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Biologically active and mechanically improved composite core-shell hydrogel for 3D bioprinting

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Introduction: Despite recent advances in hydrogels for 3D bioprinting, one remaining challenge is the lack of hydrogels with biological and mechanical properties that mimic human tissues. Here we have developed a novel core-shell composite hydrogel which has a mechanically robust shell and an ECM (extracellular matrix)-like core to achieve both optimal biological and mechanical properties in bioprinted tissue replacements.

Methodology: The hydrogel which makes the shell of the composite was made by mixing alginate and poly(ethylene glycol) diacrylate (PEGDA) to endow the hydrogel with improved mechanical properties. This alginate/PEGDA hydrogel was then combined with a biologically active hydrogel that supports cell functions in a core-shell configuration. The core-shell composite hydrogel strand was formed in a 3D bioprinting process which laid down the hydrogel strand layer-by-layer to form 3D cell-laden constructs. The cell viability and functions of various cell types in the bioprinted constructs were measured.

Results: Addition of PEGDA to alginate synergistically improved the mechanical properties of the hybrid hydrogel in a composition-dependent manner. We have also demonstrated the printability of the core-shell composite hydrogel into complex 3D structures. Various cell types encapsulated within the composite core-shell hydrogel demonstrated sustained high cell viability and function for two weeks.

Conclusions: We have developed a core-shell composite hydrogel that can be used in 3D bioprinting to form complex 3D structures with high cell viability and functions.

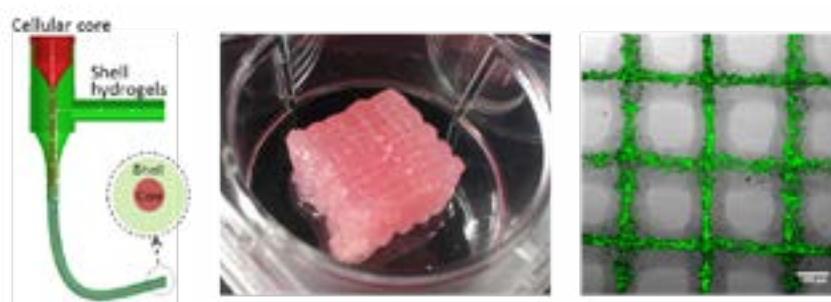


Figure 1: Core-shell composite hydrogel for 3D bioprinting of cellular constructs.

Biography

J Yang has completed his PhD from University of Nottingham, UK. He is currently an Assistant Professor in the School of Pharmacy at the same University. He has published 23 papers in peer-reviewed journals and was invited to present his work at international and national conferences in 3D Bioprinting. His research interest includes: Bioprinting, Tissue Engineering and Regenerative Medicine and Biomaterials.

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