A BIOMECHANICAL ANALYSIS OF SUPRASPINATUS ROTATOR CUFF TEAR AND REPAIR
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Introduction
Rotator cuff tears are common injuries seen by orthopaedic surgeons. Management may vary depending on patient factors, size and location of tear, and severity of symptoms. Treatment for symptomatic rotator cuff tear often includes subacromial decompression, debridement, and/or repair. The objective of this study was to determine the change in glenohumeral joint (GHJ) forces after repair of pathologic supraspinatus tears.

Methods
Six fresh frozen shoulder specimens with intact rotator cuff tendons and five fresh frozen shoulder specimens with full-thickness, 50-100% width supraspinatus tears were dissected leaving the tendons of the rotator cuff, deltoid, latissimus dorsi, and pectoralis major. A custom shoulder testing device (2) simulating the muscle forces of the humerothoracic muscles was used. The muscles loaded included the individual rotator cuff muscles, deltoid, latissimus dorsi, and pectoralis major. (Figure 1) The glenohumeral joint forces were measured using a six degrees-of-freedom load cell. All joint force measurements were resolved into three orthogonal components directed perpendicular (compression force), anterior, and superior to the glenoid. The GHJ forces in specimens with intact rotator cuff and simulated supraspinatus tear (unloaded supraspinatus), as well as specimens with supraspinatus tears both before and after tendon repair were measured. Testing of each shoulder was performed in 90° abduction, 90° external rotation, and varying degrees of horizontal abduction, neutral (scapular plane), 20° anterior to neutral and 20° posterior. ANOVA with a p-value of 0.05 was used for statistical analysis.

Results
The GHJ force was resolved into three orthogonal components: 1) anterior/posterior force (x), 2) superior/inferior force (y), and 3) compressive force (z). The force data was analyzed and compared by calculating the percentage of each force component of the resultant force vector (Fr) using the formula Fr = (x^2 + y^2 + z^2)^0.5 and a method described by Lee et al. (3). Comparisons were made between intact specimens (I) with supraspinatus loaded (SSuL) and supraspinatus unloaded (SSuL) versus supraspinatus tear specimens (T) both before and after tendon repair. Significant differences were noted in force components between SSuL (I) versus SSuL (T) or between SSL (I) and SSL before repair (T) in all positions of abduction. This suggests that the partial supraspinatus tear does not significantly affect the glenohumeral joint forces. There was a significant difference between SSL (I) and SSL after repair (T) in superior/inferior force in all three positions of abduction and compressive force in anterior and neutral positions (p<0.01-0.05) (Figure 2). In the supraspinatus tear specimens, a significant difference was noted between supraspinatus unloaded (SSuL) and supraspinatus loaded before repair (T) in both inferior and compressive force (p<0.005-0.02). No significant differences were noted between supraspinatus unloaded before and after repair except in compressive force in the anterior position only (p<0.05).

Discussion
The cadaveric model used in this study is unique for simulating the force environment in the glenohumeral joint because of the inclusion of the humerothoracic muscles. The latissimus dorsi and pectoralis major muscles act as a force vector couple counteracting the superior pull of the deltoid muscle. The results from this study suggest that the intact specimen actually acted as a force vector couple counteracting the superior pull of the deltoid muscle. The results from this study suggest that the intact specimen actually acted as a force vector couple counteracting the superior pull of the deltoid muscle. The implication is that the supraspinatus force was still transmitted in the specimens prior to repair via the intact cable of the rotator cuff as described by Burkhart (1) as the supraspinatus tears were all less than 100%.

References:

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