

Finite element analysis of the effect of shape memory alloy on the stress distribution and contact pressure in total knee replacement

ABSTRACT

As a step towards developing a biomaterial for femoral component of total knee replacement, the goals of this study were to introduce NiTi shape memory alloy as a promising material for orthopedic implant and to evaluate the effect of different material properties on contact behavior of the joint and stress distribution of the femoral bone using finite element method. Two separate finite element analyses were performed; one with rigid bones and the other with deformable femur, at 0 degree of flexion angle under static loading condition. The results showed no difference between the various materials with regards to the peak contact pressure but considerable difference with regards to the Von Mises stresses. The results also demonstrated that stress values closer to the natural femur were obtained for NiTi implant compared with other metals. Hence, this finite element analysis showed that NiTi shape memory alloy can reduce the stress shielding effect on the femoral bone.

Keyword: Shape memory alloy; Total knee replacement; Stress distribution; Contact Pressure; Finite element analysis