Pullout strength and stiffness of a non-metallic suture anchoring system for repair of the central slip of the extensor mechanism at the proximal interphalangeal joint

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INTRODUCTION

Studies have used metallic bone anchors and suturing techniques to repair acute rupture of the central slip of the extensor mechanism at the proximal interphalangeal joint of the hand which can lead to Boutonnière deformity. (Fig. 1)

![Figure 1: A. Boutonnière deformity preventing full extension of the finger. B. Top image shows normal central slip attachment to proximal interphalangeal joint. Bottom image shows torn central slip.](image)

PURPOSE

We present a biomechanical study investigating pullout strength and stiffness of the non-metallic JuggerKnot™ Soft Anchor system with MaxBraid™ suture for repair of the central slip of the extensor mechanism at the proximal interphalangeal joint. We compare our results with pure tensile testing of MaxBraid™ suture as controls on the contralateral limb.

METHODS

Ten matched pairs of cadaveric hands were used in this study:

- Two fingers (index, middle) from each hand were used
- One hand from each donor was randomized to Group 1; the contralateral limb from the same donor assigned to Group 2
- Group 1: Prepared with 1.0mm mini JuggerKnot anchor with #2-0 MaxBraid suture (n=20) (Fig. 2)
- Group 2: Prepared with #2-0 MaxBraid suture through transverse bone tunnel (n=20) in the contralateral limb

Prior to testing, areal bone mineral density (BMD) of the distal radius was obtained using dual-energy X-ray absorptiometry

- The distal phalanx is potted in bone cement and fixed to the base of the servohydraulic testing machine
- The suture is fixed to the linear actuator using flat grips (Fig. 3)
- Specimens are loaded using a displacement controlled protocol at a rate of 100mm/min until failure

RESULTS

- No significant difference in ultimate load (UL) or stiffness was found between index and middle finger specimens for the anchor (p=0.68 UL and 0.62 stiffness) or suture groups (p=0.38 UL and 0.64 stiffness)
- Mean UL and stiffness for the anchor group was 52.6±18.3N and 10.4±2.6N/mm, respectively
- Mean UL and stiffness for the suture group was 90.5±18.7N and 16.2±3.1N/mm, respectively
- All anchors failed by pullout and all sutures failed by breakage
- Regression analysis showed no correlation between anchor pullout and BMD

CONCLUSIONS

- Failure of the soft anchor system would occur through pullout from bone prior to suture breakage
- Suture repair through bone tunnels provide higher strength and stiffness than the soft anchor system, but require more bone and soft tissue disruption
- Results of this study are favorable when compared with published results of ultimate load using metallic anchors (UL=22.3+4.7N) or horizontal mattress suture (UL=24.7+5.5N) techniques

CLINICAL RELEVANCE

- UL of the soft anchor is higher than the UL found in published studies which show failure is likely to occur at the suture/tendon interface before soft anchor pullout occurs – making it a viable alternative to metallic anchor repair

REFERENCES


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