LOADING THE LONG HEAD OF THE BICEPS AFFECTS GLENOHUMERAL KINEMATICS

INTRODUCTION:
Previous studies have described the long head of the biceps as a stabilizing force in the setting of glenohumeral instability.\(^1,2,3\) However, much remains unknown about the effect of loading the long head of the biceps on glenohumeral kinematics; specifically, its effect on glenohumeral rotational range of motion, translations, and the path of glenohumeral articulation (PGA).

METHODS:
Six cadaveric shoulders were tested for glenohumeral rotational range of motion and translation using a custom shoulder testing system and the Microscribe 3DLX. (Figure 1A) Humeral rotational range of motion was measured with 2.2 Nm of torque applied. Glenohumeral translations in the anterior, posterior, superior and inferior directions were measured with 15N and 20N of force applied with the humerus secured in 90 degrees external rotation. The path of glenohumeral articulation was measured by calculating the humeral head position with respect to the glenoid articular surface at maximal internal rotation, 30, 60, 90 and maximal external rotation. Data were recorded for three biceps loading conditions: 0N, 11N, and 22N. (Figure 1B)

RESULTS:
Glenohumeral Rotational Range of Motion
Decreases in total rotational range of motion, external rotation, and internal rotation were found with increasing biceps loads. Unloaded (0N biceps load) specimens had an average total humeral rotational range of motion of 139.3±13.8°, with an average external rotation of 129.3±4.8° and an average internal rotation of 10.0±10.1° from neutral humeral rotation. With 11N biceps load, a decrease in external rotation (1.9°, \(p<0.05\)) and internal rotation (3.3°, \(p>0.05\)) was observed. With 22N biceps load, the decrease in external rotation (5.0°, \(p=0.003\)) and internal rotation (13.3°, \(p=0.007\)) was statistically significant compared to the unloaded group.

Glenohumeral Translation
Anterior-Posterior Loading. With the application of a 15N translational force, there were significant decreases in anterior (2.5mm, \(p=0.034\)) compared to the 22N load group. With the application of a 20N translational force, there were significant decreases in anterior (1.6mm, \(p=0.0028\)) and posterior (7.0mm, \(p=0.014\)) translations for the 22N group compared to the loaded group.

Superior-Inferior Loading. With the application of a 15N translational force, there were significant decreases in superior (1.0mm, \(p=0.030\)) and inferior (10.3mm, \(p=0.0007\)) translations for the 22N load group compared to the unloaded group. With the application of a 20N translational force, there were significant decreases in superior (1.2mm, \(p=0.02\)) and inferior (9.6mm, \(p=0.001\)) translations for the 22N group compared to the unloaded group.

Path of Glenohumeral Articulation (Figure 2)
The position of the humeral head apex and humeral rotation center with respect to the glenoid articular surface was measured for all three loading conditions and this arc of motion is called the Path of Glenohumeral Articulation (PGA). At maximum IR, 22N biceps load significantly shifted the humeral rotation center (HRC) 6.7±1.1mm (\(p=0.034\)) posterior compared to the unloaded HRC. At 30, 11N and 22N biceps load significantly shifted the HRC 4.5±2.4mm (\(p=0.047\)) and 6.4±2.7mm (\(p=0.003\)) posterior compared to the unloaded HRC. At 60, 11N and 22N of biceps load both significantly shifted the HRC 2.9±1.4mm (\(p=0.027\)) and 3.3±1.4mm (\(p=0.013\)) posterior compared to the unloaded HRC. At 90°, there were no significant shifts of the HRC with either 11N or 22N of biceps load. At maximum ER, 22N biceps load significantly shifted the HRC 4.2mm±1.7mm (\(p=0.027\)) anterior and 3.0mm±1.3mm (\(p=0.0058\)) superior compared to the unloaded HRC.

REFERENCES:

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