3D Bio-Plotted Composite Scaffold Made of Collagen Treated Hydroxyapatite-Tricalciumphosphate for Rabbit Tibia Bone Regeneration

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Abstract Biphasic calcium phosphate scaffolds with 20/80 HA/TCP ratio were fabricated using the 3D-Bioplotting system to heal critical size defects in rabbit tibia bone. Four different architectures were printed in a layer by layer fashion with lay down patterns viz. (a) $0^{\circ} - 90^{\circ}$, (b) $0^{\circ} - 45^{\circ} - 90^{\circ} - 135^{\circ}$, (c) $0^{\circ} - 108^{\circ} - 216^{\circ}$ and (d) $0^{\circ} - 60^{\circ} - 120^{\circ}$. After high-temperature sintering scaffolds were coated with collagen and were further characterized by (FTIR) Fourier Transform Infrared Spectroscopy, (SEM) Scanning Electron Microscopy, (XRD) X-Ray diffraction, Porosity analysis and Mechanical testing. Scaffold samples were tested for its ability to induce cytotoxicity in Balb/c 3T3 cells at in vitro condition using elution method. Skin sensitization potential of scaffolds was evaluated in male guinea pigs using guinea pig maximization test (GPMT). Further, scaffolds were implanted in eight rabbit tibia bones and biocompatibility and histological evaluations were carried out after 4 and 8 weeks implantation periods. In-vitro results include bonding, surface morphology, phases, porosity, mechanical strength and Cytotoxicity. In-vivo results include sensitization, capsule formation, inflammation, presence of polymorphonuclear cells, giant cells, plasma cells, X-Rays and degradation of the material. It was concluded that HA/TCP/Collagen scaffold with $0^{\circ} - 45^{\circ} - 90^{\circ} - 135^{\circ}$ architecture exhibits the most excellent properties in healing critical size bone defects in rabbits.

Keywords: BCP (Biphasic Calcium Phosphate), MSC (Mesenchymal Stem Cell), *in vitro, in-vivo*.

1 Introduction

Application of material science, particularly use of biomaterials in the field of health care and reconstructive surgery is one of the most exciting and challenging areas in the present world [Ratner, Hoffman and Schoen et al. (2004)]. Biomaterials are synthetic materials

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