ABSTRACT SUBMISSION

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In vitro characterization of a poly(lactic-co-glycolic) acid - hydroxyapatite 3D-printed scaffolds for bone tissue engineering

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ABSTRACT

Introduction: Current bone tissue engineering strategies are based on porous biocompatible scaffolds seeded with tissue-specific cells. Improvement in rapid prototyping technology, such as 3D printing, allows fabrication of custom-made 3D scaffolds with high resolution. Our group has developed a new material, made of medical grade Poly(lactic-co-glycolic) acid (PLGA) mixed with 10% (w/w) hydroxyapatite nanoparticles (HA) for 3D printing by Fused Deposition Modelling (FDM). It showed a low chemical degradation during manufacturing steps, expected loading and homogeneous HA distribution. Based on this, our aim was to evaluate biocompatibility and osteopromotive potential of these new materials.

Materials and Methods: PLGA and PLGA-HA 10% (w/w) filaments were used to 3D printed porous membranes. The membranes were seeded with human adipose-derived stem cells (hADSCs) or human bone marrow stem cells (hBMSCs). Cytotoxicity was assessed according ISO 10993-5, cell proliferation by CyQuant® and cell behavior by Live-Dead. Osteogenic differentiation was evaluated with qualitative alkaline phosphatase (ALP) staining and quantification of mineralization by red alizarin. Inflammatory potential was analyzed by subcutaneous implantation in rat during 1 and 4 weeks.

Results and Discussion: The composite materials were non-cytotoxic. Both hADSC and hBMSCs had high viability and proliferate on the materials, even after 21 days of culture. At day 21, hADSCs highly colonized the material and formed bridge-like structures in the pores. ALP staining and mineralization seemed higher with PLGA-HA 10% materials relative to PLGA for both cell types. Histological results for subcutaneous implantation are under way. PLGA is largely known to be cytocompatible [1]. As expected, addition of might have positive impact on osteodifferentiation [1,2].

Conclusions: Our preliminary data demonstrate that it was possible to fabricate a PLGA-HA composite biomaterial for 3D printing by FDM. Materials showed favorable properties and relevant cellular response for bone tissue engineering applications. Our next evaluations will focus on osteoblastic gene expression characterization and implantation in a critical calvaria defect model in rat to assess bone regeneration potential of developed materials.

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