Department of Biomedical Engineering
UNIVERSITY OF WISCONSIN–MADISON

Spring 2024 Seminar Series

Personalized Approaches to Reconstructive Skeletal Surgery

David Dean, PhD
Principal Investigator
Osteo Engineering Laboratory
The Ohio State University

More and more planning and conducting of reconstructive skeletal surgery is moving from the mind's eye to computers where one can plan procedures, design and produce surgical aids (e.g., cutting guides, drill guides) and design and produce implantable devices (e.g., skeletal fixation) that improve peri-operative and long term outcomes. Current Virtual Surgical Planning (VSP) software used for these procedures commonly starts with 3D CT images of the relevant anatomy. The Osteo Engineering Laboratory (OEL) is extending its VSP environment to optimize device design via simulated performance (e.g., bone grafts, both autologous and tissue engineered, skeletal fixation devices, and vascularization devices). The OEL currently uses vat photopolymerization (i.e., solid-cured, 3D polymer printing), as well as biofabrication techniques such as the chaotic printing of cell-laden hydrogels and melt electrowriting of thin membrane biotextiles, to create form-fitting bone grafts and microvasculature. The OEL also studies the use of tethered ligands versus freely circulating whole cytokines as a potential means to more accurately control growth factor dose and distribution. Finally, the OEL is exploring the use of machined and 3D printed NiTi and resorbable Mg alloys to produce stiffness-matched, partially resorbable, skeletal fixation devices to avoid stress shielding-induced bone loss and stress concentration-induced device failure. All of these technologies offer the possibility of incorporation in Point-of-Care Manufacturing workpaths.

ABOUT the SPEAKER

I have been an Associate Professor with tenure at The Ohio State University (OSU; Columbus, OH) since 2013 and currently have faculty appointments in the Departments of Materials Science and Engineering (College of Engineering) and Plastic and Reconstructive Surgery (College of Medicine). At OSU I direct the Osteo Engineering Laboratory (OEL). The OEL focuses on the design and fabrication, including point-of-care manufacturing, of devices for reconstructive skeletal surgery. Those devices currently include 3D printed metallic CMF (craniomaxillofacial) skeletal fixation, bone tissue engineered devices with tethered ligands, and biofabricated microvasculature. My appointment transferred to OSU after nearly 20 years (1994-2013) at Case Western Reserve University (CWRU; Cleveland, OH) where my primary appointment had been in the Department of Neurological Surgery (School of Medicine). I lead the 3D printing curriculum at OSU. A course, "Biomedical Device AM" (available online), that I developed, is offered to upper level undergraduate and graduate students. I have supervised the research of more than 50 Postdoctoral and Doctoral student researchers and nearly two hundred undergraduate, medical, and dental students.

Thursday, May 9 | 9:30–10:15 am
1003 Engineering Centers (Tong Auditorium)