Biomechanical Study of the L4-L5 Lumbar Spine Segment by Finite Element Analysis

Abstract structure

The spinal column constitutes one of the most important parts of the human body and a support for the mechanical behavior of the body. The spinal column in general transmits the external forces to which the human body is subjected. The study of lumbar biomechanics allows health professionals to have a better interpretation of the clinical and radiological findings of the lumbar segment in order to establish an appropriate treatment for the patient's needs. Therefore, the objective of this study is to develop a finite element model of the L4-L5 lumbar spine using personalized vertebral morphometry to study the distribution of strains and stresses suffered by the lumbar spine. Computerized images of a patient diagnosed with hyperlordosis were used. Using 3D Slicer and Meshmixer software, the 3D geometry was created. Using Hypermesh, the meshing was performed and later the finite element analysis (FEA). The results obtained from the FEA showed that the Von-Misses stress in a patient with hyperlordosis is lower in the L5 vertebra, while there is a greater risk of fracture in the area of the L4 vertebrae pedicle. On the other hand, the L4 vertebra and the intervertebral disc moved approximately 1.50e-05 mm relative to the L5 vertebra, which is recessed. This percentage of displacement could accelerate the wear of the intervertebral discs as well as the joint facet.These results suggest the significance of considering the risk of fracture in the L4 vertebra in patients with hyperlordosis and emphasize the potential wear of intervertebral discs and facet joints due to the observed displacement.

Key words:

Lumbar spine, Finite element analysis (FEA), Medical imaging, Meshing, Von-Misses,