

# Evaluation of Barbed Suture in Side-to-Side Tendon Transfer Technique using a Cadaveric Model

Kelly Jacoby<sup>1</sup>, Jordan Blough<sup>1</sup>, Mei Wang<sup>1,2</sup>, Patrick Hettinger<sup>1</sup>, Jessica Hanley<sup>1</sup>  
<sup>1</sup>Medical College of Wisconsin, Milwaukee, WI, <sup>2</sup>Marquette University, Milwaukee, WI  
Email of Presenting Author: kjacoby@mcw.edu

## Disclosures:

**INTRODUCTION:** Tendon transfers enable redundancies in the upper extremity mechanics to be re-purposed to restore functions of tendons compromised by nerve or soft tissue injuries. Recent evidence has demonstrated that a side-to-side repair technique is biomechanically superior to the traditional gold standard of Pulvertaft weave. There is also growing interest in the use of barbed, knotless repair techniques for tendon end-on repairs; however, the application of barbed sutures in tendon transfer remains largely unexplored. This study aims to assess the efficacy of the barbed suture repair technique in the setting of side-to-side tendon transfer. We hypothesize that the use of barbed sutures results in a simpler, efficient, and biomechanically comparable method.

**METHODS:** Tendons from the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) tendons of the index, middle, and ring fingers were extracted from five fresh-frozen human cadaveric forearm specimens, which included five male donors with a mean age of 52.2 years. Tendons were sorted by type, donor, and cross-sectional area, measured by a digital caliper with tendons in a semi-freeze stage, and based on the elliptical assumption. They were randomly and evenly assigned to two study groups (n=12). Each tendon was laid flat on a wooden board, and a central 6 cm section was identified and marked before being transected at midline with a scalpel. The two segments were then overlapped for 3 cm at this section for side-to-side tenorrhaphy. One group, designated the cross-stitch group, received 2 rows of running cross stitches with standard suture (3-0 Ethibond). The experimental group, the barbed group, underwent running grasping suture repair with barbed suture (2-0 Stratafix PDS). All procedures were performed by the same hand surgeon, and the timing of the repair procedure was documented. The prepared tendons were stored at -29°C until the testing day. All tests were conducted on an MTS servo-hydraulic material testing system (Landmark 370). The tendon was clamped by a pair of needle holders with cross-serration jaw surfaces, and the exposed tendon length was standardized to 40 mm. Each specimen underwent 200 cycles of tensile loading at 0.5 Hz, intended to mimic the loading conditions encountered during post-operative rehabilitation. The peak deformation was set at 10% (4 mm), and the maximum force was capped to <30 N. Data on force and deformation before and after the cyclic test were collected, and the reduction in force was analyzed to evaluate the effects of cyclic loading. Following the cyclic test, the tendon was visually inspected for damage and subsequently loaded to failure at a rate of 1 mm/s. The primary outcome variables were the ultimate force and construct stiffness obtained from the load-to-failure test and the reduction in force from the cyclic loading. A Welch's t-test was performed to compare the two groups at a statistical significance level of 0.05.

**RESULTS:** All tendons failed at the repaired section. No slippage of the tendon within the clamps was noted. In both groups, the failure occurred as the suture cut through the tendon while being pulled, leaving a shorter overlapping section. The average ultimate force was 111.4±26.1 N for the barbed group and 166.7±34.4 for the cross-stitch group (p<0.002). The corresponding displacement at the failure point was comparable between the barbed (19.7±3.1 mm) and cross-stitch (19.3±2.7 mm) groups, which were just under 50% strain. The average stiffness of the barbed group was also statistically weaker than the cross-stitch, 8.0±2.3 N/mm versus 11.9±2.4 N/mm (p<0.0006). No significant differences were found in force reduction from the cyclic loading, 39%±11% for the barbed and 34%±16% for the cross-stitch. The barbed suture technique operative time was 27.2% less than the cross-stitch (199 s vs. 273 s).

**DISCUSSION:** Results from this cadaveric model show that both types of side-to-side tendon transfer repairs exhibited tensile strengths that surpassed the estimated in vivo tendon force during the early rehabilitation protocol. However, tendons repaired with barbed suture had 33% less tensile strength and were 33% less stiff compared to the cross-stitch method. This difference may be attributed to the greater number of interlocking points in the cross-stitch technique, which allows for more uniform load distribution across the repaired area. The barbed group contained significantly fewer interlocking points, and although it featured embedded barbs for improved anchoring, it was not as strong. When cyclically loaded under physiologic force, both techniques displayed similar mechanical behavior. While the barbed repair was not as strong as the cross-stitch repair, its simplicity and efficiency may make it a useful alternative technique, especially when grasping multiple tendons (e.g. extensor digitorum communis).

**SIGNIFICANCE/CLINICAL RELEVANCE:** Early movement and rehabilitation after surgical tendon transfer are important to minimize complications including adhesions, stiffness, and prolonged rehabilitation. This study examined the biomechanical performance of the barbed suture repair under loading conditions that simulate the immediate post-operative period.



Figure 1. Testing setup.

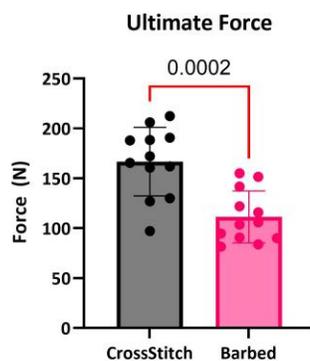


Figure 2. Ultimate force

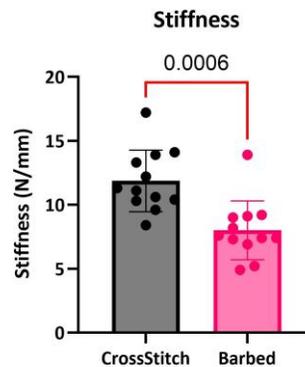


Figure 3. Stiffness