

Effects of Medial Meniscus Posterior Root Tear and Repair on *in vivo* Knee Biomechanics

Felipe F. Gonzalez^{1,2,3}, Enzo Mameri^{2,3}, Gustavo Leporace^{2,3}, Zeeshan A. Khan^{1,5}, Salvador Ayala¹, Leonardo Metsavaht², Jonathan Gustafson¹, Jorge Chahla¹

¹Rush University Medical Center, Chicago, IL, United States. ²Instituto Brasil de Tecnologias da Saúde, Rio de Janeiro, RJ, Brazil. ³Universidade Federal de São Paulo, São Paulo, SP, Brazil. ⁴Universidade Federal do Pampa, Uruguai, RS, Brazil. ⁵Rush Medical College, Chicago, IL, United States. Felipe_gonzalez@rush.edu

Disclosures: Dr. Chahla is a paid consultant for Arthrex, CONMED Linvatec, Ossur, Smith & Nephew

INTRODUCTION: Medial meniscus posterior root tears (MMT) severely impair the medial meniscus function—similar to a subtotal meniscectomy—and affect knee kinematics, leading to accelerated joint wear¹. Although meniscus root repairs (MMR) have been demonstrated to yield satisfactory patient-reported outcomes, it is unknown if knee kinematics are restored after surgical repair. This study aimed to examine if MMT patients have altered knee kinematics and if MMR can restore native kinematics.

METHODS: This abstract reports on preliminary findings derived from an ongoing cross-sectional study approved by an Institutional Review Board (Study ID: 22020701-IRB02). All subjects signed an informed consent. Two subjects with MMTs, 2 with prior MMR, and 3 healthy controls (CON) walked over ground at their normal gait speed and had three-dimensional kinematic data collected using a high-speed camera motion analysis system. Knee kinematics were calculated using a point cluster technique, which enables high accuracy in the calculation of knee translations and rotations². Due to the limited preliminary sample size, descriptive statistics were performed.

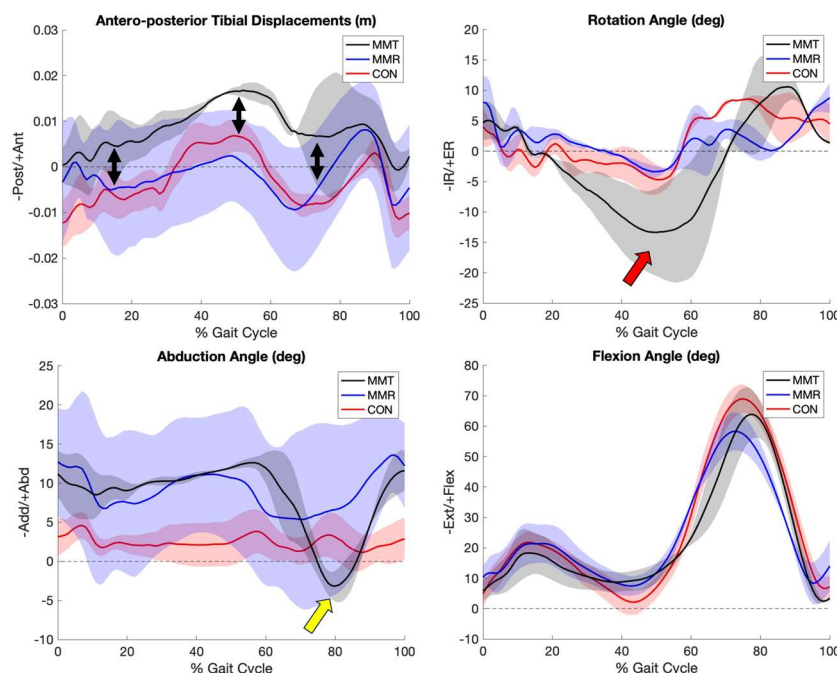
RESULTS SECTION: The MMT group presented an offset for anterior translation during the entire gait cycle (Mean MMT: 8.2 mm; MMR: -1.7mm; CON: -0.5mm) (black arrows) and increased knee internal rotation from load response to mid-swing (Peak MMT: -14.8°; MMR: -4.2°; CON: -5.2°) (red arrow) when compared to the other groups. Both MMT and MMR groups presented an offset to knee valgus compared to the CON group; however, the MMT group transitioned to knee varus during the swing phase (Peak MMT: -3.3°; MMR: 4.1°; CON: 0.6°) (yellow arrow), which was not seen in the other groups. Flexion angle waveforms were similar during all gait cycle among all groups (Range of motion MMT: 62.6; MMR: 52.3; CON: 67.3).

DISCUSSION: The findings suggest that surgical repair of the posterior root of the medial meniscus restores knee kinematics in overground walking. Anterior-posterior tibial displacements and rotation angles seem to be increased in MMT patients whereas MMR subjects showed knee biomechanics more similar to healthy, age-matched controls. Besides a common valgus position in MMT and MMR patients, only the MMT group transitioned to varus, which indicates that the repair restored the meniscus' capacity to restrain knee adduction.

SIGNIFICANCE/CLINICAL RELEVANCE: This study bridges an important gap in the field of knee biomechanics and meniscus preservation, providing *in vivo* information regarding pathomechanics, as well as demonstrating the benefit of surgical intervention. This research provides insights into clinical interventions for a severely debilitating knee condition by demonstrating restored kinematic patterns after surgery.

REFERENCES:

1. Marsh CA et al. Effect of Posterior Horn Medial Meniscus Root Tear on In Vivo Knee Kinematics. Orthop J Sports Med. 2014 Jul 11;2(7):2325967114541220. doi: 10.1177/2325967114541220. PMID: 26535342; PMCID: PMC4588528.
2. Senesh M, Wolf A. Motion estimation using point cluster method and Kalman filter. J Biomech Eng. 2009 May;131(5):051008. doi: 10.1115/1.3116153. PMID: 19388778.



IMAGES AND TABLES:

Figure 1. Average curves of knee kinematics during the gait cycle. Shaded area represents the standard deviation. Black arrows indicate anterior translation during the entire gait cycle. Red arrow indicates increased knee internal rotation from load response to mid-swing. Yellow arrow indicates knee varus during the swing phase. Abbreviations: MMT: Medial meniscus tear group; MMR: Medial meniscus repair group; CON: Control group; Ant: Anterior; Post: Posterior; ER: Tibial external rotation; IR: Tibial internal rotation; Abd: Abduction; Add: Adduction; Ext: Extension; Flex: Flexion.