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THE EFFECT OF PORE ARCHITECTURE ON CELL-ECM FORMATION IN HYDROXYAPATITE BONE SCAFFOLDS IN 3D PERFUSION CULTURE

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Calcium phosphate-based scaffolds with porous structures similar to natural bone are frequently used in bone tissue engineering. The current challenge to further improve their performance is focusing on the optimization of their 3D structure with additive manufacturing allowing to produce scaffolds with a high degree of local control on the internal pore architecture. This allows to balance the biological requirements with the biomechanical ones, such as is the case for gradient porous scaffolds (GPS) which are porous structures where the porosity changes in space with a specific gradient. To properly test the effectiveness of scaffold architecture on drawing in cells and guiding neotissue formation in vitro, an environment similar to the physiological conditions is needed. In spite of ample studies showing the importance of pore gradient in conventional in vitro models, much less research has been done on the performance of GPS biomaterials in a dynamic 3D culture environment.
Therefore, this study investigated the influence of pore architecture on cell proliferation and matrix deposition. Immortalized bone marrow mesenchymal stem cells were seeded on additive manufactured CaP scaffolds and cultured for up to 21 days in 3D perfusion bioreactor. Live/Dead staining of the construct was performed to show the presence of live cells. Contrast-enhanced nanoCT imaging was used to visualize the neotissue (cells + extracellular matrix) formed inside the scaffold.
This study provides a quantitative insight into the spatial gradient of scaffold’s pore architecture and confirms the influence of perfusion bioreactor system for the in vitro development of 3D cell–carrier constructs.

Keywords
Calcium phosphates; Pore architecture; 3D perfusion culture