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The influence of superior labrum anterior to posterior (SLAP) repair on restoring baseline glenohumeral translation and increased biceps loading after simulated SLAP tear and the effectiveness of SLAP repair after long head of biceps tenotomy

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Hypothesis: Biomechanical studies have shown increased glenohumeral translation and loading of the long head biceps (LHB) tendon after superior labrum anterior to posterior (SLAP) tears. This may explain some of the typical clinical findings, including the prevalence of humeral chondral lesions, after SLAP lesions. The first hypothesis was that SLAP repair could restore the original glenohumeral translation and reduce the increased LHB load after SLAP lesions. The second hypothesis was that SLAP repair after LHB tenotomy could significantly reduce the increased glenohumeral translation.
Materials and methods: Biomechanical testing was performed on 21 fresh frozen human cadaveric shoulders with an intact shoulder girdle using a sensor-guided industrial robot to apply 20 N of compression in the joint and 50 N translational force at 0°, 30°, and 60° of abduction. LHB loading was measured by a load-cell with 5 N and 25 N preload. Type IIC SLAP lesions were created arthroscopically, and a standardized SLAP repair was done combined with or without LHB tenotomy.
Results: No significant difference of glenohumeral translation and increased LHB load in SLAP repair compared with the intact shoulder was observed under 5 N and 25 LHB preload, except for anterior translation under 25 N LHB preload. After LHB tenotomy after SLAP lesions, no significant difference of translation was observed with or without SLAP repair.
Conclusions: SLAP repair without associated LHB tenotomy helps normalize glenohumeral translation and LHB loading. The stabilizing effect of the SLAP complex is dependent on the LHB. After biceps tenotomy, SLAP repair does not affect glenohumeral translation.

Institutional Review Board approval was not necessary for this laboratory study.

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Level of evidence: Basic Science Study, Biomechanical Study, Cadaver Model.

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One of the controversies encountered in the treatment of superior labrum anterior to posterior (SLAP) tears[8] is whether to perform SLAP repair or address the biceps differently, such as with tenotomy or tenodesis of the long head of biceps (LHB) tendon. A related question is whether to repair the SLAP tear after biceps tenotomy to maintain normal glenohumeral kinematics and stability.

The SLAP repair has been described with good[4] as well as with poor clinical results[3] compared with LHB tenotomy or LHB tenodesis. These studies did not clarify the different treatment approaches of SLAP lesions due to patient age, although SLAP repair should not perform well in patients with combined LHB synovitis or even LHB fraying.

The SLAP, including the origin of the LHB (SLAP complex),[13,16,24] and the LHB itself are the main stabilizers for the glenohumeral joint in the parasagittal plane.[5,6,9,22,24-26]

- Pagnani et al[17,18] found in biomechanical experiments that an isolated lesion of the anterosuperior portion of the glenoid labrum, with an intact supraglenoid origin of the LHB, had no significant effect on an anteroposterior or superoinferior glenohumeral translation. However, a complete lesion of the superior portion of the labrum destabilizing the insertion of the LHB resulted in significant increases in anteroposterior and superoinferior glenohumeral translation.[17]
- Warner et al[25] found evidence supporting the role of LHB as a stabilizer of the humeral head in the glenoid during shoulder abduction.
- Burkart et al[5,6] observed an increase in anterior and anteroinferior translation at 30° and 60° of abduction after the creation of an artificial SLAP tear in a cadaveric model. The authors also observed that SLAP repair could also restore normal biomechanics, joint translations, and glenohumeral stability partially.
- Alexander et al[1] observed that isolated biceps tenotomy increased anterior shoulder instability compared with an intact biceps attachment irrespective of the condition of the superior labrum.

In addition, a significant association of untreated[20] as well as failed[9,12] SLAP lesions with humeral chondral lesions, typically localized underneath the LHB tendon, has been described. A recently published biomechanical study has possibly given one explanation for this association.[19]

The studies cited evaluated the shoulder-stabilizing function of the SLAP complex and LHB and the influence of SLAP lesions on shoulder instability and clinical studies also showed an association of these lesions with glenohumeral chondral lesions. However, no study to date has investigated different types of surgical treatment for SLAP tears while considering the role of the LHB in maintaining glenohumeral stability. In addition, the effectiveness of SLAP repair on increasing glenohumeral stability after LHB tenotomy has not yet been evaluated, and the ability of surgical treatment to reduce the increased LHB load in association with SLAP lesions has not been investigated.

Thus, the aim of this controlled laboratory study was to evaluate the effect of SLAP repair with and without LHB tenotomy on glenohumeral stability and on LHB load after SLAP lesions. The role of LHB in shoulder stability was analyzed by measuring the glenohumeral translation and the LHB tension under different LHB preloads compared with the stabilizing function of the superior labrum complex alone. Our first hypothesis was that SLAP repair could restore the baseline glenohumeral stability with decreasing the shoulder instability and restoring the origin LHB load. The second hypothesis was that SLAP repair after LHB tenotomy would also have a significant effect with decreasing glenohumeral translation.

Materials and methods

For the biomechanical tests, the study used 21 fresh frozen shoulder specimens (average age, 64 years; average weight, 70 kg; 5 men), with no degenerative changes, no rotator cuff tear, or shoulder dislocation in past (ie, no Hill-Sachs defect was seen during shoulder arthroscopy) and without signs of previous operative treatment. We amputated the humerus 20 cm distal to the center of the humeral head and the clavicle 15 cm medial to the acromioclavicular joint. Skin and fat, deltoid muscle, rotator cuff muscles and tendons, and muscles of the upper arm were left intact.

The humerus and scapula were thawed at 5°C for 24 hours before embedding fixation using a cold-curing resin (Ureol FC 53, Vantico GmbH, Wehr, Germany) in a 60-mm-long and 40-mm-diameter brass cylinder for the humerus mount and a 3- × 8- × 11-cm block for the scapula mount. The humerus was firmly attached by the mount to the robot. The alignment of 10o̲ of anterior tilt and the medial border of the scapula in vertical position was secured by the scapula mount (Fig. 1).

After having armed the LHB with Krackow stitches proximal to the musculotendinous junction, it was connected with a load-measuring cell (accuracy ± 0.1 N) using 4 balancing springs and 2 pulley wheels fixed on a 40-cm tray, imitating the original orientation of the LHB (Fig. 1). Changes in the applied force in