A Comparative Study of FiberWire® Suture and Ethibond Excel® in Static Mechanical Testing

Arthrex Research and Development

Objective

The purpose of the testing was to compare the strength of 2-0, 3-0 and 4-0 FiberWire® to 2-0, 3-0, and 4-0 Ethibond Excel®* in static tensile testing. Sutures were loaded in tension to observe knot strength, elongation and the maximum force required to fail samples in straight pull.

Method

INSTRON®* 5544 Electromechanical Testing System (Canton, MA) was loaded with a 2kN load cell. Pneumatic suture clamps were attached to the top and bottom of the load frame with a pin and clevis. The INSTRON was calibrated using Bluehill®* Software. For straight pull and elongation, FiberWire or Ethibond Excel suture was gripped in the pneumatic suture clamps at 60 to 80 psi at a gauge length of 5 inches. For knot pull, a surgeon's knot was sewn to tie suture around silicone tubing. Each end of the remaining suture was gripped in the pneumatic suture clamps at a gauge length of 5 inches. Fine tuning was used to ensure that suture had neither slack nor preload. The system then applied an axial tensile force at 12 inches/minute. Data were collected at 500Hz and the maximum load and extension were recorded.

Elongation was calculated from the extension at maximum loading using equation 1:

$$Elongation\ (\%) = \frac{L_f - L_i}{L_i} \times 100 = \frac{Extension}{L_i} \times 100$$

Equation 1. *Note: Li = gauge length = 5 in = 127 mm*

Results were compared via t-test in the program SigmaPlot™ ($\alpha = 0.05$).

Results

See Table 1 to 3 for all results. FiberWire and Ethibond Excel yielded significantly different results for straight pull, elongation, and knot pull when equivalent sizes were compared. 3-0 Ethibond Excel and 4-0 FiberWire were also compared. They were also significantly different in straight pull, elongation and knot pull.

Conclusion

FiberWire was stronger and less elastic than Ethibond Excel in every comparison. Not only did FiberWire outperform Ethibond Excel in equivalent sizes, 4-0 FiberWire also outperformed the larger sized 3-0 Ethibond Excel in every test conducted.

**Registered by respective owner*

Table 1: Straight pull results of FiberWire and Ethibond Excel

	Straight Pull (kgf)			
	FiberWire	Ethibond Excel	Significantly Different?	P value
Size 2-0	14.3 ± 1.0	7.4 ± 0.2	Yes	<0.001
Size 3-0	6.3 ± 0.7	3.8 ± 0.1	Yes	
Size 4-0	6.4 ± 0.4	2.7 ± 0.1	Yes	

*Note: In every size comparison, FiberWire was significantly different from Ethibond Excel. The smaller sized FiberWire 4-0 was also significantly different from the larger sized Ethibond 3-0 ($p < 0.001$). *Data on file.*

Table 2: Percent elongation of FiberWire and Ethibond Excel

	Elongation			
	FiberWire	Ethibond Excel	Significantly Different?	P value
Size 2-0	7.7% ± 0.6%	20.1% ± 1.3%	Yes	<0.001
Size 3-0	7.6% ± 0.7%	16.2% ± 0.7%	Yes	
Size 4-0	8.4% ± 0.5%	9.9% ± 0.4%	Yes	

*Note: In every size comparison, FiberWire was significantly different from Ethibond Excel. The smaller sized FiberWire 4-0 was also significantly different from the larger sized Ethibond 3-0 ($p < 0.001$). *Data on file.*

Table 3: Knot pull results of FiberWire and Ethibond Excel

	Knot Pull (kgf)			
	FiberWire	Ethibond Excel	Significantly Different?	P value
Size 2-0	6.0 ± 0.3	3.5 ± 0.3	Yes	<0.001
Size 3-0	2.7 ± 0.1	1.9 ± 0.1	Yes	
Size 4-0	2.2 ± 0.1	1.2 ± 0.1	Yes	

*Note: In every size comparison, FiberWire was significantly different from Ethibond Excel. The smaller sized FiberWire 4-0 was also significantly different from the larger sized Ethibond 3-0 ($p < 0.001$). *Data on file.*