

Material Property Sensitivity Analysis for Exact Finite Element Model of the First Cervical Vertebra (Atlas)

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Abstract

A 3D anatomically accurate finite element model of the human first cervical vertebra (atlas), including cortical and cancellous bones, was developed in ANSYS 9 based on CT-scan images. The main objective was to investigate the effect of cancellous bone on the value and distribution of maximum and average Von Mises stress in Atlas. The results showed that the material property of cancellous bone has no significant effect on the location of maximum stress and the pattern of average stress distribution in anterior arch, the junction of posterior arch and lateral mass and the groove of the posterior arch. Although the presence of cancellous bone in the model yielded higher values for the maximum and average stresses. The boundary condition had a considerable effect on this increase. Altering the material property of cancellous bone, under neutral and hyperextension loading configurations, affected the average stress only in cancellous bone in the lateral mass, but change in the material property of cortical bone resulted in average stress change both in the cortical and cancellous bones, and in the lateral displacement of the lateral mass as well. The interconnected effects of changing the material properties of these two bone tissues were also studied.

Keywords: FEM; Cervical spine; Atlas; Exact model; Cancellous bone; Stress analysis, Material property sensitivity analysis.

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¹ Atlanto-axial
⁵ Mechanical Desktop
⁹ Isoparametric

² 3D exact finite element model
⁶ Sagittal
¹⁰ Isotropic

³ Computerized Tomography Scan
⁷ Elastic
¹¹ Yang Modul

⁴ 3D-Doctor
⁸ ANSYS
¹² Poason Modul

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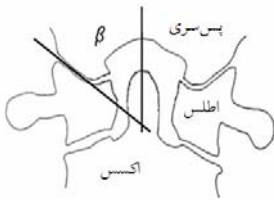
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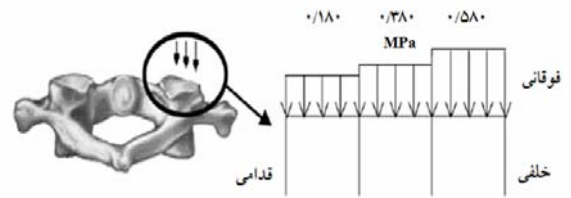
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¹⁵ Posture

