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Abstract

Biomimetic 3D bioprinting of cellular laden nanocomposite scaffold through co-axial and core-co-cultured structure

Fahimeh Shahabipour
National Cell Bank of Iran, Pasteur Institute of Iran, Tehran, Iran

Abstract:

There is a need to recapitulate the native complexity of bone structure within engineered 3D structures with tailored biological and mechanical properties. In this study, we suggest an innovative cell-printing process, supplemented with core/shell nozzle and co-cultured/mono-cultured methods, to achieve 3D osteon-like structures through cell-laden bioinks using an extrusion-based 3D bioprinter in one-step. In this study, vascularization promoting and osteogenic bioinks were developed based on different concentration of Gel-MA-alginate hydrogels with the incorporation of hydroxyapatite nanoparticles. These hydrogels were chosen due to their suitable mechanical stability, swelling ratio, and printability. To obtain a core/shell osteon-like structure (CSBP), we used a vascularization bioink combined HUVECs in the core region, and used osteogenic- MC3T3-E1 cells-laden bioinks in the shell region. Pure gelatin was concentration in all bioinks to support both of core and shell structures during 3D bioprinting. Core-co-cultured osteon-like structure (CCBP) was fabricated through co-culturing of HUVECs and MC3T3 cells within bioink in the core region. Mono-cultured printed structure composed of single cell lines served as a control. The fabricated 3D-core-cocultured of HUVECs-MC3T3 cells showed significantly higher cell viability (84%) compared to that (78%) of a 3D-core/shell of HUVECs/MC3T3 cells. Both fabricated structures exhibited outstanding cell viability in comparison with (65%) of mono-cultured 3D cell-laden scaffold (control). In addition, significant increases in osteogenic properties were observed in the co-culture samples versus the mono-culture controls. We demonstrated that both co-culture configurations were able to promote mineral deposition in the absence of exogenous osteogenic factors. Although the CSBP configuration displayed less viability than CCBP, this structure still exhibited good osteogenic and angiogenic properties. In conclusion, this investigation provided highlighted the potential of both structures as biomimetic bone scaffolds for complex bone tissue and other tissue engineering application.

Biography:

AAMER NAZIR has completed his PhD at the age of 30 years from National Taiwan University of Science and Technology (NTUST), and Postdoctoral Studies from High Speed 3D Printing Research Center (HS3DPRC), NTUST, Taipei, Taiwan. He is presently working as Assistant Professor in the HS3DPRC, NTUST, Taiwan. He has published more than 08 papers in reputed journals and has been serving as a reviewer of some reputed journals.

Publication of speakers:

1. Fahimeh Shahabipour et al;Exosomes as nanocarriers for siRNA delivery: paradigms and challenges, 2016 Oct 24.
2. Fahimeh Shahabipour et al; Exosomes: Nanoparticulate tools for RNA interference and drug delivery 2017 Jan 31.
3. Fahimeh Shahabipour et al;Relationship between Dyspnea Descriptors and Underlying Causes of the Symptom; a Cross-sectional Study, 2017 Mar 19.
4. Fahimeh Shahabipour et al; Z□r Spirit Possession in Iran and African Countries: Group Distress, Culture-Bound Syndrome or Cultural Concept of Distress?, 2015 Sep; 10.
5. Fahimeh Shahabipour et al; Oscillatory dynamics of cortical functional connections in semantic prediction, 2019 Apr 15

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