BIOMECHANICAL ASSESSMENT FOR A FOOTPRINT-RESTORING ARTHROSCOPIC “TRANSOSSEOUS-EQUIVALENT” ROTATOR CUFF REPAIR TECHNIQUE COMPARED TO A DOUBLE-ROW TECHNIQUE

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INTRODUCTION:
The persistent tear rate after rotator cuff repair remains high. A new arthroscopic “transosseous-equivalent” repair using tendon suture-bridges has been shown to improve pressurized contact over a repaired rotator cuff footprint. In addition to contact area and pressure, fixation strength is an important variable when considering the biology of healing at a repaired rotator cuff footprint. The “transosseous-equivalent” repair employs suture-bridges across medial and distal-lateral fixation points. We hypothesized that the “transosseous-equivalent” repair would demonstrate improved tensile strength and gap formation between tendon and tuberosity when compared to a double-row technique.

METHODS:
In six fresh-frozen human shoulders, a “transosseous-equivalent” rotator cuff repair was performed: a suture limb from each of two medial anchors was bridged over the tendon, and fixed laterally and distally with an interference screw (Figure 1). In six contralateral match-paired specimens a double-row repair was performed (Figure 2). For all repairs, a materials testing machine was used to cyclically load each repair from 10 N to 180 N for 30 cycles, allowing measurements for stiffness, hysteresis, strain, and gap formation (Figure 3). A power analysis was performed for gap formation; in order to detect a minimum 4 mm of gap with our materials testing equipment, with $\alpha = 0.05$, six matched pairs were found to be necessary in order to achieve a power of 97.2%. In addition, each repair underwent tensile testing in order to measure stiffness, energy absorbed, and failure loads at a deformation rate of 1 mm/min. Gap formation between tendon edge and insertion, and tendon strain over the repaired footprint, was measured using a video digitizing system.

RESULTS:
The mean ultimate load to failure was significantly greater for the “transosseous-equivalent” technique ($442.99 \pm 87.78$ N) compared to the double-row technique ($299.21 \pm 52.52$ N) ($p = 0.043$); the energy absorbed to failure was also significantly greater for the “transosseous-equivalent” repair ($3210.84 \pm 1055.72$ Nmm versus $1190.49 \pm 291.13$ Nmm, $p = 0.0077$), while the stiffness was not different between the two groups ($p > 0.05$). Gap formation during cyclic loading was not significantly different between the “transosseous-equivalent” and double-row techniques: $3.74 \pm 1.51$ mm, and $3.79 \pm 0.68$ mm, respectively ($p = 0.95$), stiffness, strain, and hysteresis for all cycles was not statistically different between the two constructs ($p > 0.05$).

DISCUSSION:
The persistent tear rate after rotator cuff repair remains remarkably high, using both open and arthroscopic techniques. Evolving techniques ideally would help optimize healing biology between injured tendon and bone. A previous study has shown that the “transosseous-equivalent” repair helps restore footprint dimensions and improves tendon-to-bone compression when compared to a double-row technique. The “transosseous-equivalent” rotator cuff repair technique improves ultimate failure loads when compared to a double-row technique, while gap formation is similar for both techniques. The current study suggests that improved contact characteristics can be better maintained with a “transosseous-equivalent” technique when compared to a double-row technique, as the former provides a stronger repair. The healing potential at a repaired rotator cuff footprint may be better optimized with the “transosseous-equivalent” technique. An in vivo study using this new technique is required to further elucidate healing capability. Ideally, with increased healing rates via improved surgical techniques, patient shoulder function can be restored more consistently.

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