Biomechanical Evaluation of #2 FiberLoop w/FiberTag: A Self-Reinforcing Suture Product for Tendon Whipstitching

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Objective

The purpose of this testing is to compare the biomechanical strength of tendon whipstitching using a self-reinforcing suture product (#2 FiberLoop w/FiberTag, AR-7264) to that of a traditional whipstitch using FiberLoop (AR-7234). The stitch security will be tested by directly loading the whipstitching suture tails and by indirectly loading the stitches by attaching an adjustable length, closed loop, suture and button construct (ACL TightRope RT, AR-1588RT).

Methods and Materials

Whipstitch Tail Direct Loading Sample Prep

Bovine extensor tendons were used for this testing and the traditional FiberLoop whipstitch began 50 mm from the end of the tendon and was terminated with a locking stitch, but no knots were tied. The FiberTag whipstitches were completed by wrapping the FiberTape portion of the construct around the end of the graft and pinning it to the tendon with the first needle pass of the FiberLoop portion. The whipstitch continued, passing the needle through the tendon and FiberTape material above and below the tendon, with each pass, to create a self-reinforcing stitch. Because of the length of the FiberTape, only 25 mm of tendon was stitched for these samples. Again, the stitch was terminated with a locking stitch but no knots were added to the construct.

ACL TightRope RT Loading Sample Prep

Bovine tendons were used for this testing, and approximately 25 mm of tendon was stitched for all samples. An ACL TightRope RT was added to the end of the FiberLoop samples by passing the stitching sutures through the TightRope loop, and then continuing the whipstitch back up the tendon graft to terminate where the stitching began with a six-throw surgeon's knot. FiberTag samples were prepared in a similar fashion, except that both the FiberTape portion and FiberLoop portion of the construct were passed through the ACL TightRope loop prior to stitching back up the tendon.

Mechanical Testing

Samples were mechanically loaded in an INSTRON materials testing machine. The whipstitched suture tails were secured to the testing surface in a pneumatic clamp and the unstitched portion of the graft was gripped with a custom brass freeze clamp and dry ice. Samples with an attached ACL TightRope were secured to the testing surface with a metal block fixture and a plate to secure the button. The ACL TightRope samples were cyclically loaded between 50 N and 250 N for 500 cycles at 1 Hz. All samples (with and without TightRope) were subjected to a 20 mm/min pull-to- failure. Load and displacement data were collected at 500 Hz. Gap formation displacement at the ACL TightRope – tendon interface was measured using digital video tracking.

Results

The ultimate loads of the whipstitch suture tail samples are compared in Figure 1. The difference in ultimate loads was analyzed using a Student's *t*-test, and the greater ultimate load of the FiberTag samples was significantly different from that of the FiberLoop samples ($P = 0.018$).

Whipstitch Tail Direct Loading Sample Prep*

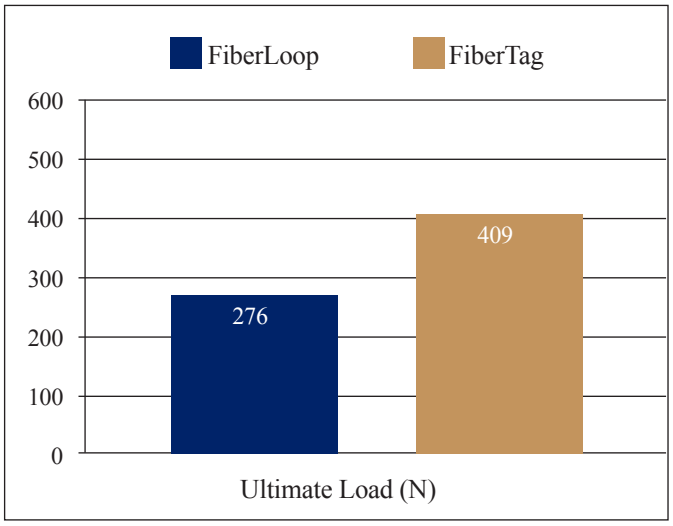
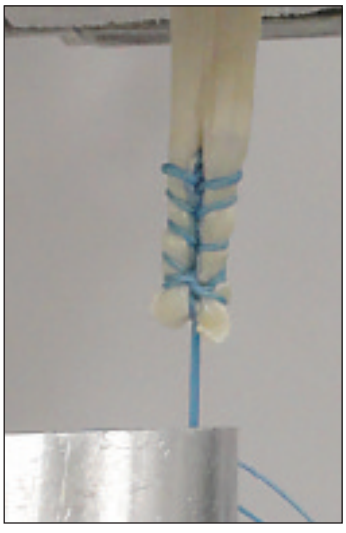


