# Biomechanical Comparison of FiberTape® Cerclage Versus Traditional Metallic Braided Cables

Arthrex Research and Development

## Introduction

Intraoperative fractures that occur during component broaching and impaction[1] and postoperative periprosthetic fractures that occur around the femoral stem[2] are complications associated with total hip arthroplasty (THA). Several fixation options are used to manage periprosthetic fractures, including monofilament wires and braided cables, plate fixation, strut grafting, and/or revision of the femoral component. The ideal fixation strategy remains controversial, and there has been renewed surgeon interest in alternative fixation techniques. This includes new materials for cerclage, such as synthetic suture cables, that carry potential advantages to traditional fixation techniques. The purpose of this study was to investigate the performance of the FiberTape cerclage suture when tested using various worst-case load-bearing protocols and compared to traditional metallic braided cable implants.

## Methods and Materials

### Performance of FiberTape cerclage when compressed between bone and plate

Two loops of FiberTape cerclage suture were passed around 30 PCF foam block and tensioned using the FiberTape cerclage suture tensioner up to the 80 mark (N = 6). A humeral suture plate was attached to the foam block using cortical screws — such that the plate was transverse and firmly fixed on top of the suture (Figure 1). The construct was then loaded in dynamic compression between 86.4 N and 864 N for 1000 cycles with 1 Hz frequency.[3]

### Performance of FiberTape cerclage under fatigue loading

FiberTape cerclage suture and 2 mm CoCr cable were fixed per surgical technique (CoCr cable was tensioned up to the 150 lb mark and FiberTape cerclage suture was tensioned up to the 80 mark on the respective tension devices) to a custom made, circular cross-section, dowel. The fixture was separated by a 0.5 mm gap (Figure 2) (N = 5). Both cerclage constructs were then loaded in dynamic tension between 50 and 500N for 1000 cycles with 1Hz frequency to measure cyclic displacement.

### Performance of FiberTape cerclage under static loading

FiberTape cerclage suture, 1.6 mm CoCr cable and 2 mm CoCr cable were fixed per surgical technique (CoCr cables were tensioned up to the 150 lb mark and FiberTape cerclage suture was tensioned up to the 80 mark on the respective tension devices) to a custom-made, circular cross-section dowel and plate fixture separated by 0.5 mm gap (Figure 2) (N = 5). All 3 cerclage constructs were then loaded in static tension with a 33 mm/s loading rate to measure the ultimate load prior to failure.

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## Performance of FiberTape® cerclage suture in dynamic compression test to investigate subsidence

A fracture model with aluminum components was created to investigate the ability of the cerclage construct to prevent subsidence. A custom-made aluminum tube with 5 mm wall thickness, representing the femoral diaphysis, was split in half to mimic a periprosthetic fracture. An aluminum rod coated with 220 grit sandpaper, representing a porous-coated femoral stem, was "sandwiched" between the two halves of the aluminum tube. Two FiberTape cerclage sutures, 1.6 mm CoCr cables and 2 mm CoCr cables were fixed per surgical technique (CoCr cables were tensioned up to the 150 lb mark and FiberTape cerclage was tensioned up to the 80 mark on the respective tension devices) to the fracture model (Figure 3) (N = 3). The construct was then loaded in dynamic compression between 90 N and 900 N for 500 cycles with 0.5 Hz frequency.[4]

**Figure 1.** Setup for dynamic compression (fatigue) test to investigate suture damage and fraying.

**Figure 2.** Setup for FiberTape cerclage suture and metallic cable testing under dynamic (fatigue) and static load.

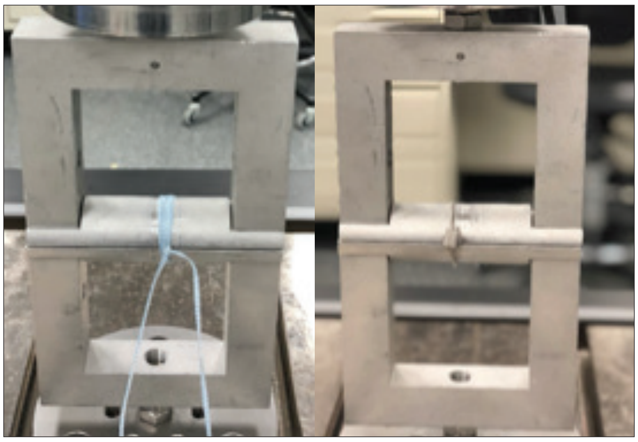
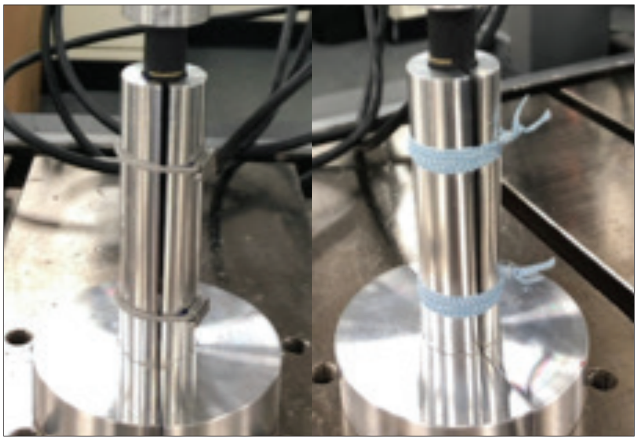


**Figure 3.** Setup for dynamic compression (fatigue) test to investigate subsidence of FiberTape cerclage suture and metallic cable.



