Biomechanical Testing of the Meniscal Cinch, Biomet MaxFire, and Smith & Nephew Fast-Fix

Arthrex Research and Development

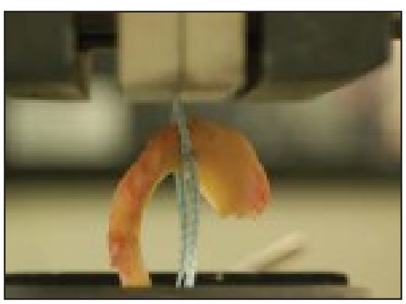
Objective

The purpose of this testing is to determine biomechanical fixation strength of the Meniscal Cinch, the Biomet MaxFire, and the Smith & Nephew Fast-Fix in human cadaver menisci.

Methods and Materials

The medial and lateral menisci of fresh frozen human donors were used for this testing. A 30 mm incision was made to each meniscus in the vertical, longitudinal plane, approximately 3 mm from the specimen's thick edge. The Meniscal Cinch repair construct was applied to six menisci, securing the sides of the incision to each other with a sliding knot. Six menisci were repaired using the MaxFire, and six were repaired using the Fast-Fix, both according to manufacture specifications. Two strands of suture tape were strung through the incision, between the two fixation points of the repair. Two vises were fixated to an Instron 8871 Axial Table Top Servohydraulic Testing System (Instron, Canton, MA), and the ends of the FiberTape were secured by the vises as seen in Figure 1.

Figure 1: Orientation of a repaired meniscus sample for mechanical testing



A preload of less than 2N was manually applied to the meniscus, and each sample was cycled from 5-20N at 1Hz for 1000 cycles. Following cycling, a load to failure was conducted at 12.5 mm/sec, as per testing reported by Zantop, et al (2005). For each sample, the displacement after 1 cycle, 100 cycles, and 1000 cycles, the ultimate load, and the mode of failure were recorded.

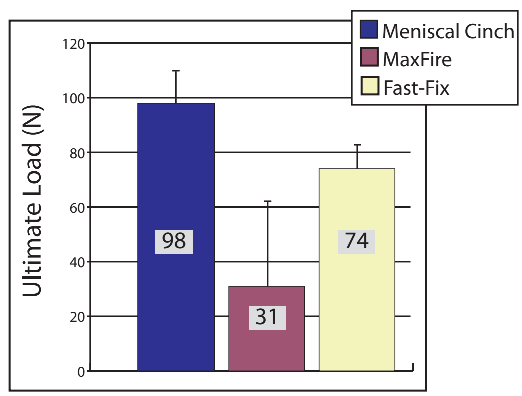
Results

Meniscal Cinch: The gap formation was 2.9 ± 0.8 mm after 1 cycle, 5.3 ± 1.6 mm after 100 cycles, and 6.5 ± 1.8 mm after 1000 cycles. The ultimate load was 98 ± 9 N, and the mode of failure for three samples (n = 6) was the implant tearing or pulling through the tissue, two samples had the suture break at the implant, and one sample had the suture break through the implant.

Biomet MaxFire: Of the six samples, four failed before the maximum load of the first cycle. For the other two samples, the gap formation was 3.8 ± 0.8 mm after 1 cycle, 7.9 ± 2.4 mm after 100 cycles, and 18.7 ± 2.4 mm after 1000 cycles. The ultimate load (including all samples) was 31 ± 33 N and the mode of failure for all samples (n = 6) was the suture pulling loose.

Smith & Nephew Fast-Fix: The gap formation was 3.2 ± 1.0 mm after 1 cycle, 5.2 ± 0.9 mm after 100 cycles, and 6.6 ± 1.3 mm after 1000 cycles. The ultimate load was 74 ± 13 N, and the mode of failure for two samples (n = 5) was the suture breaking at the knot, two samples had the knot come loose, and one sample had the suture break through the implant. One sample was eliminated because it was tested improperly. A graphical representation of the ultimate loads of the three repairs is shown in Table 1.

Table 1: Results of the mechanical testing



A One-Way ANOVA ($\alpha = 0.05$) was performed to compare the difference in the ultimate loads of the three repairs, using the Meniscal Cinch as a control group. The greater ultimate load of the Meniscal Cinch was significantly different than that of the MaxFire ($p < 0.001$).

Conclusion

The Meniscal Cinch provides a significantly stronger repair than the Biomet MaxFire, and has on average, greater repair strength than the Smith & Nephew Fast-Fix.