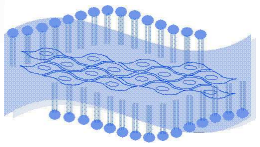
Center for Biologically Inspired Materials and Material Systems (CBIMMS)



Center for Biomolecular and Tissue Engineering (CBTE)

SEMINAR

Jeremy J. Mao, DDS, PhD
Director, Tissue Engineering Laboratory
Associate Professor, Bioengineering, Anatomy and Cell Biology and Orthodontics,
University of Illinois at Chicago

"Multi-lineage differentiation of mesenchymal stem cells and applications in regenerative medicine"

Contemporary medicine and dentistry each has two pillars: (i) to prevent and/or control disabling disorders, and (ii) to restore lost tissues and organs. The first pillar of contemporary medicine and dentistry is supported by the bulk of biomedical research in understanding the mechanisms of diseases and prevention. Hypothesis-driven research in mechanistic discoveries has yielded powerful insight in our understanding of diseases and pathological processes. By contrast, the second pillar of contemporary medicine and dentistry with the principal objective to regenerate lost tissues and/or organs from stem cells is supported by product-driven research in which understanding mechanisms is the means but not the end.

In early 1990s, tissue engineering emerged as a concept to regenerate biological tissues by ultimately seeding the patient's own tissue-forming cells in biocompatible polymers. Recent work in stem-cell based restoration of multiple tissue phenotypes by composite tissue constructs such as osteo-chrondral, fibro-osseous, and musculo-osseous grafts has offered clues for biological replacement of complex anatomical entities consisting of multiple cell lineages such as the synovial joint condyle, musculo-tendon complex, bone-ligament junction,
the teeth and the periodontium. Of greater significance is a tangible contribution by current attempts to restore the structure and function of complex, multi-tissue structures using stem cell-based composite tissue constructs to the understanding of bioengineered restoration of
complex organs such as the kidney or liver. Two examples will be provided in this seminar to demonstrate the current status of our knowledge regarding stem cell-based regeneration of a human-shaped articular condyle, and a generic fibro-osseous construct that may serve as the proof of principle for ligaments, tendons, cranial sutures, and the periodontal ligament. In each example, adult stem cell derived tissue forming cells are seeded or encapsulated in biocompatible and biodegradable polymer scaffolds tailored into given shape and dimensions
to accommodate target natural tissues. Ex vivo and in vivo approaches are coupled to manipulate cells and polymers in a reverse engineering process with an end goal that the tissue-engineered osteochondral and fibro-osseous tissues gradually approach the structural and mechanical properties of the target natural tissues. Our initial data further demonstrate that engineering composite biological tissues is associated with considerable challenges and an embedded intrinsic need for a wide range of interactions at all levels of biological organization (from single peptides to animal models) and engineering scales (from nano- to
macro-).

Thursday, Jan 27 – 203 Teer Building – 3:05–5:00 PM