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Stress Analysis of Vertebra Using Photoelastic and Finite Element Methods

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Abstract : In this study, both the photoelastic, as well as the finite element methods, are used to study the stress distribution within human vertebra (L4) under forces similar to those that occur during normal life. Two & three dimensional models of vertebra were created by the software AutoCAD. The coordinates obtained were fed into a computer numerical control (CNC) tensile machine to fabricate the models from photoelastic sheets. Completed models were placed in a transmission polariscope and loaded with static force (up to 1500N). Stresses can be quantified and localized by counting the number of fringes. In both methods the Principle stresses were calculated at different regions. The results noticed that the maximum von-mises stress on the area of the extreme superior vertebral body surface and the facet surface with high normal stress (σ) and shear stress (τ). The facets and other posterior elements have a load-bearing function to help support the weight of the upper body and anything that it carries, and are also acted upon by spinal muscle forces. The numerical FE results have been compared with the experimental method using photoelasticity which shows good agreement between experimental and simulation results.

Keywords : photoelasticity, stress, load, finite element
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