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Biomechanical Consequences of a Nonanatomic Posterior Medial Meniscus Root Repair After a Root Tear

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Summary:
Results of this study emphasize the importance of ensuring an anatomic posterior medial meniscal root repair by releasing the extruded menisci from adhesions and the posteromedial capsule, as well as preventing displacement of the meniscal root repair construct.

Abstract:
Background: Posterior medial meniscal root tears are reported to extrude with the meniscus becoming adhered posteromedially along the posterior capsule. While anatomic repair has been reported to restore tibiofemoral contact mechanics, it is unknown whether nonanatomic positioning of a meniscal root repair, in a posteromedial position, is able to restore the loading profile of the knee joint.

Purpose/Hypothesis: To compare the tibiofemoral contact mechanics of a nonanatomic posterior medial meniscal tear to the intact knee and to an anatomic repair. It was hypothesized that a nonanatomic root repair would not restore the tibiofemoral contact pressures and areas to the intact knee or anatomic repair.

Methods: Tibiofemoral knee contact mechanics were recorded in six male, human cadaveric knee specimens (average age, 45.8 years) using pressure sensors. Each knee underwent five testing conditions for the posterior medial meniscal root: (1) intact knee, (2) root tear, (3) anatomic transtibial pull-out repair, (4) nonanatomic transtibial pull-out repair, placed 5 mm posteromedially along the edge of the articular cartilage, and (5) root tear concomitant with an ACL tear. Knees were loaded with a 1000 N axial compressive force at 4 different flexion angles (0°, 30°, 60°, 90°). Contact area, mean contact pressure, and peak contact pressure were calculated via pressure sensors.

Results: Contact area was significantly lower after nonanatomic repair than for the intact knee or anatomic repair at all knee flexion angles. At each flexion angle, a nonanatomic repair resulted in significantly lower contact area than the intact medial meniscus. When averaged across the flexion angles, the reduction effect on contact area of nonanatomic repair was 44% (95% CI [35, 53]) compared to intact. The avulsed meniscal root and avulsed meniscal root with sectioned ACL groups resulted in 57% and 61% reductions in intact contact area respectively, while the anatomic repair achieved an average of 83% of the contact area of the intact meniscus. At 0° and 90°, and when averaged across flexion angles, the nonanatomic repair significantly increased mean contact pressures in comparison to the intact knee or anatomic repair. When averaged across flexion angles, the peak contact pressures after nonanatomic repair were significantly higher than the intact knee, but not the anatomic repair. When averaged across the flexion angles, the increased effect on contact pressure of nonanatomic repair was 67% (95% CI [13, 121]) compared to intact and was significant. When averaged across the flexion angles, the root tear, anatomic repair, and

root tear with sectioned ACL states resulted in an increase in mean contact pressures of 106%, 13%, and 161% in comparison to the intact knee, respectively.

Conclusions: For most testing conditions, the nonanatomic repair was unable to restore the contact area or mean contact pressures to that of the intact knee or anatomic repair.

Clinical Relevance: Results of this study emphasize the importance of ensuring an anatomic posterior medial meniscal root repair by releasing the extruded menisci from adhesions and the posteromedial capsule, as well as preventing displacement of the meniscal root repair construct.