Gelatin Chitosan and Nano Bioactive Glass Scaffold for Bone Regeneration

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Gelatin, chitosan and nano bioactive glass based composite scaffold with tailored architectures and properties has great potential for bone regeneration. Herein, we aimed to improve the physico chemical, mechanical and osteogenic properties of 3D porous scaffold by incorporation of nano bioactive glass phase into biopolymer matrix with variation in composition in the prepared scaffolds. Scaffolds were prepared from the slurry containing gelatin, chitosan and synthesized nano bioactive glass particulate using lyophilisation technique. 58 S bioactive glass nano particles were synthesized and used in different concentration varying between 10-30 wt% to prepare GCB scaffolds. With increase in nanocaramic phase content from 10 wt% to 30 wt%, the compressive strength in the scaffold increased. GCH 30 showed the highest average compressive strength of 2.2 MPa. Higher cellular activities were observed in GCB 30 scaffold as compared to GCB 0 suggesting the fact that 58S bioactive glass nanoparticles addition into the scaffold promoted better cell adhesion, proliferation and differentiation. A higher degree of lamellopodia and filopodia extensions and better spreading behaviour of MSC's were observed in FESEM micrographs of MSCs cultured GCB 30 scaffold. Scaffolds prepared from 30 wt% 58S nano bioactive glass exhibited the highest bioactivity among all the scaffolds as evident from MTT assay, RUNX-2 and osteocalcin expression from mesenchymal stem cells cultured on the scaffold. Strongly positive osteocalcin signalling within 14 days of cell culture supported the fact that the prepared scaffolds stimulated new bone tissue regeneration. Moreover, by reverse-transcriptase (RT-PCR) analysis, it was observed the expression of osteogenic gene markers from cultured MSCs were relatively high in GCB30 as compared to other scaffolds. In coherence with the in vitro appearance, histological analysis and fluorochrome study in a rabbit tibia model showed a significantly greater amount of new bone formation in GCB30 compared to other composite scaffold. The results demonstrated that the prepared GCB30 scaffold could be a good candidate as a synthetic substitute for bone tissue engineering.

Keywords: 58s Bioglass, Chitosan, Gelatin, scaffold, compressive strength, bioactivity, *in vitro*, *in vivo*