

Using design of experiments methods for assessing peak contact pressure to material properties of soft tissue in human knee

ABSTRACT

Contact pressure in the knee joint is a key element in the mechanisms of knee pain and osteoarthritis. Assessing the contact pressure in tibiofemoral joint is a challenging mechanical problem due to uncertainty in material properties. In this study, a sensitivity analysis of tibiofemoral peak contact pressure to the material properties of the soft tissue was carried out through fractional factorial and Box-Behnken designs. The cartilage was modeled as linear elastic material, and in addition to its elastic modulus, interaction effects of soft tissue material properties were added compared to previous research. The results indicated that elastic modulus of the cartilage is the most effective factor. Interaction effects of axial/radial modulus with elastic modulus of cartilage, circumferential and axial/radial moduli of meniscus were other influential factors. Furthermore this study showed how design of experiment methods can help designers to reduce the number of finite element analyses and to better interpret the results.

Keyword: Human Knee; Contact pressure; Soft tissue