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Abstract

Development and characterization of a gradient scaffold for osteochondral defects

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Osteochondral defects arising from trauma or degenerative changes in osteoarthritis present significant treatment challenges. Current therapies often fail to fully restore the complex, hierarchical structure of native joint tissue. To address these limitations tissue engineering approaches to osteochondral defect repair have shifted toward multiphasic and gradient designs [1]. Gradient designs offer smoother transitions between bone and cartilage. This enhances force distribution across the scaffold and minimizes interface instabilities, reducing the risk of delamination [2]. In this study, gradient scaffolds featuring a polycaprolactone (PCL) subchondral bone phase and a cartilage phase composed of a hydrogel blend of alginate-dialdehyde and gelatin (ADA-GEL) were 3d-printed. The scaffolds were tested under different loads to assess the mechanical properties, showing the mechanical integrity of the interface between the subchondral and chondral parts. In an in vitro co-culture of human mesenchymal stem cells (hMSCs) used in the subchondral part and primary human chondrocytes used in the cartilage part the biological performance of the gradient osteochondral scaffolds were anaylsed, showing promising osteogenic and chondrogenic responses.

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 1270/1-299150580.

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