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Novel biomaterials to prevent periprosthetic joint infection

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3D printing aims to deliver intricate biomedical devices based upon advanced diagnostic imaging. With the current upsurge in public interest and increasing access to low-cost printers, efforts are underway to produce patient-specific anatomical models, customized implants and individualized instrumentation. Examples include the development of disposable surgical saw guides and cutting blocks in total knee arthroplasty. These devices help minimize tissue loss and optimize the native biomechanics of the patient. This review explores the evolution of 3D (Three-Dimentional) printing technology in the context of biomaterials. It also aims to critiques the major challenges ahead in optimizing bio-inks and biologic performance in bringing 3D bioprinting to clinical practice. Common materials include metals, bio ceramics, synthetics and natural polymers, each have specific mechanical properties, processing methodology and cell-material interaction. Biofunctional biomaterials are an emerging class of materials that display adaptability and activity at every phase of bone growth. These biomaterials have been shown to promote osteogenic differentiation, improve Calcium Phosphate (CaP) precipitation and regulate osteoblast gene expression. When crafted to emulate the specific micro-environment of bone, polymer-surface modifications accelerate bony ingrowth. 3D printing holds promise as a scaffold for bone regeneration as precise control of the overall geometry and internal porous structure. The accompanying biomaterials may be successfully embedded within multi-cellular co-cultures and specific growth factors modulated to optimize growth and fixation. Bio ceramics such as Hydroxyapatite (HA), calcium phosphate and bio glass are osteogenic and promote cell proliferation, though they have been shown to lack appropriate mechanical strength. Composite scaffolds of HA and tricalcium phosphate and Polycaprolactone (PCL)-HA with carbon backbones have been investigated to optimize biocompatibility and architecture to improve the porosity and mechanical strength of these constructs. Furthermore, microscale manipulation of biomaterials allows for integration of antimicrobial properties to combat infection.

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