Impact of Arthroscopic Lateral Acromioplasty on the Mechanical and Structural Integrity of the Lateral Deltoid Origin: A Cadaveric Study

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Purpose: To determine whether a 5-mm and/or 10-mm arthroscopic lateral acromioplasty (ALA) would weaken the structural and mechanical integrity of the lateral deltoid. **Methods:** The acromion and lateral deltoid origin were harvested from 15 pairs (n = 30) of fresh-frozen human cadaveric shoulder specimens. One side of each specimen pair (left or right) was randomly assigned to either a 5-mm (n = 7) or 10-mm (n = 8) ALA group, and the contralateral sides (n = 15) were used as matched controls. Acromion thickness and width were measured pre- and postoperatively. After ALA, specimens were inspected for damage to the lateral deltoid origin. Each specimen was secured within a dynamic testing machine, and the deltoid muscle was pulled to failure. Statistical analysis was performed to determine whether ALA reduced the lateral deltoid's failure load. **Results:** There was no significant difference in failure load between the 5-mm ALA group (661 ± 207 N) and its matched control group (744 ± 212 N; mean difference = 83 N; 95% confidence interval [CI], −91 to 258; $P = .285$) nor between the 10-mm ALA group (544 ± 210 N) and its matched control group (598 ± 157 N; mean difference = 54 N; 95% CI, −141 to 250; $P = .532$). There was no correlation found between the amount of bone resected (measured by percent thickness and width of the acromion after ALA) and the failure load of the deltoid. Visual evaluation of the acromion after ALA revealed the lateral deltoid origin had no damage in any case. **Conclusions:** ALA did not weaken the structural or mechanical integrity of the lateral deltoid origin. Neither a 5-mm nor a 10-mm ALA significantly reduced the deltoid's failure load. The lateral deltoid origin was not macroscopically damaged in any case. **Clinical Relevance:** ALA can be performed without the potential risk of macroscopically damaging the lateral deltoid origin or reducing its failure load.

Symptomatic rotator cuff tears (RCTs) are common, with more than 270,000 repairs performed in the United States each year, 86% of which are performed on patients age 45 and older.[1] While the causes of nontraumatic RCTs are multifaceted and poorly understood,[2,3] distinct variations in the scapular anatomy, such as superior glenoid inclination and a large acromial index, are associated with degenerative RCTs.[4-10] The critical shoulder angle (CSA) is a radiographic parameter that accounts for both the glenoid inclination and the lateral acromion extension.[4] A CSA >35° has been identified as a risk factor for RCTs, and a CSA <30° is associated with an increased prevalence of osteoarthritis, suggesting that patients with a CSA between these values are at the lowest risk for either condition.[4,11-13]

Few studies have looked at how scapular anatomy influences patient outcomes after treatment of RCTs. In one study, patients with a large acromial index who underwent arthroscopic repair of full-thickness RCTs had lower patient satisfaction scores when compared with those with a small acromial index.[14] Furthermore, in a long-term follow-up of patients who underwent latissimus dorsi tendon transfer for irreparable RCTs, patients with a significantly larger CSA reported inferior outcomes.[15]

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The fact that the scapular anatomy is not associated only with prevalence of RCTs but is also associated with inferior patient outcomes has led to the idea that an arthroscopic reduction of a large CSA (>35°) to a favorable range may be beneficial to reduce the risk of primary RCTs, rotator cuff retears, and unsatisfactory outcomes after treatment of RCTs for this patient population.

Anatomical cadaveric studies have demonstrated that the CSA can be significantly reduced by arthroscopic lateral acromioplasty (ALA).[16,17] However, there is a risk of potentially damaging the deltoid origin during acromioplasty, which may lead to postoperative deltoid avulsion.[18,19] Although it was reported that the deltoid origin was not macroscopically damaged by ALA,[16,17] it still remains unclear whether ALA affects the mechanical integrity of the deltoid. The purpose of this study was to determine whether a 5-mm and/or 10-mm ALA would weaken the structural and mechanical integrity of the lateral deltoid. It was hypothesized that ALA would not significantly affect the failure load of the lateral deltoid origin.

