Fall 2023 Joint Colloquium
Materials Department & Materials Research Laboratory

Marley Dewey, PhD

UCSB
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Engineering Biomaterials and Matrix Signals to Repair Large-Scale Bone Defects

Biomaterial strategies to repair craniomaxillofacial (CMF) defects, or large-scale bone defects, require materials which can provide structural support, resist infection, and provide cellular signals to promote bone formation. Mineralized collagen scaffolds are biomaterials capable of regenerating bone in small animal models; however, like many biomaterials, struggle to repair large-scale defects in clinically-relevant models (porcine). To improve repair of CMF defects using mineralized collagen scaffolds, we take a close look at the material and mechanical properties of biomaterial scaffolds to create a more biomimetically similar material and overcome challenges of large-scale bone repair. Specifically, we tailor porosity and pore orientation of the scaffold, and manipulate mechanics and degradation speed with various 3D-printed biomaterials and print designs. Through the creation of anisotropic pores, and incorporating shape-fitting Voronoi structures, we can improve the ability of scaffolds to repair bone. Furthermore, one of the primary principles of tissue engineering is incorporating signaling elements within biomaterials to guide cell behavior. Extracellular vesicles (EV), nano-scale lipid vesicles secreted by all cells, represent a source of cell-signaling cargo which can influence cell behavior. We examine the role of EV in bone repair and regenerative medicine applications, including the role of a new class of extracellular vesicle, matrix-bound nanovesicles (MBV), located within the extracellular matrix. Future work aims to combine biomaterials with a diverse population of EV to guide cell behavior and bone repair in CMF defects, as well as other skeletal repair problems such as implant infection and bone cancer.

Bio

Dr. Marley Dewey recently joined the Bioengineering Department at UCSB in Fall 2023 as an Assistant Professor. Dr. Dewey earned her B.S. in Chemical Engineering from the University of Maine and her Ph.D. in Materials Science and Engineering from the University of Illinois Urbana-Champaign. During her graduate career, she was a National Science Foundation Graduate Research Fellow, won various image of research contests, and was awarded the Annual Innovation Award for Outstanding PhD Thesis (University of Illinois). As a graduate student in the laboratory of Dr. Brendan Harley, she modified the mechanical, immunological, osteogenic, and antimicrobial properties of mineralized collagen scaffolds for enhanced repair of large-scale, craniomaxillofacial bone defects. After her graduate career, she was a postdoctoral NIH TL1 Clinical and Translational Science Fellow in the laboratory of Dr. Stephen Badylak at the McGowan Institute for Regenerative Medicine at the University of Pittsburgh. As a postdoc, she worked on understanding the biology behind a novel class of extracellular vesicles, termed matrix-bound nanovesicles, and the use of

these as a therapy for glaucoma and optic nerve repair. Dr. Dewey's lab combines biomaterials with extracellular vesicles for skeletal repair and disease treatment, including broader impacts.

https://bioengineering.ucsb.edu/news/all/2023/new-faculty-member-dr-marley-dewey-joins-ucsb-bioengineering

Hosted by Angela Pitenis