

ACL TightRope and EndoButton® Biomechanical Testing

Arthrex Research and Development

Objective

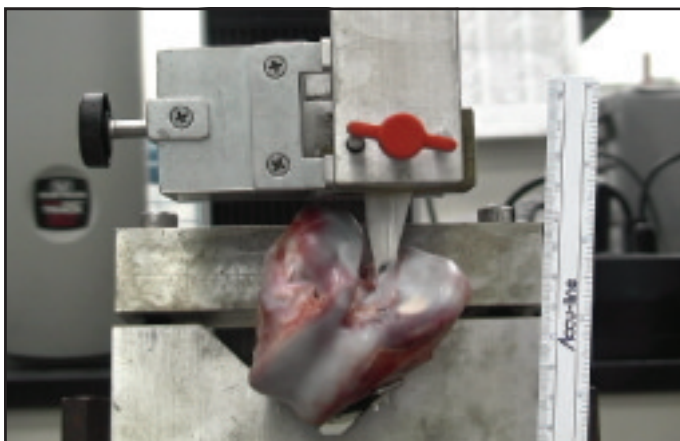
The purpose of this testing is to compare the biomechanical fixation strength of the Arthrex ACL TightRope, a knotless, adjustable-length suture and button construct, to that of the Smith & Nephew® EndoButton®, which is a knotless, specific-length suture and button construct.

Methods and Materials

Distal porcine femurs were used for this testing to provide a testing medium similar to that of a healthy young adult. Bovine extensor tendons were used as ACL reconstruction graft material. A 9 mm diameter socket was drilled over a 4 mm spade-tipped guide pin, leaving a 5-7 mm bone bridge. The 9 mm diameter folded tendons were strung through the sutures of the two fixation devices, and the grafts were pulled into the sockets. Tension was applied to the ACL TightRope sutures to adjust the loop length, such that the graft was snug against the back wall of the socket.

Tensile tests were performed using an INSTRON 8871 Axial Table Top Servohydraulic Testing System (INSTRON, Canton, MA) with a 5 kN load cell attached to the cross-head. Each potted specimen was mounted to the base of the INSTRON testing system in an adjustable angle fixture, so that the direction of pull was in line with the socket. A custom freeze clamp and dry ice were used to clamp the free tendon strands, leaving a 30 mm gauge length. The testing setup is shown in Figure 1.

Figure 1: A femur sample secured to the INSTRON for mechanical testing.



Constructs were preconditioned by cycling at 1 Hz from 10 to 50 N for 10 cycles followed by cyclic loading from 50 to 250 N at 1 Hz for 500 cycles. Following cycling, a load-to-failure test was conducted at a rate of 20 mm/min. Data sampling was collected at 500 Hz. Additionally, digital video tracking was used to determine the plastic cyclic displacement of the graft at the femoral socket. Six samples of each construct were tested, and the results were compared using a student's t-test ($\alpha = 0.05$).

Results

The results of the biomechanical testing of the two sample groups are shown in Table 1.

Table 1: Ultimate load and video tracking of the two ACL repair constructs.

Device	Ultimate Load (N)	Displacement (mm)
EndoButton	656 ± 241	3.2 ± 0.5
ACL TightRope	749 ± 145	3.0 ± 0.6

The mode of failure of all six EndoButton samples and three of the TightRope samples was the button pulling through the cortical bone. The mode of failure for the other three ACL TightRope samples was the suture breaking. There was no significant difference found between the ultimate load ($p = 0.433$, $P = 0.05$) or video tracking displacement ($p = 0.651$, $P = 0.05$) of the two groups. However, on average, the TightRope samples had improved biomechanical characteristics compared to the EndoButton samples.

Discussion

The results of this testing suggest that the ACL TightRope provides fixation strength that is at least equivalent to that of the EndoButton, while still providing a knotless construct with an adjustable loop length. This testing is clinically relevant because it is desirable to maximize the socket depth, while still leaving enough room to secure fixed loop length constructs.