Bioprinting of Biomimetic Nano-Hydroxyapatite Functionalized Bioinks for Bone Tissue Engineering

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Abstract

Recently, the conventional concept of bone tissue engineering has shifted toward biomimetic approaches in which materials, biology and technology are integrated to recapitulate the complexity of bone tissues, allowing fabrication of patient-specific and anatomically shaped constructs. Thus, the whole concept of the scaffold in terms of design, architecture and fabrication technology is moving toward 3D bioprinting of hydrogels functionalized with tissue-mimicking components.

The current study aimed to bioprint human bone marrow-derived mesenchymal stem cells (hBMSC) in GelMA bioink, photopolymerized through lithium phenyl-2,4,6-trimethylbenzoylphosphinate (LAP), able to absorbs light and perform a crosslinking reaction in the visible region, producing benefits over the commonly used UV photo-initiators, functionalized with two chemically and morphologically different types of nano-hydroxyapatite (nHA), to provide cells with proper cues to form bone-like matrix and evaluate their effects on the bioprinting process. The nHAs were characterized utilizing X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), thermo-gravimetric analysis (TGA), induced coupled plasma (ICP) and scanning electron microscopy (SEM-FEG). Printability of GelMA/nHAs inks was evaluated and the best crosslinking method assessed, then cells viability, proliferation and differentiation evaluated by live/dead stain, CCK8 proliferation kit and immunohistochemistry. The results of the live/dead stain and CCK8 confirmed the viability of the cells and the ability of the cells to proliferate in the bioinks, while the immunohistochemistry showed proof of differentiation even if not specifically related to the nHAs presence.

The addition of both nHAs to GelMA system resulted to enhance the printability and stability of the structures. The use of LAP as photointiator with high energy visible light maintained high cell viability and proliferation and structural stability, thus holding great promises for 3D bioprinting of hBMSC for bone tissue engineering.

Biography

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