Biomechanical Comparison of 3 Suture Anchor Configurations for Repair of Type II SLAP Lesions

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Purpose: Our purpose was to compare 3 commonly used suture anchor configurations for repair of type II SLAP lesions. **Methods:** Biomechanical testing was performed on 3 groups of 7 cadaveric shoulders by use of an optical linear strain measurement system. Standardized type II SLAP lesions were created and repaired via 3 suture anchor configurations: (1) a single simple suture anterior to the biceps; (2) two simple sutures, one anterior and one posterior to the biceps; and (3) a single mattress suture through the biceps anchor. Cyclic traction was applied to the biceps tendon, and strain failure (defined as 2 mm of permanent displacement), yield, and pullout loads were measured. **Results:** The mean load to strain failure was 63 N in group 1, 70 N in group 2, and 106 N in group 3. The mean load to ultimate failure was 140 N in group 1, 194 N in group 2, and 194 N in group 3. Strain failure load was significantly higher in the mattress suture group than in either of the other two groups ($P < .05$). Groups 2 and 3 both had a significantly higher load to ultimate failure than group 1. **Conclusions:** When type II SLAP lesions were subjected to cyclic traction, the load to strain failure was greater with a single anchor and mattress suture than with one or two anchors with simple sutures around the labrum. Fixation with two simple sutures appears to provide intermediate load to strain failure. **Clinical Relevance:** The results of this study suggest that a single anchor with a mattress suture may be a biomechanically advantageous construct for the repair of type II SLAP lesions. **Key Words:** SLAP—Labrum—Repair—Biomechanics—Shoulder—Arthroscopy.

Injuries to the superior aspect of the glenoid labrum near the insertion of the long head of the biceps are the source of significant disability to patients, specifically the overhead-throwing athlete.[1-3] Andrews et al.[4] first described this lesion in 1985 and hypothesized that the biceps tendon acted to "pull off" of the labrum during the deceleration phase of throwing. In 1990 Snyder et al.[3] named these injuries SLAP lesions and classified them into 4 types. The most commonly reported was a type II lesion, in which the superior labrum and the biceps anchor were avulsed off of the glenoid.

Surgical repair of symptomatic type II SLAP lesions has become the standard of care. Many authors have reported favorable results using suture anchors or bioabsorbable tissue tacks as a means to fix the labrum to the glenoid.[1-3,5-12] Although a variety of techniques and suture configurations have been described, biomechanical data comparing the initial strength of the various repairs are sparse. DiRaimondo et al.[8] compared the initial strength of repair of type II lesions with 2 suture anchor configurations (2 simple sutures *v* 2 mattress sutures, both through the labrum) and 1 tissue tack. They found that the 2 suture anchor configurations were equivalent and both provided better fixation as compared with the tissue tack, although this difference did not reach statistical significance. Panossian et al.[13] showed that glenohumeral translation is increased by creation of a SLAP lesion and is

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decreased by repair of the lesion, but they used only 1 repair technique. Although this study provides useful information, there is no conclusive evidence to support any one repair technique.

The purpose of this biomechanical study is to compare the initial fixation strengths for 3 suture anchor configurations in the repair of type II SLAP lesions.

METHODS

Cadaver Preparation

Twenty-one fresh-frozen cadaveric shoulders were obtained. All donors were men aged under 65 years (mean age, 57.4 years) with no history of shoulder injury or surgery. After thawing of the specimens at room temperature, soft tissues were dissected off of the shoulders, sparing the biceps tendon and glenoid labrum. The humerus was disarticulated from the glenoid. The biceps tendon and anchor, as well as the glenoid labrum, were inspected to ensure that all were intact. The scapula was potted in resin and rigidly mounted to a metal frame with 4 bolts. Standardized type II SLAP lesions were created according to the protocol used by DiRaimondo et al.[8] The lesions were created by sharp dissection 5 mm medial to the glenoid rim and extended 7 mm from the anterior and posterior borders of the biceps tendon. The bone density of the specimens was not tested because pullout of the anchor from the bone was not expected to be the mode of failure.

Repair Techniques

The cadaveric shoulders were divided into 3 groups by random assignment. All repairs were performed with Arthrex 3-mm Bio-SutureTak absorbable suture anchors, loaded with No. 2 FiberWire (Arthrex, Naples, FL). Holes were predrilled in the glenoid rim at a 45° angle to the glenoid face by use of the notched drill guide, and the anchors were impacted to the recommended depth. This technique simulated the technique of anchor insertion through an anterior portal. All sutures were tied with 6 sliding half-hitches by use of a knot pusher and standard arthroscopic knot-tying technique.

In group 1 a single suture anchor was placed at the anterior border of the biceps tendon. A simple knot was tied by passing one limb of the suture over the labrum and tying the knot over the top of the labrum (Fig 1).

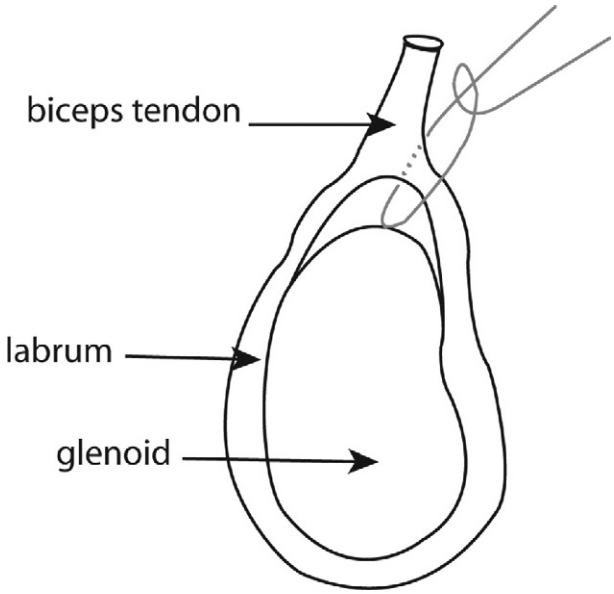

Figure 1. Single simple suture (group 1).

In group 2 two suture anchors were placed, one at the anterior border and one at the posterior border of the biceps tendon. A simple suture was tied around the labrum from each anchor (Fig 2).

In group 3 a single suture anchor was placed directly medial to the biceps tendon, and a horizontal mattress stitch was tied over the top of the biceps anchor in the following manner. A spinal needle was used to penetrate the biceps anchor 1 mm anterior to the posterior border of the tendon. A No. 3 Prolene suture (Ethicon, Somerville, NJ) was passed through the spinal needle, and the needle was withdrawn. The Prolene suture was tied to one limb of suture from the suture anchor and was used to pull the limb through the biceps anchor from inferior to superior. The same procedure was repeated for the second suture limb, passing it through the biceps anchor 1 mm posterior to the anterior border of the tendon. The two sutures were then tied over the top of the biceps anchor, completing the horizontal mattress suture (Fig 3). This simulated our arthroscopic technique in which the spinal needle is placed through the site of the portal of Neviaser and directed through the biceps anchor. The spinal needle is used to pass the shuttle suture through the labrum, which is then retrieved through the anterior portal and used to pass the suture from the anchor.

Biomechanical Testing

The scapula was potted in resin and mounted on a custom-made linear displacement platform (Parker