Hydrogel-based 3D bioprinting: for bone and cartilage tissue engineering

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Abstract

As a milestone in soft and hard tissue engineering, a precise control over the micropatterns of scaffolds have lightened new opportunities for the recapitulation of native body organs through 3D bioprinting approaches. Well-printable bioinks are prerequisites for the bioprinting of tissues/organs where hydrogels play a critical role. Despite the outstanding developments in 3D engineered microstructures, current printer devices, suffer from the risk of exposing loaded living agents to mechanical (nozzle-based) and thermal (nozzle-free) stresses. Thus, tuning the rheological, physical, and mechanical properties of hydrogels are promising solutions to address these issues. The relationship between the mechanical characteristics of hydrogels and their printability is important to control printing quality and fidelity. Recent developments in defining this relationship have highlighted the decisive role of main additive manufacturing strategies. These strategies are applied to enhance the printing quality of scaffolds and determine the nurture of cellular morphology. In this regard, it is beneficial to use external and internal stabilization, photo curable biopolymers, and cooling substrates containing the printed scaffolds. The objective of this study was to review cutting-edge developments in hydrogel-type bioinks and discuss the optimum simulation of the zonal stratification in osteochondral and cartilage units.

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