Transactions on Additive Manufacturing Meets Medicine
Trans. AMMM, 2024, Vol. 6, No 1, Suppl. 1, Article ID 1849, 1 Page

Abstract

Direct ink writing of highly loaded polycaprolactone-barium titanate/bioactive glass composites for osteochondral tissue engineering

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Osteochondral defects are caused by injury or morphological change of the cartilage due to osteoarthritis. Current clinical treatments still face enormous challenges. The field of osteochondral tissue engineering aims to provide solutions for the repair of joint damage. As articular cartilage has a complex and hierarchical structure, a monophasic material is not sufficient for osteochondral repair. Therefore, the trend moves towards multiphasic and gradient materials [1]. Our research aims to develop an additive manufacturing process for multiphasic scaffolds addressing the needs of each segment of the osteochondral area. In this study, we focus on the fabrication using direct ink writing (DIW) and characterization of subchondral bone scaffolds made of highly loaded Polycaprolactone (PCL) with different fillers, such as barium titanate (BTO) and the bioactive glass 45S5 (BG). Different compositions are used to tailor the materials' piezoelectric, mechanical and bioresponsive properties. By adding BTO, the piezoelectric and mechanical properties of spongy bone could be achieved, while the addition of BG increased the bioactive and osteogenic potential of the composite scaffolds compared to pure PCL. In summary, these novel material compositions provide a promising approach for developing multiphasic scaffolds for osteochondral tissue engineering.

Author's statement

Conflict of interest: Authors state no conflict of interest. Animal models: No animal experiments were conducted. Ethical approval: The research related to human use complies with all the relevant national regulations, institutional policies and was performed in accordance with the tenets of the Helsinki Declaration, and has been approved by the authors' institutional review board or equivalent committee. Local Ethical Committee approval number: 2010-10. Informed consent: Informed consent has been obtained from all individuals included in this study.

Acknowledgments: Research funding: This study is funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) —SFB 1270/1,2-299150580.

References

[1] Zhou L, Gjvm VO, Malda J, Stoddart MJ, Lai Y, Richards RG, Ki-Wai Ho K, Qin L. Innovative Tissue-Engineered Strategies for Osteochondral Defect Repair and Regeneration: Current Progress and Challenges. Adv Healthc Mater. 2020 Oct 26:e2001008. doi: 10.1002/adhm.202001008

DOI: 10.18416/AMMM.2024.24091849