

Hybrid scaffold for bone engineering

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Introduction

The advancement of tissue engineering strategies has led to the development of hybrid scaffolds combining biomaterials, which are designed to enhance bone regeneration [1]. The aim of this study was to develop a multilayer hybrid scaffold composed of an electrospun and 3D printed polymeric structure and a bioceramic encapsulated in a hydrogel for bone regeneration.

Methodology

The scaffold, comprising the hydrogel alginate, a bioceramic and polymer polycaprolactone (PCL), was produced using 3D printing and electrospinning techniques [2]. The viability of stem cells on scaffolds and their osteogenic differentiation was evaluated using the MTT assay and alizarin red S, respectively. Rat calvaria bone regeneration was examined post-lesion, comparing natural healing to a scaffold comprising 6% alginate, 1% BC and PCL processed by 3D printing and electrospinning.

Results

The results indicated that there were statistically significant differences in stem cell viability between the 1% and 6% alginate groups ($p < 0.01$), with absorbance means and standard deviation of 0.025 ± 0.007 and 0.072 ± 0.004 , respectively. Osteogenic differentiation was confirmed by alizarin red staining. *In vivo* tests on rat skull caps demonstrated enhanced tissue integration with the hybrid scaffold, as evidenced by increased bone formation compared to the control group, observed in both macroscopic and histological analyses.

Conclusions

In conclusion, the development involved the combination of various biomaterials to establish a multilayer scaffold. To enhance bone regeneration, a composite scaffold was developed, merging calcium alginate hydrogel, a bioceramic, and PCL processed via 3D printing and electrospinning. The increased rigidity of this hybrid system, compared to individual materials, supports its use in bone tissue engineering because it allows for the creation of a hybrid scaffold with properties superior to those of the individual biomaterials. The constructed structure fosters a three-dimensional environment conducive to the

survival of mesenchymal stem cells *in vitro*. *In vivo* analyses indicate that this scaffold possesses the potential to serve as a viable platform for bone tissue engineering. Consequently, the scaffold system holds considerable promise in the cultivation of stem cells to emulate native bone tissue, a feat that could be instrumental in facilitating tissue restoration within the domain of regenerative medicine.

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References

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