Figure 1: The ultimate load of the FiberTag constructs were significantly greater than that of the FiberLoop constructs.



FiberTag Reinforced Stitch

*data on file

The ultimate loads of the ACL TightRope samples are compared in Figure 2. The difference in ultimate loads was analyzed using a Student's *t*-test, and the greater ultimate load of the FiberTag samples was significantly different from that of the FiberLoop samples ($P = 0.002$).

ACL TightRope RT Loading Sample Prep

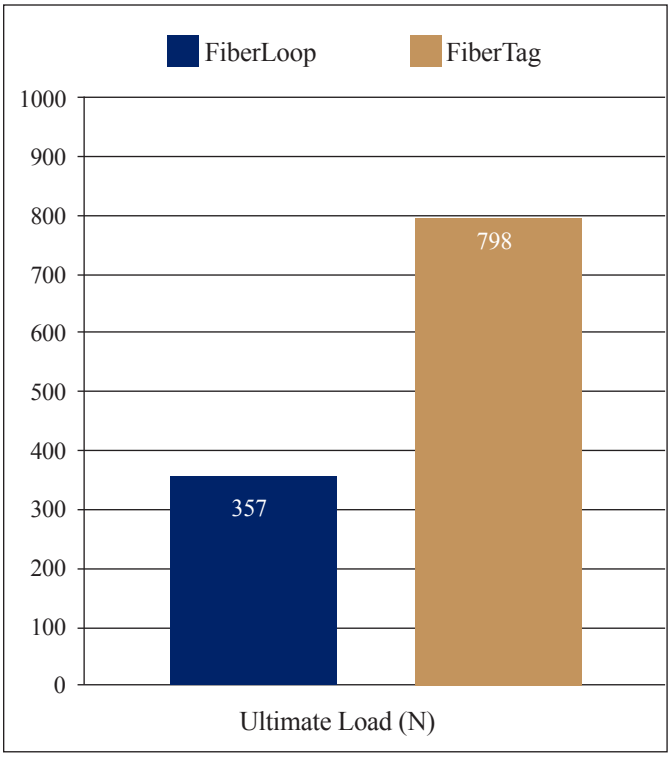


Figure 2: The ultimate load of the FiberTag and ACL TightRope samples was significantly greater than that of the FiberLoop and ACL TightRope samples.

FiberTag Sample, Post-cyclic loading

Of the two ACL TightRope sample groups, four of the six FiberLoop samples failed during cyclic loading (average of 3.4 mm gap formation displacement for the surviving samples), while all six FiberTag samples survived cyclic loading (1.2 mm average gap formation displacement). Because of the uneven survivorship of these samples, no statistical analysis was performed on the video tracking displacement results.

Conclusions

Whipstitching using a self-reinforcing FiberTag construct provides higher ultimate loads for tendon grafts than traditional FiberLoop whipstitching. Furthermore, based on the results of this testing, utilizing the FiberTag construct in conjunction with an ACL TightRope allows for safer single-strand graft construction, such as quadriceps tendon grafts for ACL reconstruction, when compared to using traditional FiberLoop.