THE EFFECT OF FLEXION OF THE FEMORAL COMPONENT IN TKA: A MUSCULOSKELETAL SIMULATION STUDY

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Introduction/Aim: More flexion of the femoral component (FFC) is a surgical option to better restore the femur anatomy in the sagittal plane in Total Knee Arthroplasty (TKA), and to prevent notching of the anterior femoral cortex. However, its true effects on the patellofemoral joint (PFJ) during activities of daily living (ADLs) remain unknown. We studied the effect of FFC on quadriceps and PFJ forces during ADLs. We hypothesised that more FFC has advantages for the knee extensor mechanism.
Materials and Methods: A previous validated musculoskeletal model of cruciate-retaining TKA was used (Fig. 1) to simulate a rising-from-a-chair activity [1]. We simulated a baseline case with the original post-operative FFC (0°). We then increased the FFC by 3°, 6°, 9°, by referencing the posterior femoral condyles (Fig. 2) and repeated the simulation. Quadriceps forces, PFJ ligament forces and PFJ contact forces were calculated.
Results: Peak quadriceps force decreased by 48 N (6.5 %BW), on average, for every 3° of FFC at 90° flexion (Fig. 3a). The peak PFJ contact force decreased by 64 N (8.7 %BW), on average, for every 3° of FFC at 90° flexion. Conversely, peak medial and lateral PFJ ligament forces increased by 23 N and 25 N, respectively, on average, for every 3° more FFC (Fig. 3c-d).
Discussion: FFC moderately affects the PFJ mechanics. Reduced PFJ contact force with more FFC is explained by reduced quadriceps force. More FFC, thus, benefits the knee extensor mechanism, due to increased quadriceps moment arm. More FFC over-tightens both medial and lateral PFJ ligaments, due to a wider PFJ gap, although the effect on ligament forces is not dramatic.
Conclusions: More FFC reduces the quadriceps and PFJ force to rise from and sit on a chair. This surgical option can potentially help preventing anterior femoral notching, while at the same time provide a better knee function.
References: [1] Marra MA, Vanheule V, Fluit R, et al. A Subject-Specific Musculoskeletal Modeling Framework to Predict In Vivo Mechanics of Total Knee Arthroplasty. ASME. *J Biomech Eng.* 2015;137(2):020904-020904-12

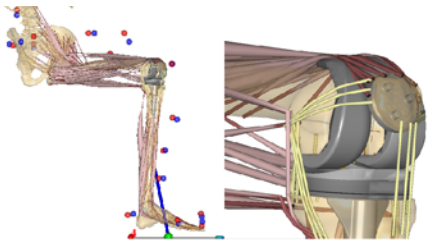

Figure 1. The musculoskeletal model of TKA.

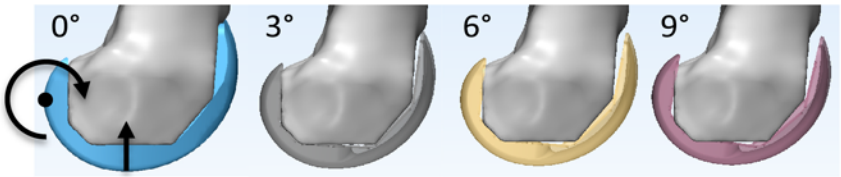

Figure 2. Model variations of the femoral component flexion angle.

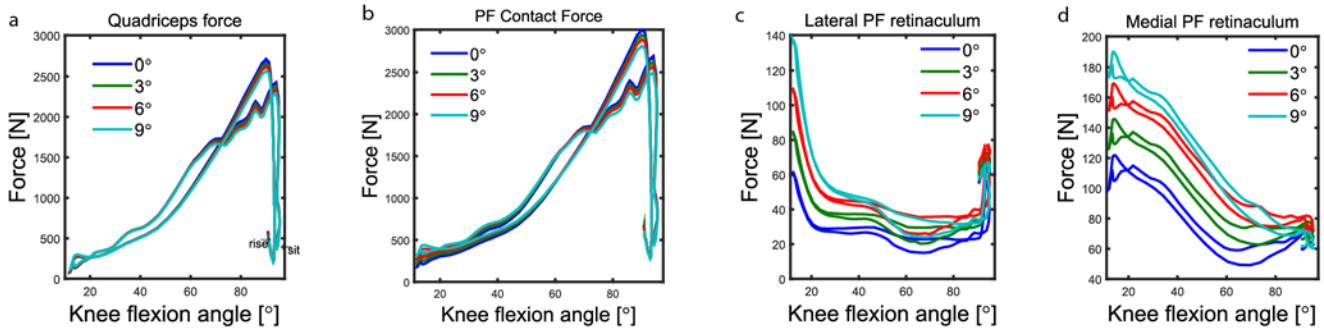

Figure 3. Quadriceps muscle forces (a), patellofemoral contact forces (b), lateral (c) and medial (d) patellofemoral ligament forces.