¹⁶ Flexion

¹⁷ Extension

¹⁸ von Mises

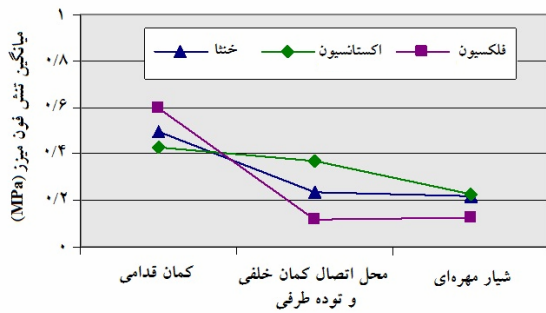
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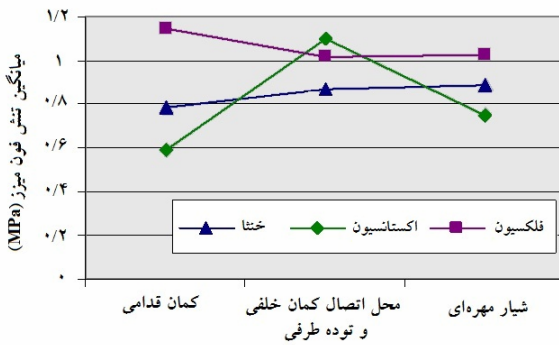
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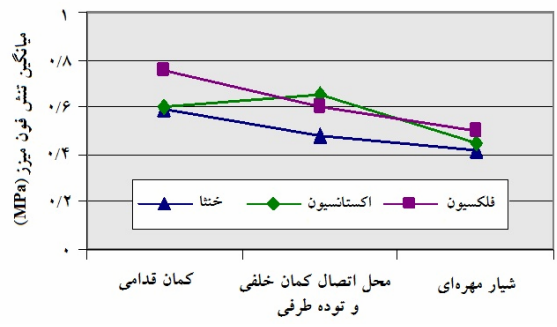
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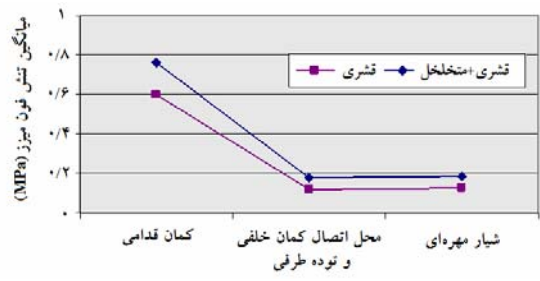
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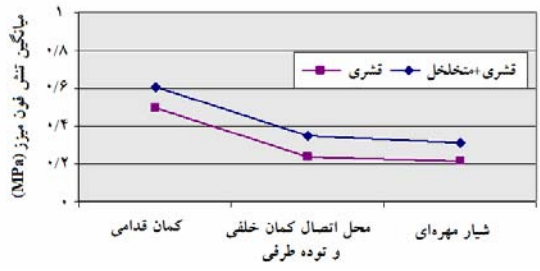
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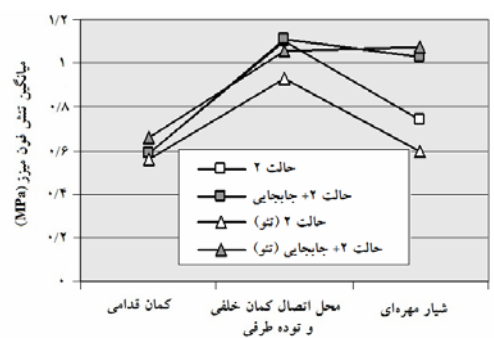
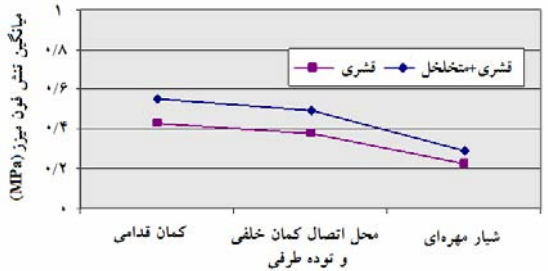
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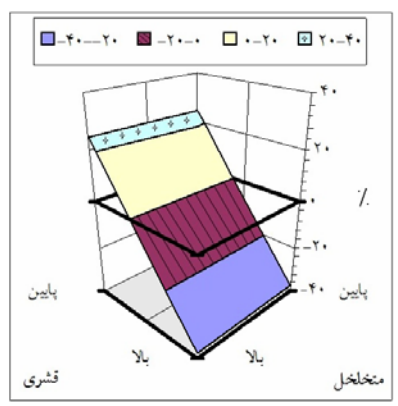
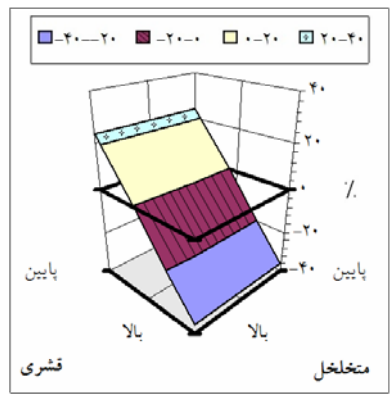
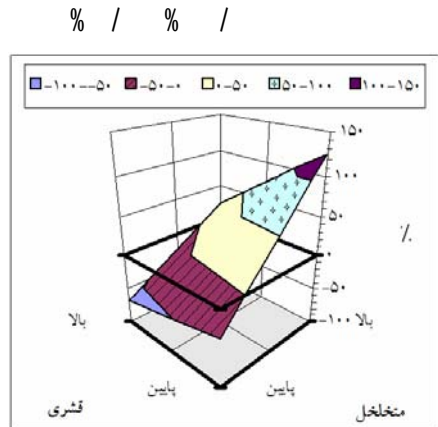
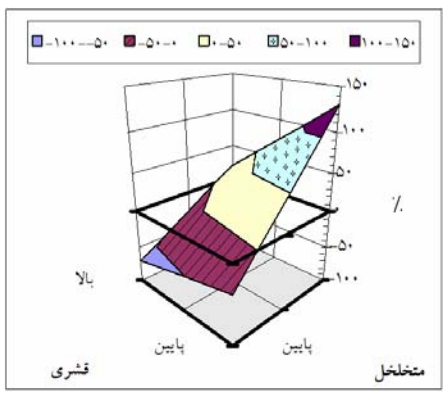


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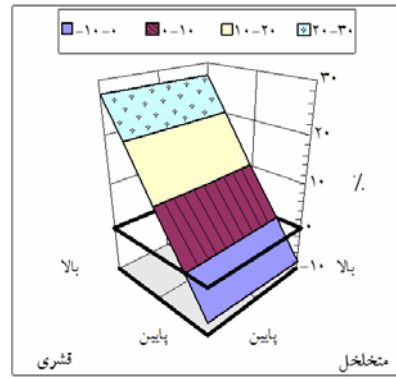
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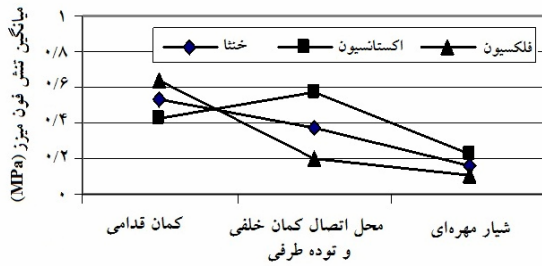
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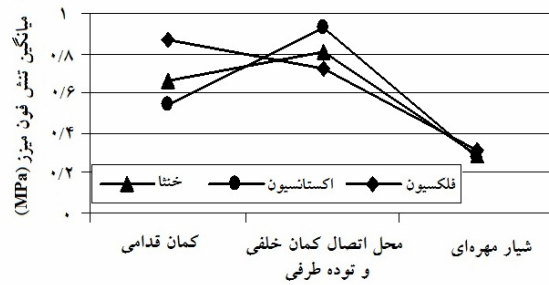
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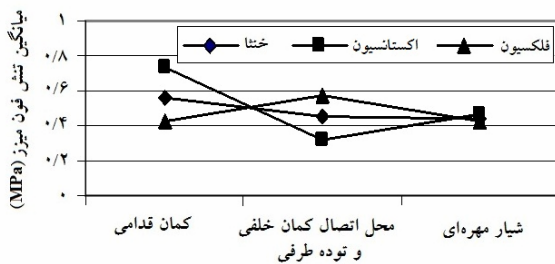
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