Stevens Institute of Technology

Nanotechnology Graduate Program

Tissue Engineering by Integrating Stem Cells and Polymeric Biomaterials

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Regeneration of tissues that function as native replacements remains to be broadly realized. A common approach for tissue regeneration is cell delivery, including stem cells that are transplanted directly or as committed tissue progenitors. However, cell based therapy encounters several critical barriers in translation towards clinical therapeutics. Immune rejection, pathogen transmission, potential tumorigenesis, packaging/storage/shipping, and anticipated difficulties in clinical adoption, cost reimbursement and regulatory approval are among some of the roadblocks. Economic viability of cell delivery, especially if it requires substantial ex vivo cell manipulation, is far from trivial. I will present emerging data from my laboratory and others in several recent reports in Lancet, PNAS and Nature Biotechnology that chemotactic cell homing is responsible for the regeneration of multiple and, in some cases, complex tissues, such as dermal, muscle, dental, cardiac, cartilage and bone. Data from these independent reports suggest an emerging concept that single or complex tissues can regenerate by the homing of endogenous cell lineages and potentially without cell transplantation. A multitude of approaches will be discussed to orchestrate cell homing including active recruitment of host endogenous cells by chemokines, cytokines, drugs, polymeric materials and bioengineering models. We will further explore the potential and limitations of tissue regeneration by cell homing and contrast cell homing with cell delivery approaches. Information on the mechanisms of cell homing will be explored primarily by in vitro studies of cell migration, cell recruitment and cell motility in 2D and 3D models. Endogenous stem cells may accelerate clinical application of stem cell technology.

Dr. Jeremy Mao is Professor of Growth and Development and Biomedical Engineering at Columbia University, and also holds Zegarelli Endowed Chair at Columbia University Medical Center. He is the author of multiple books including “Translational Approaches in Tissue Engineering and Regenerative Medicine”. He is a fellow of American Institute of Biological and Medical Engineers, and recipient of several prestigious awards including Gies Award, Spanadel Award and Yasuda Award. His research interest is in the interface of biomaterials and stem cells, and applications in tissue engineering, having published over 160 scientific articles and given over 330 keynote and plenary lectures worldwide.

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