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Abstract

A clinician-friendly patient-specific scaffold design suite for treating bone defects

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3D-printed biodegradable Scaffold Guided Bone Regeneration (SGBR) has shown promise in pre-clinical and clinical studies for patient-specific reconstruction of large bone defects. However, its widespread clinical adoption is partially hindered by the lack of a streamlined, cost-effective, and user-friendly system for scaffold design and manufacturing. In our preliminary work [1][2], a semi-automated digital workflow for scaffold design was developed in the Rhino3D-Grasshopper software. While the workflow was validated in two complex clinical cases it is currently only usable by someone with computer aided design (CAD) expertise and warrants the development of a surgeon-friendly solution.

Clinical adoption requires both an intuitive software interface and a manufacturing system suitable for clinical settings. In collaboration with surgeons and a 3D printing company, we are developing a standalone software that enables surgeons without CAD expertise to design patient-specific scaffolds via a guided, step-by-step interface. Beginning from a segmented digital bone defect model, the software guides the surgeon to virtually resect the defected region and replace it with a porous scaffold based on the Voronoi structure (which mimics natural bone) while making allowance for scaffold fixation via nail or plate. The average design time is reduced, and the designs are compatible with a compact cleanroom 3D printer. Here, we present the first software prototype, to be tested on 15 retrospective clinical cases and assessed for ease of use, design time, and efficiency.

The streamlined design and manufacturing workflow has the potential to provide a fully independent software solution for real-time clinical applications.

AUTHOR'S STATEMENT
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