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Finite element modeling and experimental analysis of a recently developed gelatin/bioactive nanocomposite scaffold imposed to mechanical compression

Melika Sarem[1], Fathollah Moztarzadeh[1,2] and Masoud Mozafari[2,3]
[1]Sports Engineering Group, Amirkabir University of Technology, Iran
[2]Biomaterials Group, Amirkabir University of Technology, Iran
[3]School of Material Science and Engineering, Oklahoma State University, USA

In the current research study, the mechanical behavior of a recently developed macroporous gelatin/bioactive glass nanocomposite scaffold prepared by layer solvent casting combined with freeze-drying and lamination techniques for bone tissue engineering and regenerative medicine [Mozafari et al., Ceramics International, 36 (2010) 2431–2439] was analyzed. The interest of processing bone tissue-engineered scaffolds with both highly porous structure and desired mechanical strength drives us to focus on preparing scaffolds using the materials compounding synthetic gelatin with bioactive glass particles. As a critical issue encountered in simulation and finite element modeling is the generation of the finite element model, a model was built in Computer Aided Design (CAD) environment (solid work software) and then imported into the finite element software. Based on the mean value of pore side and pore diameter of the scanning electron microscopy (SEM) micrographs from the original porous scaffold, a three-dimentional (3D) anatomical shape of the scaffold was optimized to create the 3D-model. The finite element model was used to calculate the stress fields in complex scaffold structures and thus predict their mechanical behavior during service. The method was applied to identify the stress which scaffold can bear. In addition, the predictions for the compressive configurations and Young modulus were compared to experimental data from uniaxial compression tests. Moreover, the stress contour maps in several sections of the 3D-model revealed a detailed stress distribution of the porous structure, enabling thus a full investigation of its mechanical behavior.

Biography

Melika Sarem is currently master student at Amirkabir University of Technology; her master thesis is on meniscus tissue engineering. Her primary results has presented in ORS 2012. Prof. Fathollah Moztarzadeh has completed his Ph.D. in Materials Science at Technische Universitat Clausthal on 1976. He is full professor of Biomedical Engineering department at Amirkabir University of Technology. He has published more than 200 papers in reputed journals. Masoud Mozafari is PhD student at Amirkabir University of Technology and currently he is working as research associate at Oklahoma State University he has published more than 30 journal papers.

m.sarem@aut.ac.ir