

## Tight Medial-Knot Tying may Increase the Risk of Re-Tearing After Transosseous Equivalent Repair of Rotator Cuff Tendon

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### Summary:

Transosseous equivalent suture with medial knot tying provided the higher equivalent stress in the repaired tendon than that without medial knot tying, which may cause the postoperative re-tearing. Re-tearing risk may further increase if surgeons give additional tension during medial knot tying since the equivalent stress increased with increasing suture tension applied to the medial knot.

### Abstract:

#### INTRODUCTION

Transosseous equivalent (TOE) suture is now widely used as the standard surgical techniques for arthroscopic rotator cuff repair. However, it has not yet been fully clarified whether the medial knot tying should be added or not to improve the healing rate after this procedure. The purpose of the present study was to clarify the difference in the stress distribution pattern inside the tendon between TOE suture with and without medial knot tying (tied TOE and knotless TOE, respectively) using 3-dimensional finite element method. Moreover, we hope to clarify the role of suture tension applied to the medial knot in the stress distribution inside the repaired tendon particularly in the tied TOE model.

#### METHODS

CT data of a normal cadaveric shoulder (69-year-old male) were used to develop a three-dimensional finite element model of rotator cuff tendons attached to humeral head using software, Mechanical Finder (Extended Edition, version 7.0, RCCM, Japan). In this model, supraspinatus tendon was detached from the superior facet to recreate the full-thickness rotator cuff tear. Suture thread configurations of TOE repair with and without medial knot tying were designed using computer graphics software, Metasequoia (version 3.1.4, tetraface Inc., Japan) to reattach the torn rotator cuff tendon to the superior facet. A tensile load (20N) was applied to each suture thread along its direction to recreate the suture tension applied during the fixation. A tensile load was also applied to the proximal end of each cuff tendon to simulate shoulder abduction at hanging arm position (supraspinatus: 50.5N, infraspinatus: 22.5N, subscapularis: 63.3N). Then, the elastic analysis was performed and the distribution pattern as well as the highest values of von Mises equivalent stress was compared between two models. Moreover, in the tied TOE model, the amount of tensile load applied to the medial knot increased to 40, 60, 80 and 100N to clarify the role of the tension applied during medial knot tying.

#### RESULTS

The area with high stress concentration was wider in the tied TOE model than the knotless TOE model. The highest value of equivalent stress in tied and knotless TOE models was 4.7N and 3.3N, respectively. It was interesting to note that the equivalent stress around the medial knot increased with increasing the tensile load applied to the medial knot in the tied TOE model. The highest equivalent stress in 20, 40, 60, 80, and 100N models was 4.7, 6.7, 9.2, 11.9, and 14.7MPa, respectively.

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### DISCUSSION & CONCLUSION

Previous clinical studies revealed that the re-tearing of the repaired tendon was frequently observed near the musculotendinous junction after TOE repair. Since the results of the present study clearly demonstrated that the tied TOE model demonstrated the greater value of the highest equivalent stress than the knotless TOE model, we assumed that medial knot tying may increase the risk of re-tearing in TOE repair. Furthermore, it seemed that the re-tearing risk may further increase if surgeons give additional tension during medial knot tying, since the equivalent stress increased with increasing suture tension applied to the medial knot.