Interference Screw Versus Suture Anchor Fixation for Subpectoral Tenodesis of the Proximal Biceps Tendon: A Cadaveric Study

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Purpose: The purpose of this study was to compare the biomechanical properties of 2 fixation methods for subpectoral proximal biceps tenodesis. **Methods:** In 9 matched pairs of cadaveric shoulders, an open subpectoral tenodesis was performed 1 cm proximal to the inferior border of the pectoralis major tendon by use of either an 8 × 12–mm Bio-Tenodesis screw (Arthrex, Naples, FL) with No. 2 FiberWire sutures (Arthrex) or a 5.5-mm Bio-Corkscrew double-loaded suture anchor (Arthrex) with No. 2 FiberWire sutures. The specimens were dissected and mounted in a material testing machine. Cyclic loading (20 to 60 N, 100 cycles, 0.5 mm/s, 5-N preload) was performed, followed by an unloaded 30-minute rest, a 5-N preload, and a load-to-failure protocol (1.25 mm/s) with a 100-lb load cell. Ultimate load (in Newtons), stiffness (in Newtons per millimeter), and modes of failure were recorded. Data were analyzed by use of paired *t* tests and Wilcoxon signed rank tests. **Results:** Proximal biceps tenodeses with Bio-Tenodesis screws had a significantly higher mean load to failure (169.6 ± 50.5 N; range, 99.6 to 244.7 N) than those with Bio-Corkscrew suture anchors (68.5 ± 33.0 N; range, 24.2 to 119.4 N) (P = .002). Bio-Tenodesis screws also had a significantly higher stiffness (34.1 ± 9.0 N/mm; range, 20.6 to 48.9 N/mm) than Bio-Corkscrews (19.3 ± 10.5; range, 5.9 to 32.9 N/mm) (P = .038). **Conclusions:** In this cadaveric study the Bio-Tenodesis screw showed a statistically significantly higher load to failure and significantly higher stiffness than the Bio-Corkscrew anchor when used for tenodesis of the proximal biceps tendon in a subpectoral location. **Clinical Relevance:** Biomechanical comparison of these 2 fixation techniques provides information on stiffness and load to failure of alternate fixation methods.
Key Words: Biceps brachii—Tenodesis—Subpectoral—Bone screw—Suture anchors—Proximal.

Pathology of the proximal tendon of the long head of the biceps brachii is a common finding in the painful shoulder.[1] Biceps pathology can include tendonitis, tendinosis, subluxation, and partial- or full-thickness tears. Symptomatic biceps disease may be isolated or accompanied by rotator cuff disease and labral pathology.

Tenodesis is a surgical option for biceps pathology that aims to preserve flexion and supination strength with good cosmesis in patients with active lifestyles.[1-3] Tenodesis may be performed arthroscopically or in an open manner, and it may be done proximally (within the glenohumeral joint or bicipital groove) or distally (adjacent to the inferior border of the pectoralis major insertion).[4]

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The biomechanical properties of a tenodesis construct may be particularly important for early range of motion in patients with isolated biceps pathology. A variety of fixation devices have been used to achieve tenodesis of the biceps, and biomechanical studies have compared various techniques in human[3,5,6] and sheep[7,8] specimens. Richards and Burkhart[6] compared suture anchor fixation with interference screw fixation in a proximal tenodesis within the intertubercular groove in human cadavers and found that screw fixation had a significantly higher load to failure. Mazzocca et al.[3] compared fixation by use of arthroscopic suture anchors and arthroscopic interference screws in a proximal tenodesis within the intertubercular groove with open subpectoral interference screw fixation as well as open subpectoral bone-tunnel fixation; there were no significant differences in load to failure, despite mean loads similar to Richards and Burkhart.

The purpose of this study was to compare the biomechanical characteristics of a bioabsorbable interference screw (Bio-Tenodesis screw; Arthrex, Naples, FL) with those of a single bioabsorbable suture anchor loaded with composite polyethylene suture (Bio-Corkscrew; Arthrex) for subpectoral biceps tenodesis. We hypothesized that the screw construct would have a significantly higher load to failure and stiffness than the anchor construct.

METHODS

Nine matched pairs of cadaveric shoulders were assigned to two procedure groups. For each pair, one shoulder underwent tenodesis of the long head of the biceps with the Bio-Tenodesis screw and the contralateral shoulder underwent tenodesis with the Bio-Corkscrew. The assignment of the left side or right side to each treatment group was random. After an initial arthroscopic tenotomy of the long head of the biceps, the arm was abducted and internally rotated, and a 3-cm incision was made on the medial aspect of the inferior border of the pectoralis major tendon. Following the technique of Wiley et al.,[9] we identified the tendon of the long head of the biceps at the upper border of the pectoralis major tendon. For placement of fixation hardware, a 2 × 1–cm area of bone was denuded of soft tissue, 1 cm above the inferior border of the pectoralis major tendon.

Following the technique of Mazzocca et al.,[10] we used a guidewire and an 8-mm reamer to create a 15-mm-deep bone tunnel in the Bio-Tenodesis screw group. The tenotomized biceps tendon was cut 25 mm proximal to the musculotendinous junction, and by use of a No. 2 FiberWire (Arthrex), a Krackow stitch was inserted into 15 mm of the stump of the tendon. One limb of the stitch was passed through the cannulated Bio-Tenodesis screw and screwdriver, and the other limb was left free. The end of the tendon was drawn into the tip of the Bio-Tenodesis screw. An 8 × 12–mm Bio-Tenodesis screw was used to fix the tendon in the previously drilled hole in the humerus. The 2 strands of No. 2 FiberWire sutures were tied to each other outside the screw with 3 pairs of square knots.

By use of the same approach as described previously, a hole was created with a punch in each humerus in the Bio-Corkscrew group for the 5.5 × 14.7–mm Bio-Corkscrew, which was double-loaded with No. 2 FiberWire. The 2 FiberWire sutures were passed through the biceps tendon, each in a horizontal mattress at right angles to the other in an arthroscopic Mason-Allen configuration, and each was secured with 3 pairs of squared knots. The humeri were dissected to remove all tissue other than that of the repair and were frozen until testing. Each specimen was thawed to room temperature for at least 24 hours before testing.

The shaft of each humerus was potted in a fast-setting resin and fixed to an inverted knee clamp to secure the resin to the base of a material testing machine (model TTS-25 series; Adelaide Testing Machines, Toronto, Ontario, Canada). The tendon was secured in a custom sinusoidal clamp such that the angle of pull was in line with the long axis of the tendon and the humerus (Fig 1). The construct was preloaded to 5 N and underwent cyclic loading from 20 N to 60 N for 100 cycles at 0.5 mm/s, monitored by a 100-lb load cell. Any specimens in which failure did not occur during the cyclic loading protocol underwent a load-to-failure protocol. After a 30-minute rest in the unloaded state, the constructs were loaded to failure at 1.25 mm/s. A 5-N preload was applied, and a 100-lb load cell was used to monitor the process. Ultimate load (in Newtons), stiffness (in Newtons per millimeter), and mode of failure were recorded. Data were analyzed by use of paired t tests and Kolmogorov-Smirnov tests (SPSS software, version 14; SPSS, Chicago, IL). The experiment was designed by an a priori power analysis. For 9 cadaveric shoulders, the power of t tests with an α value of 0.05 is 80% for a very large effect size (Cohen $d = 1.5$).

RESULTS

Table 1 lists the demographic and biomechanical testing data for matched shoulder pairs with a proxi-