Methods

Cadaveric Specimen Preparation

The acromion and lateral deltoid muscle were harvested from 15 pairs (n = 30) of fresh-frozen human cadaveric shoulder specimens (mean age, 57 years [range, 41 to 63 years]; 7 male, 8 female) that met the following inclusion criteria: intact and undamaged lateral deltoid origin, with at least 4-cm distal extension of intact deltoid muscle, and no macroscopic bony abnormalities of the acromion. Specimens were stored at −20°C and thawed for 24 hours prior to dissection. Since the structural and mechanical integrity of the lateral deltoid origin in the proximity of the ALA was of interest, the anterior and posterior portions of the deltoid muscle were removed and only the lateral portion of the deltoid origin was included for biomechanical testing (Fig 1A). Starting 1 cm distal to the lateral deltoid origin, the deltoid muscle was whip-stitched using no. 2 polyethylene/polyester suture (FiberWire, Arthrex Inc., Naples, FL).

A digital caliper (Fowler Company, Inc., Newton, MA; manufacturer-reported accuracy of 0.02 mm) was used to take several measurements of the acromion and lateral deltoid origin. These measurements included the medial-lateral width of the acromion (measured from the most posterior point of the acromioclavicular joint to the lateral edge of the acromion) and the lateral acromion thickness (measured at the anterolateral and posterolateral edges of the acromion and the midpoint in between; Fig 2). After ALA, the acromion thickness and width were measured again using the exact same

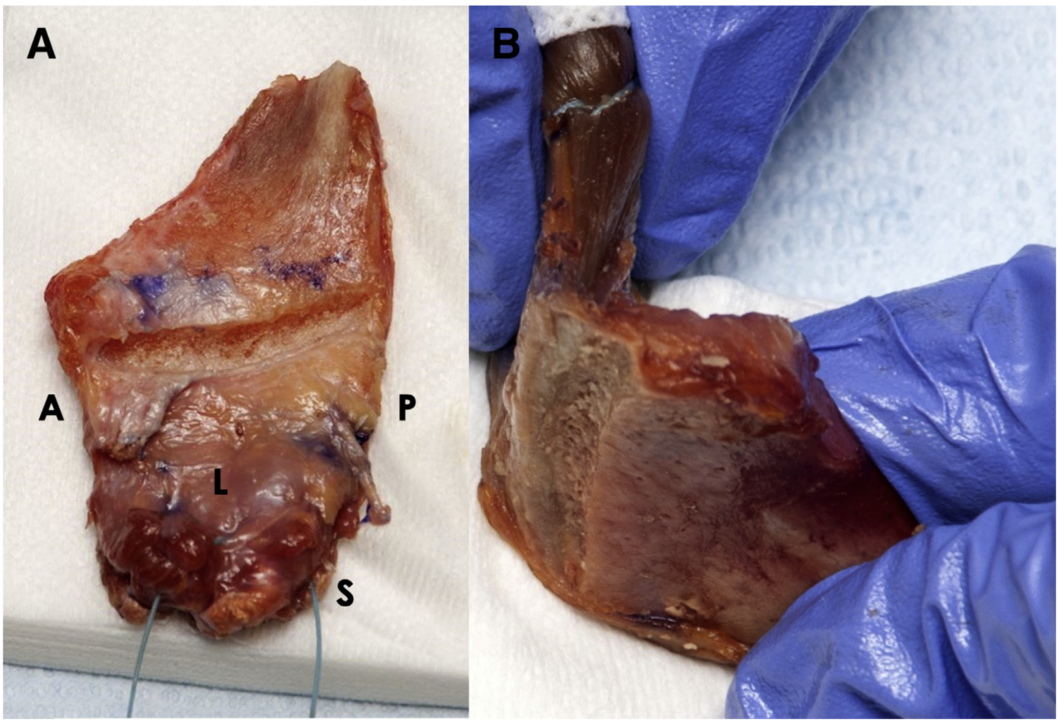

Fig 1. (A) Specimen prepared for biomechanical testing with a no. 2 suture (S) whip stitch after a 5-mm arthroscopic lateral acromioplasty; anterior (A) and posterior (P) portions of the deltoid muscle were removed, and only the lateral (L) portion of the deltoid was included for biomechanical testing. (B) Postoperative image after ALA; the deltoid muscle is elevated superiorly to visually evaluate the lateral deltoid origin. The burr had only shaved down the bone and did not macroscopically damage the lateral deltoid origin.