Importance of rotational position of the components: biomechanical standpoint

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Purpose:
Proper positioning of the components is critical for ensuring better function, clinical score, and range of motion after total knee arthroplasty (TKA). However, accurate rotational placement of the tibial component is difficult to achieve freehand, because landmarks for rotational alignment are ambiguous compared with femoral rotational alignment. Malrotation of the tibial component would lead to various complications after TKA. In this study, we analyzed the effects of malrotated tibial component on lateral and medial collateral ligament (LCL and MCL) tensions, tibiofemoral and patellofemoral contact stresses during a squat.

Methods:
A musculoskeletal computer model was used, and was simulated with a posterior cruciate-retaining TKA. The neutral rotational alignment of the femoral and tibial components was aligned according to the femoral epicondylar axis and the tibial anteroposterior axis, respectively. The tibial rotational alignments were changed from 15° external rotation to 15° internal rotation in 5° increments.

Results:
For the MCL, the neutral rotated tibial components caused a maximum tension of 67.3 N. However, the 15° internally rotated tibial components increased tensions to 285.2N as a maximum tension. By contrast, with external rotation of the tibial component, the MCL tensions increased only a small amount. The LCL tension also increased but up to less than half of the MCL value. The rotational kinematics of the femur against the tibia during flexion was affected by the rotational alignment of the tibial component. The tibiofemoral and patellofemoral contact stresses increased because of a decreased contact area.

Conclusions:
Excessive internal rotation in the tibial component increased MCL tensions and patellofemoral and tibiofemoral contact stresses. The current study suggests that increased MCL tensions and patellofemoral and tibiofemoral contact stresses caused by

a malrotated tibial component could be one cause of patient complaints and polyethylene problems after TKA.

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