Optimizing neovascularization of biomimetic implants for repair of large craniofacial defects
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Clinical challenge: The ideal reconstructive implant should be a biomimetic reproduction of the matrix of native bone, fashioned into defect-specific geometry.

This project investigates the utility of hydroxyapatite tricalcium phosphate implants in promoting bone repair and regeneration in a murine calvarial defect model; developing a CT-guided computer aided design microprinter to machine customized defect-specific implants and investigating mechanisms to augment implant osteoinduction, osteoconduction, and osteointegration by optimizing neovascularization. We first establish a critical size defect and test the fidelity of custom porous stacked lattice implants. Subsequently, we aim to heal the critical size defect with angiogenic copper biomaterial technology, vasculogenic progenitor cell seeding, and a novel vacuum assisted scaffold perfusion system.

Current resorbable implant technology has limited bone in-growth and heals only small intercalary defects. By augmenting neovascularization, for the first time, we will be able to repair large craniofacial bone defects. Furthermore, our technology is scalable to enable high throughput production for patient care.