Femoral Version Alters Patellofemoral Joint Mechanics: Insights from Musculoskeletal Modeling

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Objectifs: Abnormal femoral version (FV) may lead to compensatory mechanisms in the lower limb during gait. However, the influence of abnormal FV on patellofemoral joint mechanics is not well understood as most musculoskeletal investigations so far did not include a detailed model of the patellofemoral joint.

***Question de recherche*:** How does FV affect patellofemoral joint mechanics?

***Méthode*:** In this conceptual study, we used a musculoskeletal model with a detailed 12 degrees of freedom (DoF) knee, along with gait data provided in the OpenSim JAM resources (https://github.com/opensim-jam-org/jam-resources). Ten models with different FV, ranging from -9 to 54 degrees, were developed by rotating the proximal part of the femur in the transverse plane, while keeping the distal part unaffected. Muscles attachments were also adjusted, and all other elements including markers remained unchanged. A level walking trial was simulated using OpenSim COMAK with a cost function that minimizes the sum of the squared muscle activations while accounting for ligament forces and patellofemoral articular contact forces.

***Résultats*:** Our findings revealed that by increasing the FV, the RMS of patellofemoral compressive force, pressure, and contact area decreased during the early stance. In contrast, the RMS of patellofemoral compressive force, medial shear force, pressure, and contact area increased during the late stance. Patellar tended to tilt and shift laterally with increasing FV. The moment arms of the gluteus minimus and medius with respect to hip abduction decreased, while their moment arms with respect to hip extension increased. Therefore, hip abductor muscles also produce hip extension moment. This leads to increased hip flexor muscle forces in late stance to keep the net hip flexor moment the same.

***Conclusions*:** Patellofemoral mechanics is subject to the function of rectus femoris muscle. These findings may explain why individuals with abnormal FV adopt compensatory gait patterns, and could have clinical implications for patellar lateral tracking and increased joint stress.