Paper #36

Total Knee Arthroplasty in the Osteoporotic Tibia: A Biomechanical Evaluation of the Role of Stem Extensions and Cementing Techniques

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Introduction: When total knee arthroplasty(TKA) is performed in the osteoporotic patient, poor functional outcomes and aseptic loosening increase, primarily due to compromised fixation of the prosthetic components. This may be addressed by adding stem extensions to the components, however, little data exists to support this practice. In this biomechanical study, we evaluate the impact of a stem extension on the stability of tibial fixation in the osteoporotic patient.

Methods: A standard design of tibial tray was implanted in a modified replica of the male osteoporotic tibia previously validated for fixation testing studies. Twenty-four implantations were performed using 3 variations of implant and cementing (8 surrogate tibias per group): 1) Primary implant (34mm keel) with surface cementing only, 2) Primary implant with full cementing, 3) Same as #2 with addition of a 30mm stem extension. Each construct was mounted in an MTS load frame and subjected to 500 cycles of multiaxial loading simulating walking. The 3D components of tray-tibia micromotion were measured at medial and lateral sites using digital image correlation (DIC) analysis.

Results: Total interface motion of the primary implants was 25.9μm±14.7μm with surface cementing and 10.6μm±7.6μm with full cementing ($p=0.001$). In comparison, the 3D motion of the fully cemented primary implants with a stem extension was only 4.4μm±3.9μm. This is only 17% of the surface cemented case ($p<0.0001$) and 42% of the fully cemented components without a stem extension ($p<0.009$).

Conclusion: As tibial components displayed greater stability when fully cemented, we do not recommend cementing of only the proximal surface of the osteoporotic tibia. As we observed the least micromotion after addition of a stem extension to the primary implant, we believe that the use of a longer stem may provide an advantage in osteoporotic TKA.

Notes