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Development of a Physiological Model for the Human Spine
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The intervertebral disc in a human spine is a complex structure consisting of three distinct parts: the nucleus pulposus, the annulus fibrosus, and the cartilaginous end-plates. The Nucleus Pulposus is centrally located within the disc surrounded by annulus fibrosus. It consists of a loose network of fibers and cells in a proteoglycan gel, which merges indistinctly at its outer margin with the annulus fibrosus. A viscoelastic constitutive model is proposed for the nucleus pulposus of the human spine to facilitate the development of a flexible intervetebral device designed for application in the thoraco-lumbar region of the human spine during surgery. A novel experimental set up was designed to establish application limits of the design concept for different approaches in spinal surgery. Both static and fatigue mechanical tests based on the ASTM standards provided a basis for the comparison with some existing clinically successful spinal implants designed for similar applications. Also, these mechanical tests and in-vitro comparison with normal spine provided the application limits of this design in surgery to maintain physiologic functional performance at the affected spinal level. The model is used to investigate the effect of the various design parameters on the biomechanical environment of the spine segment.

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