Abstract

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Comparative Biomechanical Analysis of Lumbar Disc Arthroplasty using Finite Element Modeling

Lumbar total disc replacement (LTDR) is a surgical procedure for the treatment of degenerative disc disease (DDD) and lumbar spinal distortion to preserve range of motion (ROM). The SB Charité™ is the first device for LTDR but it produces more complications and long-term issues, causing a shortage of SB Charité™ disc. Currently, the evolution of lumbar disc arthroplasty based on some criteria like prosthetics structure, biomechanical model, tissue engineering and biomaterials approach. The optimal biomechanical model is based on kinematic and kinetic parameters together to ensure a long-term implantation with a lower rate of damage from disc implant in the spinal column. The finite element method (FEE) of human lumbar spinal is advanced to support biomechanical modeling techniques which are related to biomaterials guideline for choosing better material for implantation. Therefore, this paper presented a 3D biomechanical FEM model of L1 to L3 lumbar spines by different types of discs and materials. We applied a compressive force, and compressive force plus extension moment to this model to calculate Tresca stress of annulus fibers, strain and von Mises stress on the vertebral endplate at each intervertebral level under COMSOL Multiphysics® software.