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Porosity pattern of 3D chitosan/bioactive glass tissue engineering scaffolds prepared for bone regeneration

Hoda G H Hammad
Misr university for science and technology, Egypt

Aim: The study was conducted to investigate the obtained external and internal porosity and the pore-interconnectivity of specific fabricated bioactive composite tissue engineering scaffolds for bone regeneration in dental applications.

Materials and Methods: In this study, the bioactive glass [M] was elaborated as a quaternary system to be incorporated into the chitosan [C] scaffold preparation on a magnetic stirrer to provide bioactivity and better strength properties for the attempted composite scaffolds [C/ M] of variable compositions. The homogenous chitosan/bioactive glass mix was poured into tailor-made cylindrical molds [10cm×10cm]; a freeze-dryer program was used for the creation of uniform and interconnected macropores for all prepared chitosan-based scaffolds. The morphology of fabricated chitosan [C] and chitosan-bioactive glass [C/ M] composite scaffolds was studied by a scanning electron microscope [SEM] and a mercury porosimeter. In addition, the in-vitro biodegradation rate of all elaborated scaffolds was reported after immersing the prepared scaffolds in a simulated body fluid [SBF] solution. Furthermore, for every prepared scaffold composition, characterization was performed for phase identification, microstructure, porosity, bioactivity, and mechanical properties using an X-ray diffraction analysis [XRD], an X-ray Fourier transfer infrared spectroscopy [FTIR], a mercury porosimetry, a scanning electron microscopy [SEM] coupled to an energy-dispersive X-ray spectrometry [EDS] and a universal testing machine, respectively.

Results: All the prepared porous chitosan-based composite materials showed pore sizes suitable for osteoblasts seeding, with relatively larger pore sizes for the C scaffolds.

Conclusion: The smart blending of the prepared bioactive glass [M] with the chitosan matrix offered some advantages, such as the formation of an apatite layer for cell adhesion upon the scaffold surfaces, the reasonable decrease in scaffold pore size, and the relative increase in compressive strength that were enhanced by the incorporation of [M]. Therefore, the morphology, microstructure, and mechanical behavior of the elaborated stress loaded bio composite tissue engineering scaffolds seem highly dependent on their critical contented bioactive glass.

Biography

Hoda Gaafar Hammad completed her Bachelor of Oral Medicine and Dental Surgery at Cairo University, Egypt during 1990 to 1994. She completed her PhD in Restorative Dentistry at Cairo University. Currently working as Assistant Professor of Operative Dentistry and Head of Division of Dental Biomaterials, BMC (Batterjee Medical College), Dental Program, Jeddah, Saudi Arabia (KSA) since 15 October 2018 to till date.

dr.hodahammad@gmail.com