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Building the inhomogeneous finite element model by the data of computed tomography

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Abstract

© Sachenkov O.A., Gerasimov O.V., Koroleva E.V., Mukhin D.A., Yaikova V.V., Akhtyamov I.F., Shakirova F.V., Korobeynikova D.A., Khan H.Ch., 2018. The aim of the work is to reveal a methodology for constructing a finite element model by tomography data. To evaluate the model, calculations of the femur were carried out. The relevance of this study is confirmed by the effect of the distribution of the mechanical properties of the bone on stress-strain state and the need for individualizing the approach to modeling. Numerical studies were performed using the finite element method in the Ansys software, computer tomography data processing was carried out in the Avizo software. The problem of a linear inhomogeneous elastic body was considered. Power functions of the optical density were used to determine the Young's modulus and the limiting voltage, in turn, the optical density was determined from linear relations depending on the Hounsfield numbers. For finite element model, the mechanical properties of the material were distributed for each element according to the tomography data. After solving the problem of the stress-strain state, at each node a factor of safety was determined adjusted for the properties of the material from the tomography data. Inhomogeneous and homogeneous models with average properties were built. Calculations for both models were performed. Numerical results clearly illustrate significant differences in the results of the stress-strain state of the inhomogeneous and homogeneous models of the organ. Inhomogeneous model allows us to evaluate the local strength of bone tissue taking into account individual characteristics.

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Keywords

Computed tomography, Inhomogeneous media, Mathematical modeling

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