The Effect of Tibial Slope on the Biomechanics of Cruciate-Retaining TKA: a Musculoskeletal Simulation Study.

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Introduction

• More posterior tibial slope may reduce flexion gap tightness in cruciate-retaining total knee arthroplasty (CR-TKA) and widen the range of knee flexion.
• However, it is unknown how knee kinematics and loads during daily activities are affected by variations in tibial slope.

Objective

We studied the effect of tibial slope and surgical technique on the kinematics of the tibiofemoral contact points, quadriceps muscle forces, and patellofemoral contact forces during squat.

Materials and Methods

• Validated musculoskeletal model¹ of CR-TKA

Results

Knee kinematics

Knee loads

Discussion and Conclusion

ACR technique

• kinematics more unstable with more slope, due to slackening of knee ligaments
• reduced quadriceps-femur load sharing

CPR technique

• stable kinematics with more posterior contact points with more slope
• reduction in patellofemoral contact forces

Conclusion

Tibial slope should be pre-planned and executed using the CPR technique. Surgeons should be very careful when increasing the tibial slope using the ACR technique in CR-TKA, as it may have huge effects on knee kinematics and loads in daily activities.

References


Figure 1. (a) Full-body musculoskeletal model used to simulate a squat activity using a detailed force-dependent kinematic knee model. The model is muscle actuated and takes ground reaction forces and moments (GRF&Ms) and skin marker trajectories (not shown) as input. (b) Anteromedial view showing medial patellofemoral ligament (MPFL), medial collateral ligament (MCL) and patellar ligament (PL). (c) Posterolateral view showing anterolateral ligament (ALL), posterior cruciate ligament (PCL) and lateral collateral ligament (LCL).

Figure 2. Variation of tibial slope using (a) anterior tibial cortex-referencing technique (ACR) and (b) central referencing technique (CPR).

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