Stabilizing Function of the Biceps in Unstable Shoulders

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The biceps brachii has two heads: the long head (LHB) and the short head (SHB). Because of its intimate relationship with the humeral head, we hypothesized that the LHB would stabilize the humeral head. In order to prove our hypothesis, we conducted a series of studies. We are going to summarize what we have done in clarifying the function of the biceps in shoulders with various degrees of instability.

Stabilizing function in adduction

The first study was to determine the effect of loading the LHB on displacement of the humeral head. Nine fresh frozen cadaveric shoulders were tested in the hanging arm position. Stress tests were simulated by applying a 1.5-kg load to the proximal humerus in various directions. The position of the humeral head was monitored using an electromagnetic tracking device under the following conditions: 1) 0 or 1.5 kg of translation force to the proximal humerus in the anterior, posterior, and inferior directions, 2) 0, 1.5, or 3 kg on the LHB, and 3) in three different rotations of the arm. Displacement in the anterior and posterior directions was significantly decreased by LHB loading and was less significant in internal rotation. Inferior displacement was significantly decreased in external rotation. From these results, we conclude that: 1) the LHB has a function to stabilize the glenohumeral joint in the hanging arm position, and 2) the stabilizing function is influenced by the rotation of the arm.

Stabilising function in abduction

Next, we studied the contributions of the LHB and SHB to anterior stability of the shoulder with the arm in 90 degrees of abduction using 13 cadaveric shoulders. The position of the humeral head was monitored with or without an anterior translational force; with 0 kg, 1.5 kg or 3 kg loads applied on either LHB or SHB tendons in 60 degrees, 90 degrees or 120 degrees of external rotation; and with the capsule intact,

vented, or damaged by a Bankart lesion. The anterior displacement of the humeral head under 1.5 kg force was significantly decreased by both the LHB and SHB loading in all capsular conditions when the arm was in 60 degrees or 90 degrees of external rotation. At 120 degrees of external rotation, anterior displacement was significantly decreased by LHB and SHB loading only when there was a Bankart lesion. We conclude that 1) LHB and SHB have similar functions as anterior stabilizers of the glenohumeral joint with the arm in abduction and external rotation, and 2) their role increases as shoulder stability decreases.

Comparison with the cuff muscles

Then, we compared the stabilizing effect of each of the rotator cuff muscles and that of the biceps on the glenohumeral joint. The muscles were loaded one at a time with forces proportional to their cross-sectional areas. We recorded the positions of the humeral head before and after the application to the humerus of an anterior force of 1.5 kg with various degrees of instability. When the capsule was intact, the anterior displacement with the subscapularis loaded was significantly larger than with the other muscles loaded ($p = 0.0009$). With the capsule vented, the displacement with the biceps loaded was significantly smaller than that with the subscapularis loaded ($p = 0.0052$). After creating an imitation Bankart lesion, the displacement with the biceps loaded was significantly less than with any of the rotator-cuff muscles loaded ($p = 0.0132$). We conclude that 1) the subscapularis is the least important anterior stabilizer in the intact shoulder, and 2) the biceps becomes more important than the rotator-cuff muscles as stability from the capsuloligamentous structure decreases.

Biceps activities

We extended our biceps study in the clinical field. We investigated EMG

activities of the biceps in 40 shoulders with full-thickness rotator cuff tears and 40 asymptomatic shoulders, with a normal rotator cuff on MRI, to determine the role of the biceps in cuff-deficient shoulders. Biceps activities were recorded during arm elevation and %MVC was obtained at different angles of elevation. In the normal shoulders, %MVC of the biceps was always less than 10% through the arc of elevation. Among 40 shoulders with rotator cuff tears, 14 showed increased activities of the biceps more than 10% in %MVC ($p < 0.0001$), whereas the remaining 26 shoulders had activities similar to the normal shoulders. The biceps activities in these 14 shoulders increased with load application and at higher angles of elevation. The muscle strength tended to be weaker in shoulders with increased biceps activities than in those without. Our findings suggest a potential supplemental function of the biceps in shoulders with rotator cuff tears.

Depressor function in cuff-tear shoulders

We investigated the function of the biceps in 18 patients (mean age, 59 years) with rotator cuff tears. Another series of 18 patients (mean age, 55 years) with normal rotator cuff acted as a control group. A brace was used to maintain contraction of the biceps during elevation. Anteroposterior radiographs were obtained with the arm elevated at 0, 45, and 90 degrees with and without biceps contraction. The distance between the center of the humeral head and the glenoid was compared in the two groups. We found that in the group with tears there was significantly greater proximal migration of the head of the humerus at 0 and 45 degrees of elevation without biceps contraction but depression of the humeral head at 0, 45, and 90 degrees when biceps was functioning. We conclude that biceps is an active depressor of the humeral head in shoulders with rotator cuff tears.

From these studies, it is clear that the biceps has a stabilizing function of the

humeral head in various directions. Either in post-traumatic anterior instability or in rotator cuff tears, the biceps seems to have a potential role in stabilizing the shoulder, which may be beneficial in rehabilitation program and in conservative treatment.

References

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