What Effect Does a Self-Tensioning Suture Have on Tendon Tissue?

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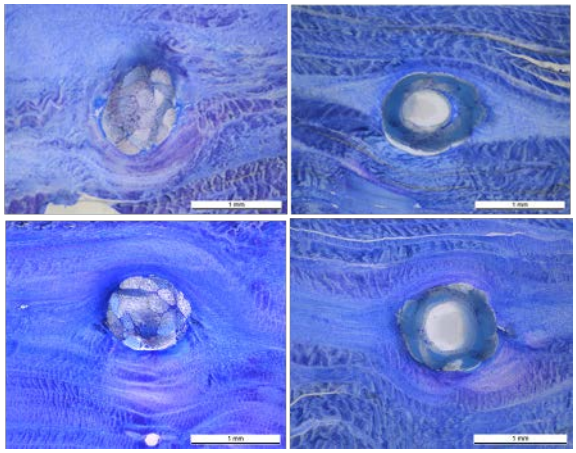
Statement of Purpose: In orthopaedics, there are a variety of reasons why repairs of soft tissue to bone fail, including loosening through suture slippage causing a loss in tension(1). One potential solution to such loosening is to construct a suture that reacts to the local stress environment by minimizing suture laxity across the repair. Theoretically, such a suture could maintain soft tissue apposition to bone and therefore improve healing. However, the self-tensioning property would need to be tightly controlled to avoid overtightening of the soft tissue and potential ischemia. It is important to understand the tissue-level effects of a self-tensioning suture in comparison to a traditional high-strength suture. Our hypothesis was that there would be no difference in the interaction between these sutures and tendinous soft tissue in an *in vivo* ovine partial tenotomy repair model.

Methods: A high-strength, self-tensioning suture was constructed, including inner and outer sheaths of ultra-high molecular weight polyethylene (UHMWPE) and polyester Poly(ethylene terephthalate). The test suture, DYNACORD™ (DePuy Synthes Mitek Sports Medicine, Raynham MA), also has a silicone/salt composite inner core. If a minimum amount of tension is not applied to the suture, the core expands radially and therefore the suture shortens in length until tension is restored. The predicate suture was a traditional suture: FiberWire® (Arthrex Inc., Naples FL). Both are slightly oversized in diameter, but otherwise meet the United States Pharmacopeia (USP) requirements for size #2 suture. Except for the salt in the core of the test suture, both sutures have identical materials of construction.

This study was performed in compliance with Food and Drug Administration Good Laboratory Practice (GLP) regulations and was conducted under an approved Institutional Animal Care and Use Committee (IACUC), according to the Swiss laws of animal protection and welfare and approved by the local governmental veterinary authorities (license no. ZH093/17). Using an *in vivo* ovine shoulder model, the infraspinatus tendon was partially transected from the caudal edge and then repaired with either the self-tensioning or traditional sutures. Six animals each were taken to either 6 or 13 weeks before sacrifice. Tendon specimens from all 24 animals were harvested, dehydrated, and embedded in Methyl-Methacrylate (MMA). Ground sections were prepared from each block and surface stained with Giemsa. A semi-quantitative histological evaluation was performed on the following parameters: tendon disruption, necrosis, tendon regeneration, cheesewiring, fibrosis, and metaplasia. Statistical analyses of data for individual parameters and a summative, total score were performed using a Student's t-test, comparing differences between sutures at each timepoint as well as comparing the two timepoints for each suture. Statistical significance was set to 5% *a priori*.

Results: The self-tensioning suture exhibited significantly less fibrosis than the traditional suture at both 6 and 13 weeks (p=0.028 and 0.010, respectively). For tendon disruption at 6 weeks, the self-tensioning suture performed better than the traditional suture (p=0.002), although the difference did not rise to the level of statistical significance at 13 weeks. Unsurprisingly, most parameters scored better for the 13 weeks group compared to the 6 weeks. This was especially evident for tendon necrosis (p=0.043 for the self-tensioning suture and p=0.024 for the traditional suture) and tendon regeneration (p=0.041 and p=0.023, respectively). These differences drove an overall statistically significant difference between the self-tensioning and traditional sutures at 6 weeks (p=0.006) but not at 13 weeks. The lack of statistical significance may be due to the higher variability seen with the traditional sutures at that later timepoint.



(Figure 1: Giemsa-stained histologic sections of traditional sutures (left) and self-tensioning sutures (right) at 6 weeks (top) and 13 weeks (bottom).

In summary, the self-tensioning suture was equivalent or better than the traditional suture in terms of tissue-level effects. There was no difference in necrosis between the sutures; however, in the case of fibrosis (both time points) and tendon disruption (6 weeks only) the self-tensioning suture was superior to the traditional suture. It remains to be seen how the results from this *in vivo* ovine model will translate into clinical use.

References:

(1. Barber FA. Arthroscopy 2009; 25:192-199).