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Investigation on 3D Printing of Calcium silicate Bioceramic Slurry for Bone Tissue Engineering

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Abstract : The state of the art in major 3D printing technologies, such as powder-based and slurry based, has led researchers to investigate the ability to fabricate bone scaffolds for bone tissue engineering using biomaterials. In addition, 3D printing technology can simulate mechanical and biological surface properties and print with high precision complex internal and external structures that match their functional properties. Polymer matrix composites reinforced with particulate bioceramics, hydrogels reinforced with particulate bioceramics, polymers coated with bioceramics, and non-porous bioceramics are among the materials that can be investigated for bone scaffold printing. Furthermore, it was shown that the introduction of high-density micropores into the sparingly dissolvable CSiMg10 and dissolvable CSiMg4 shell layer inevitably leads to a nearly 30% reduction in compressive strength, but such micropores can easily influence the ion release behavior of the scaffolds. Also, biocompatibility tests such as cytotoxicity, hemocompatibility and genotoxicity were tested on printed parts. The printed part was tested in vitro, and after 24-26 h for cytotoxicity, and 4h for hemocompatibility test, the CSiMg4@CSiMg10-p scaffolds were found to have significantly higher osteogenic capability than the other scaffolds of implantation. Overall, these experimental studies demonstrate that 3D printed, additively-manufactured bioceramic calcium (Ca)-silicate scaffolds with appropriate pore dimensions are promising to guide new bone ingrowth.

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