INCREASING TENDON-BONE CONTACT AREA AND PRESSURE WITH A NEW DEVICE

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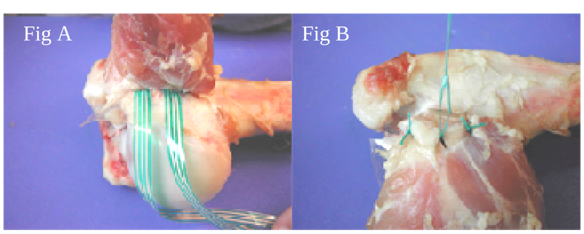
INTRODUCTION:

Surgical repair of rotator cuff tears has evolved over the years from transosseous suture techniques in an open fashion to the use of suture anchors in open or arthroscopic techniques. Ultimately, healing and correct positioning of the repair relies on intimate contact between the tendon and the underlying bone. A variety of suturing techniques and suture anchors/devices have been used in tendon–bone repairs with the hope of providing sufficient initial fixation strength to permit rehabilitation while healing occurs. Efforts to improve fixation properties have been reported with PTFE, polyethylene or PLA patches/buttons/scaffolds.[1-4] Caldwell et al.[4] also reported an increase in ultimate strength of transosseous suture repairs when the sutures were placed more distal to the tip of the greater tuberosity, or when tied over a wider bone bridge. Demirhan et al.,[5] recently reported improved static failure properties for cuff repairs when combing the use of 2 transosseous tunnels and a single suture anchor.

While these techniques improved the failure loads of the repair, they did not examine the contact area or pressure at the tendon-bone interface where healing occurs. Improvements in apposition between soft tissue and bone have been shown to play an important role in the healing of Bankart lesions.[6] An in-vitro porcine model was used in this study to examine the contact area and pressure distribution at the tendon–bone interface of transosseous repairs and a new device designed to improve contact area and pressure (Quick-T, Smith & Nephew Endoscopy, Andover MA) at the site of tendon-bone healing.

METHODS:

Eight adult porcine shoulders obtained from a local slaughterhouse were used in a repeated measures study design. The subscapularis muscle and tendon was dissected and a 15 mm wide full-thickness cuff tear created using a #10 scalpel blade. The contact pressures and contact area between the tendon and underlying bone were measured using 2 panels of an electronic pressure sensors (Iscan 6911,TekScan, South Boston, MA) at each stage of the repair (Fig A). The sensors were placed at the tendon-bone interface between the points of fixation. The sensors were carefully fixed to ensure that the measurements were recorded in the same site throughout the experimental procedure. Repairs were performed in the following sequence; 2 transosseous (TO), 3 TO sutures (#2 Ethibond) and finally 2 TO with the Quick T device (Fig B) (Smith & Nephew Endoscopy, Andover, MA) placed at the site of the middle TO suture repair. The same surgeon performed all repairs using standard surgeons knots apart from when the Quick T device was used. Measurements were continuously recorded at each stage of the repair for each shoulder for 60 seconds. The mean contact area and pressure distributions were analyzed using a repeated measures analysis of variance followed by a Tukey HSD post hoc test using SPSS for Windows.



RESULTS:

All stages of repair were successfully completed in the 8 specimens. The electronic pressure sensors did not move during the stages of the repair and allowed the contact area and pressure to be measured with each modification of the repair technique. Variations between measurements within a repair technique for each sample were less than 5% in this study and did not significantly vary during the data acquisition. Contact area and pressure measurements confirmed virtually no tendon–bone contact and pressure with 2 transosseous sutures apart from directly adjacent to the suture. A "dead zone" were the contact pressure was virtually zero was noted with 2 transosseous sutures. The addition of a 3rd transosseous suture increased the contact area and pressure between the fixation sites. The use of the Quick T device resulted in a significant increase (nearly 3 fold) in the contact area (Figure 1) and pressure distribution between the tendon and bone compared to all other techniques ($p<0.05$).

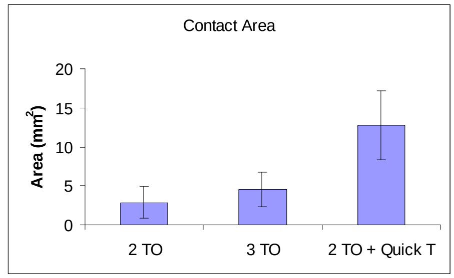


Figure 1: Contact area for the 3 repair techniques examined in this study; 2 Transosseous sutures (2 TO), 3 Transosseous sutures (3 TO) and 2 TO with the Quick T device.

DISCUSSION:

The results of this study demonstrate the contact area and pressure distributions at the tendon-bone interface can be influenced by fixation methods. Contact area and pressure distributions were significantly increased with the use of the Quick T device compared to transosseous suture fixation. This study is limited in that a porcine model was used and the static and dynamic failure properties with this device were not assessed. However, our goal was to specifically examine the contact areas and pressure distributions of the repair site. The addition of a suture anchor with 2 transosseous repairs has been reported to significantly improve the strength of the repair[5] but has yet to be evaluated with the Quick T device used in the current study.

Coaptation of soft tissue to bone may play a critical role in the overall clinical success in shoulder surgery. Itoi et al.,[6] reported improving coaptation between soft tissue and bone might play an important role in improving healing following Bankart lesion repairs. Similarly, the presence of persistent cuff defects following surgical repair has been noted.[7] Increasing tendon-bone coaptation may play a significant role in improving clinical success of rotator cuff repairs by providing more surface area involved in healing, decrease persistent cuff defects and improvement in watertight healing.

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