SwiveLock Tenodesis for Biceps Tendon Repair

Arthrex Research and Development

Objective

Determine biomechanical strength of a biceps tendon repair device and compare the results to those presented in current literature.

Methods and Materials

The proximal humerus and biceps tendon were dissected from fresh frozen cadaver shoulders (age 64.3 ± 8.5 yrs). Using an 8 mm pilot-headed reamer, a 20 mm deep pilot hole was created just superior to the pectoralis major insertion site. The forked tip of a 7x15 mm BioComposite SwiveLock Tenodesis (shown in Figure 1) anchor was used to push the tendon to the bottom of the pilot hole, and hold it in position while the anchor was inserted by use of the driver. No tendons were whipstitched for this testing.

Figure 1: 7x15 mm BioComposite SwiveLock Tenodesis Anchor

Load-to-failure testing was performed using similar methods to those reported by Slabaugh, et al (2011)[1], and Mazzocca, et al (2005)[2]. Mechanical testing was performed using an 8871 Servohydraulic INSTRON machine. A clamp fixture held the bone samples to the testing surface, and a custom freezing fixture secured the distal end of the tendon to the crosshead with dry ice. Each sample was pretensioned to 10 N followed by a load-to-failure at a rate of 1 mm/s. The ultimate load and mode-of-failure were recorded for each sample. The ultimate load results obtained by Slabaugh were used for comparison purposes. Slabaugh tested six different sample groups, using PEEK anchors (Biceptor; Smith & Nephew, Andover, MA), which are described in Table 1, along with the SwiveLock group, for reference.

Table 1: Sample group description reported by Slabaugh with anchor type and size, and pilot hole location and preparation, as compared to the SwiveLock preparation

Anchor	Size	Fixation Location	Pilot Hole Prep
Biceptor 1	7x15	bicipital groove	7 mm, tapped
Biceptor 2	7x25	bicipital groove	7 mm, tapped
Biceptor 3	8x15	bicipital groove	8 mm, tapped
Biceptor 4	8x25	bicipital groove	8 mm, tapped
Biceptor 5	7x15	within pectoralis footprint	8 mm, tapped
Biceptor 6	8x15	within pectoralis footprint	8 mm, tapped
SwiveLock	7x15	proximal of the pectoralis	8 mm, untapped

Conclusion

The average ultimate load of each sample group was compared using a One-Way ANOVA with each group's standard deviation and sample size.

Results

The ultimate load of the SwiveLock Tenodesis anchors was 153.4 ± 25.9 N, and the mode of failure for three samples was the tendon tearing at the screw-bone interface, and two samples failed by tendon pullout. The ultimate loads of the Biceptor samples, as reported by Slabaugh, are listed in Table 2.

Table 2: Ultimate loads of the six sample groups tested by Slabaugh, et al

Anchor	Ultimate Load (N)
Biceptor 1	154.5 ± 26.4 N
Biceptor 2	143.8 ± 39.2 N
Biceptor 3	135.8 ± 25.2 N
Biceptor 4	176.8 ± 30.6 N
Biceptor 5	165.6 ± 80.1 N
Biceptor 6	158.7 ± 44.9 N

Any differences between the SwiveLock sample group and the sample groups tested by Slabaugh are minimal or nonexistent.

Discussion and Conclusions

Based on the results of this testing, as well as those reported by Slabaugh, there does not appear to be a biomechanical difference between the Arthrex SwiveLock Tenodesis and the Smith & Nephew Biceptor. Mazzocca, et al reported load values of 237.6 ± 27.6 N using an 8x23 mm Arthrex Bio-Tenodesis Screw for tenodesis fixation, and 252.4 ± 68.6 N using an 8x12 mm Arthrex Bio-Tenodesis Screw for interference fixation. These larger loads can most likely be attributed to the effect of whipstitching each tendon sample and connecting the whipstitch to the cannulation of the screw through use of a knot. Furthermore, the predominant mode-of-failure of tendon tearing of the SwiveLock Tenodesis samples matched that reported by Mazzocca, even though the SwiveLock Tenodesis samples did not use a whipstitch.

Considering that the force transmitted to the biceps tendon while holding a 1 kg load with the elbow at 90° flexion is only 112 N[3], an ultimate load above 150 N should be sufficient to provide biceps tendon fixation during healing.

References

1. Slabaugh, M. A., R. M. Frank, et al. Biceps tenodesis with interference screw fixation: a biomechanical comparison of screw length and diameter. Arthroscopy 2011; 27(2):161-6.

2. Mazzocca, A. D., J. Bicos, et al. The biomechanical evaluation of four fixation techniques for proximal biceps tenodesis. Arthroscopy 2005;21(11):1296-306.

3. Pereira, D. S., R. S. Kvitne, et al. Surgical repair of distal biceps tendon ruptures: a biomechanical comparison of two techniques. Am J Sports Med 2002; 30(3):432-6.