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Bioceramics and their applicability in dentistry

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Statement of the Problem: Different type of ceramic scaffold materials are widely used in dentistry, oral surgery and implantology. The most often used are hydroxyapatite (HA) and β -tricalcium phosphate (β TCP) bioactive modified scaffolds among the ceramic scaffolds. The appropriate mechanical properties, capable of supporting cell attachment and proliferation are critical parameters at the designing of a scaffold. Moreover, porosity, the mechanical integrity and effect of surface morphology on cell adhesion and proliferation are important parameters that must be examined in constructing the scaffold. The purpose of this study is to characterize and investigate the possible dental application of HA and β TCP containing mesoporous silica based aerogel. Methodology & Theoretical Orientation: Modified aerogels with different HA/ β TCP ratio were fabricated by sol-gel technology and supercritical drying in carbon dioxide at 80°C. In our in vitro study the cytotoxicity of modified aerogel was analysed based on Alamar Blue assay (Invitrogen, USA) by using malignant osteosarcoma cell line (SAOS-2, ATCC® HFB- 85™, Rockville, MD, USA). The gene expression changes were measured with BMP-2, Runx2, TaqMan® assays (ABI, USA), normalized to the GAPDH level. In our in vivo experiments modified aerogels discs were implanted into the prepared rat calvaria defects to investigate the osteointegration around the inserted aerogels. The thickness of prepared histological bone section containing modified aerogel were under 10 micrometres and stained based on the haematoxylin-eosin (H&E) staining protocol. Findings: These measurements showed that modified aerogels are biocompatible and non-toxic for SAOS-2 cell type. The gene expression analysis showed that β TCP and/or HA containing composites can trigger differentiation of SAOS-2 cells to osteoblasts, however, β TCP containing aerogel looks more effective than the HA containing aerogel. In vivo experiments showed early signs of osteointegration after 1 month intervention. Conclusion & Significance: These materials showed promising properties to be useful scaffolds for bone regeneration.

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