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Abstract

Design and Additive Manufacturing of Biodegradable Patient-Specific Implants for Bone Regeneration

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Critical-sized bone defects due to trauma, infection, or tumour resection are defined as the smallest defect that will not heal over one's lifetime without (surgical) treatment [1]. Despite multiple innovations in the 21st century, current treatment options have significant limitations and there is a strong demand for clinically translatable treatment alternatives, such as scaffold-guided bone regeneration (SGBR) [2]. Our interdisciplinary team has studied tissue engineering applications with biodegradable 3D-printed scaffolds for critical-sized bone defects over the last 17 years in pre-clinical trials and demonstrated successful bone regeneration [3–5]. These findings were recently translated into a clinical setting, and we were able to provide bespoke SGBR solutions for selected patients in Australia and Germany who suffered critical-sized bone defects of 10 to 34 cm [6,7]. The scaffolds were designed in close collaboration with the treating surgeon and prototyped in-house using fused filament fabrication with polylactic acid (PLA) and finally 3D-printed using medical-grade polycaprolactone tricalcium phosphate, sterilized, and shipped to the hospital by a certified supplier. Here, we are presenting the design process from the computed tomography images to the final prototype along with its challenges and resulting opportunities for a series of clinical cases where a patient-specific 3D-printed scaffold was required.

AUTHOR'S STATEMENT

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