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3D-PRINTED SCAFFOLDS FOR ENHANCED CELL ADHESION AND OSTEOGENESIS

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Abstract: Bone tissue represents the second most frequently transplanted tissue, posing a significant challenge in regenerative medicine due to the clinical drawbacks of current grafting standards. The field of biotechnology is capable of addressing these challenges through the development of biomimicking scaffolds that act not only as mechanical support but also as biointeractive systems, able to simulate the cellular microenvironment. Central to this evolution is 3D printing technology, which enables the fabrication of customized, porous architectures that replicate the hierarchical complexity of human bone .

• Introduction

Bone tissue regeneration remains a major challenge in regenerative medicine [**1,2**] due to the limitations of conventional grafting approaches. 3D-printed biomimetic scaffolds offer a promising solution by replicating the hierarchical structure of bone and supporting enhanced cellular responses.

• Materials and methods

Scaffolds were fabricated using 3D printing technology with biocompatible polymers. Surface modification was performed to tailor micro-scale roughness and optimize the scaffold's topographical features. A bioactive coating, containing osteoinductive molecules, was subsequently applied to enhance cell–material interactions. The scaffolds were characterized using high-resolution imaging, physicochemical analysis, and *in vitro* biological assays.

• Results and Discussion

The fabricated scaffolds (**Fig. 1**) exhibited well-defined porous architectures and highly promising structural characteristics. Surface characterization confirmed that the desired nano-roughness was successfully achieved and the coating was uniformly and effectively deposited onto the scaffold structure. These initial morphological results strongly indicate that the combination of 3D printing and surface biofunctionalization has effectively led to scaffolds for future biological evaluation.

Fig. 1: Porous scaffolds monitored through microscopy

• Conclusions

The successful fabrication of 3D-printed scaffolds with tailored surface properties shows strong potential for bone tissue engineering applications. While cell responses are yet to be evaluated, the optimized surface engineering—including the achieved nanoroughness and uniform coating—provides an ideal foundation for promoting future osteogenesis. Overall, the adopted approach represents a highly promising strategy for the development of next-generation bioactive implants.

References:

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