A BIOMECHANICAL COMPARISON OF THE PULVERTAFT WEAVE VERSUS A MODIFIED PULVERTAFT WEAVE FOR USE IN TENDON TRANSFER IN THE HAND

+*Poepping, T MD; *Bednar, M MD; **Sartori, M BS
+*Loyola University Medical Center, Maywood, IL . 708-216-6906, Fax: 708-216-5858, poeppingt@yahoo.com

Introduction: Rehabilitation following tendon transfer in the hand has long been a balance between preventing adhesions and avoiding early postoperative ruptures. The benefits of early postoperative motion can be realized with the aid of a repair that resists the tension applied to the tendon during rehabilitation. Previous studies have shown that the mean amount of tension in the flexor digitorum profundus (FDP) tendons reached during unresisted active flexion is 19 Newtons. Other studies have shown that the tendon repair is the weakest at approximately one week after the repair. At this point, the repair is 20% as strong as the original repair due to physiologic changes during the healing process. By deduction, a tendon repair would need to be five times as strong as the tension generated in the tendon to allow early postoperative motion. In the case of the FDP tendons this value is approximately 95 Newtons. The Pulvertaft weave has been used to allow early postoperative motion but the exact strength of this repair has not been elucidated. It is possible to make a simple modification to the Pulvertaft weave which will theoretically improve the strength of the repair. The purpose of this study is to determine the strength of the Pulvertaft weave versus the modified Pulvertaft weave using a hand model.

Methods: Three matched pair fresh-frozen hand and wrist specimens were obtained for this experiment. Each hand was designated to receive all Pulvertaft or all modified Pulvertaft weaves using the flexor tendons of the hand. All tendons used were dissected out of the hand but left attached to its respected phalanx. The weaves were made with the flexor digitorum superficialis (FDS) tendon woven through the FDP tendon for the index, middle, and ring finger. The fourth weave for each hand was created by weaving the flexor pollicis longus (FPL) through the FDP of the small finger. One specimen was broken prematurely by the testing equipment. Therefore, the corresponding matched specimen was not run. This yielded 11 weaves in each group. All Pulvertaft weaves had three passes through the tendon and were sutured at these three points with a single 2-0 Ethibond horizontal mattress suture. The modified pulvertaft group was started in the same way. However, the modification involved placing the free end of the FDS or FPL tendon back over the entire length of the weave. The tendon was then sutured back over the Pulvertaft weave with a 2-0 Ethibond simple, running suture. The suture was anchored eccentrically in the FDP tendon. The suture was then continued every 2-4mm in a simple, running fashion to the end of the weave. Once at the end of the weave, the running suture was brought back in the same intervals on the opposite side of the tendon, in an attempt to “zip-up” the weave, until the anchor was reached in the FDP tendon. A Kirschner wire was passed perpendicular through the long axis of each phalanx and the specimens mounted on an Instron model 1122. The weaves were cycled at 20 Newtons of force for 1200 cycles and the stretch of the weave measured. Next, the tendons were loaded to failure. The results were compared using a Student’s paired t-test.

Results: The modified Pulvertaft weave showed a statistically significant increased load to failure. The mean load to failure for the Pulvertaft group was 117 ± 22.3N compared to 242 ± 47.9N for the modified Pulvertaft group (p < 0.001). The modified weave also demonstrated a statistically significant decreased stretch of the weave. The mean increase in the length of the weave for the Pulvertaft group was 2.62 ± 0.84mm and for the modified Pulvertaft group was 1.28 ± 0.60mm (p = 0.001).

Conclusion: The modified Pulvertaft offers a significant increase in strength for tendon transfer in the hand with little added operative time or difficulty. All weaves in the modified group far exceeded the 95 Newton requirement for early postoperative motion. Three tendons in the Pulvertaft group failed to surpass this goal. This could allow early postoperative motion of the involved hand. The effect on adhesions is as yet unknown but could substantially speed the rehabilitation and prevent repair rupture in the postsurgical patient.

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**Hines Veterans Administration Hospital Musculoskeletal Laboratory, Hines, IL.**

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