

Biomechanical Evaluation of Ultra-High Strength Suture Wire Versus Thinner Suture Tape in Vertical Inside-Out Meniscal Repair

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Introduction: Meniscal injuries are common and can significantly impact the function of the knee joint. Surgical repair is often necessary, with meniscal preservation being preferable to meniscectomy. This study aimed to compare the biomechanical properties of ultra-high strength suture wire and thinner suture tape used in vertical inside-out meniscal repair.

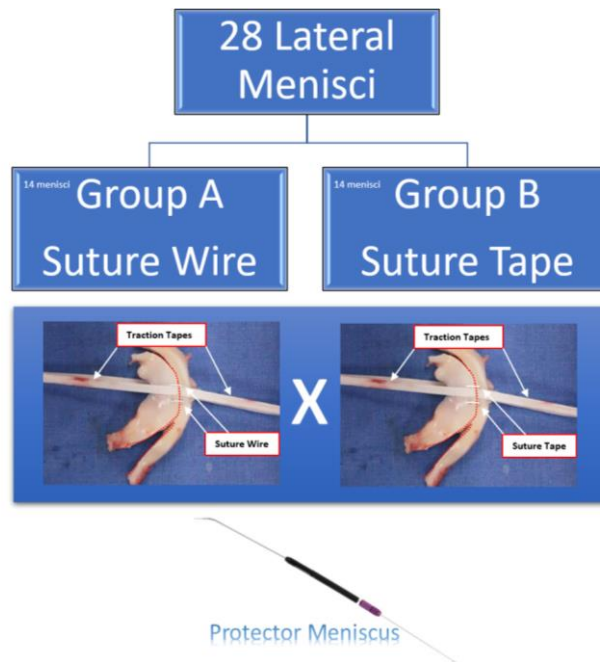
Methods: 28 porcine knees were selected for this controlled biomechanical evaluation in a laboratory setting. The knees were divided into two groups: Group A (vertical inside-out meniscal sutures using ultra-high molecular weight polyethylene (UHMWPE) suture wire) and Group B (vertical inside-out meniscal sutures using UHMWPE tape). A 1.5 cm longitudinal tear was created in the lateral meniscus, followed by two vertical sutures on the femoral surface of the meniscus.

Biomechanical analyses were performed using a testing machine, including cyclic load testing and load-to-failure tests.

Results: The findings showed no significant difference in tear gapping after cyclic testing or in load-to-failure between the two groups. However, system stiffness at the 5th and 30th cycle was significantly higher in Group B (tape) compared to Group A (suture wire). System stiffness at maximal load-to-failure did not differ significantly between the groups. These findings suggest a similar biomechanical behavior of the two materials under axial loads.

Discussion: Thinner tapes used in meniscal repair demonstrated biomechanical properties comparable to ultra-high strength suture wires, making them attractive options for meniscal repair due to their reduced thickness, which may result in less cartilage abrasion. Further research and clinical studies are needed to validate these findings.

Significance/Clinical Relevance: This study indicates that the suture thinner tapes and UHMWPE wires are biomechanically similar under axial loads, analyzing this biomechanical aspect of the study, we can infer that the thinner tapes are safe in this aspect. We reinforce that Further research and clinical studies are needed to validate these findings.



| | Widening Gap after 30 Cycles [mm] | Ultimate Failure Load [N] | Stiffness at Cycle [N/mm] | Stiffness at 5 Cycle [N/mm] | Stiffness at 30 [N/mm] | Ultimate Load Stiffness [N/mm] |
|----------|---|---------------------------------|------------------------------------|--------------------------------------|---------------------------------|--------------------------------------|
| T (n=14) | 1.98 ± 0.88 | 107.7 ± 47.1 | 21.1 ± 1.8 | 26.1 ± 2.5 | | 26.5 ± 1.6 |
| S (n=14) | 1.95 ± 0.67 | 105.9 ± 43.6 | 19.2 ± 2.0 | 23.1 ± 2.4 | | 25.0 ± 1.6 |
| p-value | 0.9039 | 0.9178 | 0.0132 | 0.0028 | | 0.0171 |