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Abstract

Production, Characterisation, and In Vitro Evaluation of 3D Printed PCL/HANp/PEGDA Scaffold for Bone Regeneration †

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Reconstruction of bone defects with mechanical integration with the original surrounding bone tissues is essential for a patient's rehabilitation. In this research, a novel approach is explored to produce synthetic bone grafts mimicking the complex bone structure using additive manufacturing, comprising the construction of 3D scaffolds. For this purpose, three types of scaffolds were produced and tested: one using a thermoplastic polymer, polycaprolactone (PCL), another using a combination of PCL and hydroxyapatite nanoparticles (HANPs), and the third using a combination of the two materials and polyethylene glycol diacrylate (PEGDA). After production, optimisation, and characterisation of the scaffolds, an in vitro evaluation was performed with human dental pulp stem cells (hDPSCs).

According to the results, the scaffolds were produced successfully, presenting interconnected channel networks and good geometric accuracy. Regarding the mechanical behaviour, the results demonstrate that the addition of HANPs seems to have improved the compressive rigidity of the scaffolds. After analysis of the in vitro tests, it was verified that the PCL/HANp/PEGDA-based scaffolds presented superior cell proliferation when compared to the other groups.

This study demonstrates that PCL/HANp/PEGDA scaffolds associated with hDPSCs are a very promising therapeutic system in critical fracture treatment, to accelerate and improve bone regeneration. The research of this system's performance in critical bone defects is an important step to its progression to clinical applications.

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