ROTATOR CUFF REPAIR: AN EX VIVO MECHANICAL STUDY COMPARING TRANS-OSSEOUS SUTURES, SUTURE ANCHORS AND BIO-ABSORBABLE SCREWS

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Introduction: Rotator cuff tears are a common cause of shoulder pain and dysfunction. Surgical repair of the tendon tear has approximately a 25-35 % rate of developing a recurrent tear. The aim of this study was to identify the mode of failure of rotator cuff repairs and identify technical factors that contribute to the re-tearing in an ex vivo model.

Methods: Eighty-three fresh frozen sheep infraspinatus tendons were repaired using eight different repair techniques. The repair techniques included: trans-osseous sutures with two mattress stitches; two suture anchors with either simples stitches, mattress stitches, or modified Kessler stitches (Figure 1); five suture anchors with mattress stitches; or three types of two bio-absorbable screws. The repairs were tested to determine their tensile load to failure and mode of failure (Figure 2). Statistical analyses included both descriptive statistics as well as a one-way analysis of variance (ANOVA) using the Tukey HOC test.

Results: No difference was identified between trans-osseous sutures (147 ± 68 Newtons (N), mean ± SD) and suture anchors (140 ± 36N) when two mattress stitches were used. The weakest construct with suture anchors was when the tendon was grasped with simple stitches (72 ± 25N). Repair strength increased two-fold with mattress stitches (140 ± 36N; p = 0.026), and three-fold with modified Kessler stitches (204 ± 32N; p<0.001). Of the bio-absorbable screws, two BioTwists™ (76 ± 35N) and two Headed Bio-Absorbable Corkscrews™ (100 ± 29N) had similar failure loads as two suture anchors and simple stitches. Two BioCuffs, a bio-absorbable screw and washer construct, had much better failure load properties (190 ± 56N). The highest tensile load was observed with five suture anchors grasping the tendon with mattress stitches (336 ± 59N; p<0.001) (Figure 3).

With regards to the mode of failure, all of the tendon repairs that utilized two suture anchors with either simple or mattress stitches failed as a result of the tendon pulling through the sutures. In addition, all of the bio-absorbable screws failed secondary to the tendon pulling through the implant. However, the group repaired with modified Kessler stitches failed secondary to suture breakages in nine out of the ten tendon repairs. The other failure was secondary to the tendon pulling through the sutures.

Conclusions: This study shows that increasing the number of suture anchors and using suture patterns that grab more adjacent tendon fibers can increase initial rotator cuff repair strength up to 4.7 fold. The design of bio-absorbable screws significantly affects repair strength. With regards to rotator cuff repairs, this study suggests that increasing the number of tendon fixation points, or using implants or suture configurations that gain a better tendon purchase, result in a higher load to failure. These principles are likely to be especially important during rotator cuff repairs when the tendon quality is poor.

**Figure 1.** Schematic illustration depicting the different sutureing configurations used in the various groups. (A) simple stitch (B) mattress stitch (C) modified Kessler stitch

**Figure 2.** Schematic illustration of the mechanical tensile testing machine (Shimadzu AG-50 KNE, Shimadzu, Japan)

**Figure 3.** Ultimate tensile strength of the eight methods of rotator cuff repair (mean ± standard error). Abbreviations: BT = bone tunnels; Mit = Mitek® Rotator Cuff QuickAnchor®; Simp = simple stitch; Mat = mattress stitch; ModK = modified Kessler stitch; BioTwist = two BioTwist™ screws; Corkscrew = two Headed Bio-Absorbable Corkscrew™; BioCuff = two BioCuff, medium size, bio-absorbable screw and washer implants.

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