

Open Knee(s): The Role of the Transverse Ligament in Cartilage and Menisci Mechanics and Tibiofemoral Joint Kinematics

Abstract (maximum 250 words):

The transverse ligament (TL) connects anterior regions of the menisci in the knee joint. Studies on the biomechanical effects of this structure on menisci and cartilage loading and tibiofemoral joint kinematics are scarce. Removal of this ligament in surgical procedures may lead to destabilization of menisci and alterations in cartilage contact that may contribute to onset of degenerative diseases such as osteoarthritis. The purpose of this present work was to modify an existing finite element (FE) model of the tibiofemoral joint via addition of the TL to examine its effect on joint kinematics and cartilage and menisci mechanics. In addition, the role of the TL in model fidelity was analyzed by examining the convergence characteristics of the simulations. The Open Knee(s) – Generation 1 model was modified by defining the TL across the anterior aspects of the menisci as springs with a spring stiffness of 200 N/mm. The model simulated passive flexion up to 45 degrees. Presence of the TL constrained the motion of the menisci, specifically, the posteromedial translation of the lateral meniscus. In addition, the stress distribution of both menisci and femoral cartilage changed from the initial model. Qualitative inspection indicated that the TL also impacted tibiofemoral kinematics. Furthermore, the model converged quicker and easier in the presence of the TL, encouraging its inclusion in future modeling endeavors. Due to the TL's role in knee biomechanics, the TL should be considered during surgical interventions and the development of meniscal implants to limit further deterioration of articular cartilage for patients.