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A 3D Bioprinting System for Engineering Cell-Embedded Hydrogels by Digital Light Processing

Authors : Jimmy Jiun-Ming Su, Yuan-Min Lin

Abstract : Bioprinting has been applied to produce 3D cellular constructs for tissue engineering. Microextrusion printing is the most common used method. However, printing low viscosity bioink is a challenge for this method. Herein, we developed a new 3D printing system to fabricate cell-laden hydrogels via a DLP-based projector. The bioprinter is assembled from affordable equipment including a stepper motor, screw, LED-based DLP projector, open source computer hardware and software. The system can use low viscosity and photo-polymerized bioink to fabricate 3D tissue mimics in a layer-by-layer manner. In this study, we used gelatin methylacrylate (GelMA) as bioink for stem cell encapsulation. In order to reinforce the printed construct, surface modified hydroxyapatite has been added in the bioink. We demonstrated the silanization of hydroxyapatite could improve the crosslinking between the interface of hydroxyapatite and GelMA. The results showed that the incorporation of silanized hydroxyapatite into the bioink had an enhancing effect on the mechanical properties of printed hydrogel, in addition, the hydrogel had low cytotoxicity and promoted the differentiation of embedded human bone marrow stem cells (hBMSCs) and retinal pigment epithelium (RPE) cells. Moreover, this bioprinting system has the ability to generate microchannels inside the engineered tissues to facilitate diffusion of nutrients. We believe this 3D bioprinting system has potential to fabricate various tissues for clinical applications and regenerative medicine in the future.

Keywords : bioprinting, cell encapsulation, digital light processing, GelMA hydrogel
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