

The Role of Bone Morphology of the Greater Tuberosity and Lateral Acromion on Subacromial Space during Scapion: A Three-Dimensional Dynamic Simulation Analysis

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INTRODUCTION:

The bone morphology of the greater tuberosity and lateral acromion plays a central role in subacromial impingement syndrome. The critical shoulder angle (CSA) and greater tuberosity angle (GTA) are two-dimensional measurement parameters that have been validated to evaluate it radiologically. These markers are, however, static and don't consider the dynamic effect of glenohumeral motion.

This study aimed to better understand the biomechanics in subacromial impingement with a dynamic simulation based on a validated 3D biomechanical model coupling joint kinematics and 3D reconstructed computed tomography.

METHODS:

Sixty-one patients were included in this study: 44 with degenerative rotator cuff tears, and 17 with glenohumeral instability. Patients with previous surgeries, traumatic cuff tears, and cuff tear arthropathy were excluded. CSA, GTA, and impingement-free range of motion (IF-ROM) of the glenohumeral joint in scaption were calculated. Correlation tests were used to determine the relationship between ROM and CSA, GTA, and combined CSA and GTA values.

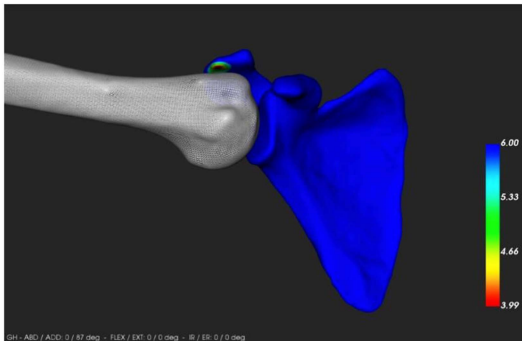
RESULTS:

CSA and GTA were significantly higher in the rotator cuff tear group ($P = 0.001$ and <0.001), while IF-ROM was significantly higher in the instability group ($P = 0.001$). There was no overall correlation between CSA and GTA ($R = 0.02$, $P = 0.8$). Individual correlation between both angles with IF-ROM was negatively weak for CSA ($R = -0.4$, $P < 0.001$) and negatively moderate for GTA and IF-ROM ($R = -0.5$, $P < 0.001$). However, combining both angles resulted in a negatively high correlation with IF-ROM ($R = -0.7$, $P < 0.001$).

DISCUSSION AND CONCLUSION:

Subacromial space narrowing during scaption is highly correlated to the cumulative values of GTA and CSA. These findings suggest that the combined bony morphology of the lateral acromion and greater tuberosity plays an important role in subacromial impingement.

Figure 2. Visualization of the acromio-humeral distance during scaption



Visualization of the acromio-humeral distance during scaption. The colors represent the variations of the distance between the acromion and humeral head with the red color denoting the zone of minimum distance.

Table 2. Correlation test among the outcome variables.

Variables	Correlation	P value
CSA vs GTA	0.02	0.83*
CSA vs ROM	-0.44	0.0004**
GTA vs ROM	-0.52	<0.0001**
CSA+GTA vs ROM	-0.7	<0.0001**

CSA: Critical Shoulder Angle; GTA: Greater Tuberosity Angle; ROM: Impingement-free Range of Motion. * Pearson correlation test. ** Spearman correlation test.