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3D Printed Bioceramics for Personalized Drug Loaded Osteoconductive Bone Implants

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Introduction: 3D printing reveals opportunities for the fabrication of personalized bone grafts and applications in bone regeneration [1]. Patient-specific 3D printed implants can be produced from computed tomography datasets with complex geometries and full functionalities. However, the incorporation of active pharmaceutical ingredients into 3D printed scaffolds represents a challenge as drug stability and activity, appropriate drug loading capacity and desired controlled release profiles need to be attained [2].
Aims: The aim of this study was to develop a novel 3D drug delivery system combining powder-binder jetting based 3D printing of bioceramics with controlled drug release of simvastatin.
Methods: An industrial powder printer Voxeljet (VX200, Voxeljet AG, Friedberg, Germany) was used to 3D print the bioceramic materials. Bioceramics consisted of porous beta-tricalcium phosphate (β-TCP) granules (Degradable Solutions AG, Schlieren, Switzerland). For drug incorporation β-TCP granules were coated with poly(D,L-lactide-co-glycolide) containing the drug simvastatin as previously described [3]. Drug loading and *in vitro* drug release were measured by an UPLC-MS method.
Results: Bone implants were generated by digitally-controlled layer-by-layer deposition of bioceramic materials under low temperature conditions to create freeform geometries with adequate mechanical stability. Drug loading was achieved by incorporating simvastatin into the polymer coating of the TCP granules, which served as starting material for the 3D printing process. Implant properties were optimized by varying binder to active substance composition. Simvastatin was released *in vitro* from bone grafts in its bioactive form, simvastatin acid, over the course of several weeks.
Conclusions: 3D printed bioceramic bone grafts hold promise as combinatory 3D drug delivery system to improve osteoconductive and eventually osteoinductive scaffolds properties. Further, cell assays and preclinical evaluation will be needed to elucidate its potential for personalized treatments and its applicability for the delivery of drugs to bone tissue.

Keywords: powder-binder jetting based 3D printing, drug delivery systems, bioceramics, bone implants, osteoconductive.

References:
[1] Brunello G et al. Biotechnol Adv 2016 Sep-Oct; 34(5): 740-53.
[2] Moulton SE, Wallace GG. J Control Release 2014 Nov 10;193: 27-34.
[3] Luginbuehl V et al. J Biomed Mater Res B 2010 Feb; 92(2):341-52.
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