Engineering and Evaluation of 3D Printed and Bioprinted Novel Photocuring Polymer Composite Scaffolds for Bone Tissue Regeneration

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The regeneration of bone defects caused by trauma, fracture, and disease is a significant clinical challenge for patients in the United States and around the world. Annually, the cost for bone fracture repair exceeds $19 billion and costs are projected to increase by 50% in 2025. The ideal scaffold for bone repair should provide biocompatibility, pore architecture, biodegradability, mechanical support, and cell attachment sites. Conventionally fabricated polymer scaffolds are still unable to make ideal scaffolds for bone repair. In this study, new 3D printing technology was used to print porous scaffolds using poly(ethylene glycol) methacrylate (PEGMA), methyl cellulose, and nano- hydroxyapatite (nHA) as the main components. The hypothesis of this study is to engineer 3D bioprinted porous scaffolds that can mimic porosity, pore morphology, mechanical properties, biocompatibility, and cell attachment and growth similar to human bone. Polymer scaffolds with a pore size of 1000 μm were designed using computer software. These scaffolds were printed and cured using a UV-visible light energy in 3D printer. These scaffolds were characterized for structural analysis, and pore morphology using Fourier Transform Infra Red (FTIR) Spectroscopy, and Scanning Electron Microscope (SEM), respectively. Scaffolds were also evaluated for cell viability, and cell proliferation with murine osteoblasts. The scaffolds show biocompatibility and cell proliferation as determined by in vitro Live/Dead cell assay. These scaffolds also showed mechanical properties similar to human bone. Potentially 3D printed porous scaffolds can be used for bone tissue regeneration applications.

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