## Results

Post-suture compression test, visual inspection under stereo microscope revealed that there was no damage or fraying of the suture (Figure 4). Ultimate load, cyclic displacement and rod subsidence for static and dynamic tests are reported in Figures 5 to 7, respectively. Statistical significance between groups is also shown in Figures 5 to 7.

**Figure 4.** FiberTape® cerclage suture condition postcompression. There is no visible damage or fraying in the suture.

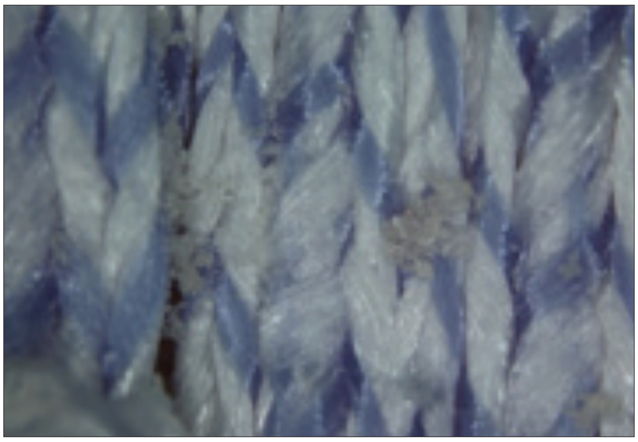


**Figure 5.** Static testing ultimate load for all groups.

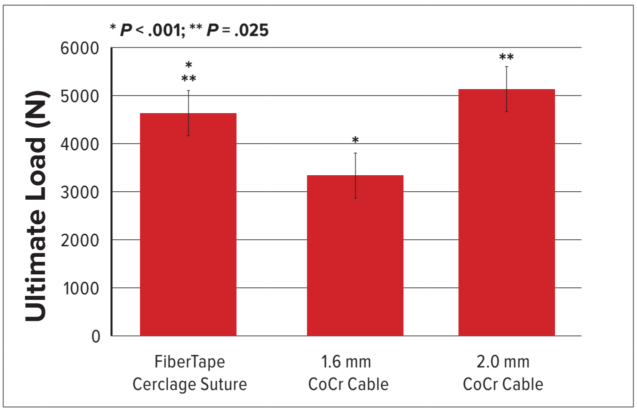



**Figure 6.** Dynamic (fatigue) testing cyclic displacement for all groups.

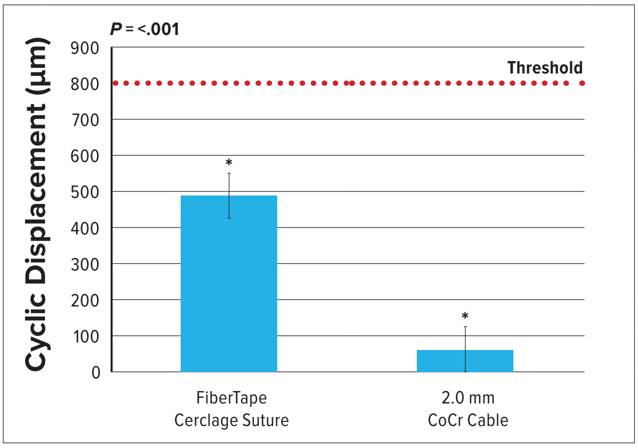
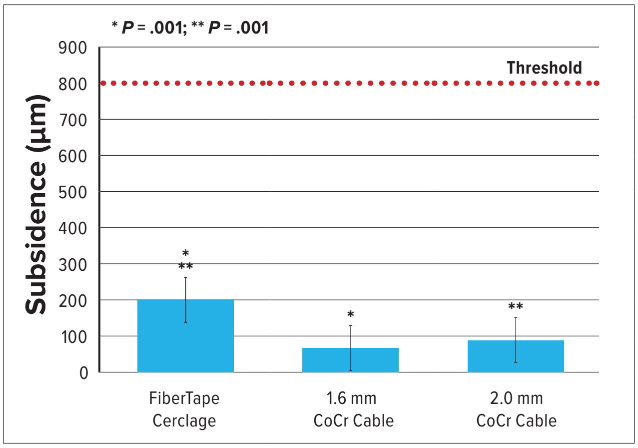



**Figure 7.** Dynamic (fatigue) testing subsidence for all groups.




## Discussion

When used in conjunction with and placed under a metal fracture plate, FiberTape cerclage suture can be considered damage- and fray-resistant — as visual inspection under stereo microscope did not reveal any damage even under the worst-case scenario. Ultimate load prior to failure for FiberTape cerclage suture was statistically higher than the 1.6 mm CoCr cable, which indicates that it is stronger than the commonly used cable cerclage constructs. Although FiberTape cerclage suture had statistically higher cyclic displacement than the 2 mm CoCr cable, both FiberTape cerclage suture and the CoCr cable were significantly below the 800µm threshold (the distance required between two bone ends of a fracture to heal by the gap healing process).[5,6] When visually inspected, there was no gross implant subsidence in either the FiberTape suture group or CoCr cable cerclage groups. The micromotion for FiberTape cerclage suture was statistically higher than that of the CoCr cables; however, no visual subsidence or increased micromotion was seen when compared to that of the CoCr cables. This may be favorable as it indicates that FiberTape cerclage suture offers adequate fixation while avoiding fixation constructs that are too rigid. Rigid fixation may be problematic — as some degree of movement is necessary for callus formation, and an increased stiffness of a cerclage construct may lead to mechanical failure.[7,8]

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## References


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