ABSTRACT

Biomechanical Study of Lumbar Spine with Interspinous Device using Three-dimensional Nonlinear Finite Element Method

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Recently a variety of spinal implants have been designed to treat spinal disorders and age-related spinal degeneration associated with pain. Spinal implants can be classified into artificial intervertebral disc (AID) and posterior stabilization device (PSD), and PSD is widely accepted by its simple construct and relatively plain surgical procedure. To evaluate the spinal behavior after its instrumentation, in vivo or in vitro experiments are quite limited and clinical trials require time. Finite element analysis(FEA) is

therefore employed to provide detailed biomechanical investigation of human spine which are difficult to measure experimentally.

The aim of this study is to develop an accurate finite element(FE) model of the lumbar spine and predict the influence of the interspinous spacer, one of PSD, on the mechanical behavior. The intact FE model of multispinal segments(L2~L5) are generated from CT scan images and validated with cadaveric experimental data in flexion, extension, lateral bending, and rotation using three-dimensional nonlinear finite element method. To examine the role of the spinal implant, the degeneration of the intervertebral disc is first modeled from the intact model and then the finite element model of the interspinous spacer is placed at the L3/L4 level in the degenerated model.

The instrumentation significantly reduces the amount of the range of motion(ROM) at the instrumented level and does not significantly alter the kinematics of the motion segments at adjacent levels. It also unloads the intervertebral disc at the instrumented level and does not significantly change the disc pressure at the adjacent levels. It may not lead to pressure-induced disc degeneration. It is expected that the establishment of the analysis process provides support in the optimal design and application of the spinal implant.

Key word: spine, lumbar spine, spinal implant, finite element method (FEM), spine finite element (FE) model.