The Effect of 3D Peptide Hydrogel Scaffold Stiffness on Osteoblast Proliferation and Differentiation for Bioengineering Applications

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While bone diseases may not receive as much attention as heart disease, cancer, and other serious illnesses, they account for more than half a million hospitalizations and the annual placement of nearly 180,000 individuals into nursing homes. Several metabolic and oncogenic bone diseases are characterized by abnormalities in bone formation caused by interruptions in the proliferation and differentiation of osteoblasts (OBs). Therefore, this study paves the way to finding a more promising approach to bone diseases than the existing treatments. To mimic the ECM, the IIZK-based hydrogel was used as a body-like material for 3D tissue culturing and bioprinting scaffolds with high shape fidelity and enabling long-term OB survival. The following procedures were followed during the experimentation: matrix stiffness analysis, cell subculturing, 3D tissue culturing, and 3D bioprinting. To ensure accurate results, each step was repeated three times. According to the rheology study, the results suggest a positive relationship between peptide concentration and hydrogel stiffness. Additionally, per the viability and proliferation results, OBs survived in all hydrogel concentrations: 2mg/mL, 4mg/mL, and 6mg/mL over a two-week testing duration. The cytoskeleton staining results show clear signs of OB differentiation into osteocytes through morphological transformations. The proliferation and differentiation of cultured OBs point to the strong potential of the IIZK peptide bioink for 3D bioprinting and bone tissue engineering. This study may be implemented in procedures such as bone remodeling, bone reconstruction, and finding a potential cure for degenerative and inflammatory diseases through bone and tissue transplantation.

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