acromion with a mean angle of 15.58 deg with a standard deviation of 9.54.

DISCUSSION AND CONCLUSION: There are significant anatomical variations in the anatomy of the acromion and coracoid that could affect surgery. We suggest using computer manipulated 3D modeling, augmented reality, and 3D printing to enhance individualized surgical plans for glenoid reconstruction.