# In vitro Mechanical Testing of Different Fixation Techniques for a Novel Silk Fiber-Based Scaffold for ACL Regeneration

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**Disclosures:** Andreas Teuschl-Woller and Thomas Nau are co-founders and shareholders of the spin-off company "MorphoMed Gmbh" related to this project.

INTRODUCTION: We have developed a novel silk fiber-based scaffold for ACL regeneration which has shown ligament regeneration and bony integration in previous large animal studies in sheep (1,2). However, despite promising histological results, biomechanical testing was not satisfactory, as the graft fixation has been an ongoing problem. It was the aim of the present in-vitro study to test different surgical fixations of the novel silk fiber-based scaffold, in order to identify the optimal technique for the consequent in-vivo studies.

METHODS: After approval from the local ethical committee conforming to the laws and regulations of Austria, 12 cadaveric sheep knee joints were included. We performed an ACL-reconstruction using the novel silk-fiber based scaffold after creating a mid-substance ACL tear. Three different fixation methods were tested:

Method A: Fixation with screw and dowel system in the femoral and tibial tunnel, Depuy Synthes
Method B: Fixation with screw and dowel system and additional staple tibial, Depuy Synthes, Arthrex
Method C: Fixation with screw and dowel system, additional 2 staples tibial and 1 staple femoral, Depuy Synthes, Arthrex

Biomechanical testing was performed using a uniaxial mechanical testing machine (Zwick Roell). The joint capsule and all ligaments, apart from the reconstructed ACL, were removed, and the bones were embedded in resin. After 5 cycles of pre-tensioning, the maximum tensile strength (load to failure) was determined.

RESULTS SECTION: Method A resulted in a mean maximum tensile strength of 78.75 (range, 20-140) N, with the scaffold slipping from either the femoral or tibial tunnel. Method B resulted in a mean maximum tensile strength of 400 (range, 280-720) N, with the scaffold slipping from either the femoral or the tibial tunnel. Method C resulted in a mean maximum tensile strength of 872 (range, 680-1070) N, with the scaffold breaking either at the intraarticular portion or the edge of the tibial plateau.

DISCUSSION: Among the three surgical fixation techniques, only the fixation with screw and dowel system, additional 2 staples tibial and 1 staple femoral (Method C) was able to achieve biomechanical results comparable to the natural ACL in this in-vitro study. These findings will allow us to proceed with in-vivo studies of ACL regeneration using the novel silk fiber-based scaffold.

SIGNIFICANCE/CLINICAL RELEVANCE: (1-2 sentences): ACL regeneration can only be translated into clinical practice, if satisfactory biomechanical results can be shown in pre-clinical studies. The results of the present series identified a surgical fixation technique which may provide the basis for further in-vivo studies.

REFERENCES:

(1) Osteointegration of a Novel Silk Fiber-Based ACL Scaffold by Formation of a Ligament-Bone Interface. Teuschl AH. et al. Am J Sports Med 2019;47:620-27.
(2) A Novel Silk Fiber-Based Scaffold for Regeneration of the Anterior Cruciate Ligament: Histological Results From a Study in Sheep. Teuschl AH, et al. Am J Sports Med 2016;44:1547-57