CYCLIC LOADING OF ROTATOR CUFF REPAIRS: AN IN VITRO BIOMECHANICAL COMPARISON OF BIOABSORBABLE ANCHORS WITH TRANSOSSEOUS SUTURES

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Introduction
Suture anchors allow consistent reattachment of tendons and ligaments to bone. Newer designs employ suture-based, nonsuture-based, metal and bioabsorbable anchors.1,2,3,4 Previous studies have compared repair strengths between various anchors, in both maximal load and cyclic loading models.5,6,7 Others have compared anchor and suture-based repairs.5-8 Two studies have shown no correlation between bone mineral density and anchor pullout strength.2,9 The purpose of this study was to compare rotator cuff repair strength after stepwise cyclic loading of bioabsorbable nonsuture-based anchors and traditional transosseous sutures, and to correlate the results with bone mineral density, age and gender. Our hypothesis was that rotator cuff repair strength with bioabsorbable nonsuture-based anchors would be inferior to traditional transosseous sutures, and that rotator cuff repair strength would be directly related to bone mineral density.

Methods
This study utilized eight paired proximal humeri with intact rotator cuff tendons (mean age 73.3 ± 5.7 years). A standardized full-thickness defect (20 mm x 10 mm) was created in each supraspinatus tendon. One specimen from each pair was then randomized and repaired with two bioabsorbable nonsuture-based anchors (BioTwist, Linvatec, Inc.). The opposite specimen was repaired using two transosseous sutures. A stepwise cyclic loading protocol, utilizing a custom designed loading apparatus was employed. This protocol was initiated at 50 N and increased in increments of 50 N, to a maximum of 350 N (500 cycles at each load at a rate of 0.5 Hz). Repair site migration was measured using an optical measurement system, consisting of a digital camera and custom software. Mode of failure, number of cycles and load to failure were measured for 50% (5 mm) and 100% (10 mm) loss of repair. These results were correlated with bone mineral density, age and gender. Statistical analysis utilized paired t-tests and Pearson correlations.

Results
The anchor-based repair failed more often at the anchor-tendon interface (7/8), whereas the transosseous suture repair failed through the sutures (7/8). The number of cycles and load to failure for 50% loss of repair were 206 ± 88 cycles and 44 ± 15 N for the suture-based repair, and 1193 ± 252 cycles and 156 ± 20 N for the anchor-based repair. These values were significantly higher for the anchors (p<0.05). The corresponding values for 100% loss of repair were 2458 ± 379 cycles and 294 ± 252 cycles and 156 ± 20 N for the anchor-based repair, and 2292 ± 333 cycles and 263 ± 28 N for the anchor-based repair. These values were not significantly different (p>0.05). These measurements did not correlate with bone mineral density, age or gender.

Discussion and Conclusion
This study has shown that bioabsorbable nonsuture-based anchors and traditional transosseous sutures demonstrate two different modes of failure. Also, bioabsorbable nonsuture-based anchors provide improved initial rotator cuff repair strength, in comparison to traditional transosseous sutures. We speculate that this may be due to the relative less deformability of the anchor construct. This may be relevant clinically, as in the early post-operative period, while tendon healing to bone is occurring, anchors may offer improved strength, therefore allowing improved early healing. Similar to previous studies, the strength of the two repair methods did not correlate with bone mineral density.2,9 This may be attributed to the fact that each repair failed primarily through the suture repair construct itself or at the anchor-tendon interface, as opposed to the bone-construct interface.

Strengths of this study include the use of paired specimens, the stepwise cyclic loading protocol, as well as the accuracy of our measurement system. Limitations include the use of an in vitro model and a simulated, standardized rotator cuff tear.

In conclusion, initial rotator cuff repair strength with bioabsorbable nonsuture-based anchors is superior to traditional transosseous sutures, and this strength is unaffected by bone mineral density, age and gender. This may be advantageous, as these anchors facilitate an arthroscopic procedure, decrease operative time, and may allow a faster post-operative recovery. As well, this study has described a new high-resolution method of measuring tendon repair failure and may be considered for use in future studies.

References