INTRODUCTION: Optimal soft tissue tension maximizes function after total knee arthroplasty (TKA). Excessive tension may lead to stiffness and or pain, while inadequate tension can lead to instability. Truly perfect soft tissue balancing is achieved in less than 8% of all TKA's. Composite component thickness is a prime determinant of this soft tissue tension. Polyethylene component inserts currently allow for 2-3 mm incremental changes. Currently intra-operative assessment of joint loads is performed qualitatively. The relationship linking joint loads and insert thickness has not been extensively studied.

The goal was to employ a load measurement system in a cadaveric model to determine the effect of increasing insert thickness on tibiofemoral (compartamental) loads. This study analyzed the effect of 1-mm incremental changes in polyethylene thickness on soft tissue tension. Our hypothesis was that soft tissue tension would be markedly affected by increases in insert thickness.

METHODS: Eight fresh-frozen cadaveric knee specimens (4 pairs, 76±18 years) were used in this study. Computer assisted (Stryker Knee Navigation) TKA was performed on each specimen, and cemented posterior stabilized (PS) components were implanted. Kinematics were recorded using the computer navigation software. A validated instrumented tibial insert was used to measure medial and lateral compartmental loads independently (Figure 1a). The knees were passively moved through full flexion-extension range of motion (ROM), for each tibial construct thickness. ROM was repeated five times, and then the tibial insert thickness was increased.

Stainless steel shims were inserted in the tibial construct, below the polyethylene contact surface, to increase the thickness of the component (Figure 1b). The effect of 1-mm incremental increases in polyethylene thickness on compartmental loads was evaluated.

RESULTS: An increase in compartmental loads was measured with increasing insert thickness (Figure 2). Loading in contralateral compartments showed differing behavior, reflecting varying tension in the medial and lateral sides.

DISCUSSION: The compartment loads varied as a function of insert thickness. Data for seven of eight specimens showed signs of soft tissue failure, although there were no clear indications of failure during the experimental procedure. The effect of this “micro-failure” on the outcome of TKA is questionable, as it could in fact be a minor contributor to ligament balancing. The high sensitivity of compartmental loads with a 1-mm incremental thickness increase is significant and has not been previously appreciated, especially intra-operatively. The currently available TKA inserts with 2-3 mm incremental sizing may make obtaining optimal soft tissue tension difficult. In addition to the current focus of obtaining accurate leg alignment, further computer assisted techniques are required to address soft tissue tension.


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