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Biomechanical Effect of an Implant System on Lumbar Spinal Segments

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Spinal implant systems, which are used to facilitate fusion, correct deformities, and stabilize and strengthen the spine, are typically employed in surgical interventions on the spinal unit. The aim of this study was to investigate the biomechanical effect of a spinal implant system on the spinal unit model. A three-dimensional model of the lumbar spine (L2-L3) was constructed from computed tomography data (Figure 1). The model involved two vertebrae, an intervertebral disc, two facet joints, ligaments (anterior, posterior, interspinous ligaments, and ligamentum flavum), screws, and rods. The screw insertion regions and angles were determined for each vertebra. Von Mises stress analysis was performed in Ansys software. The lower vertebra was fixed and a compressive preload of 500 N combined with an 8 Nm moment were applied to the finite element model. Stress distribution was calculated. Most of the stresses were accumulated on the rods and the tail of the pedicle screws. Since facet joints transmitted the compressive forces, the stress distribution was much higher in the joint areas. In conclusion, although the implant system decreased mobility of the system, it allowed to stabilize the model.
Keywords: biomechanics, lumbar spine, implant, stress analysis.

Figure 1. The finite element model of the lumbar spine (L2-L3) used in the study.