Department of Biomedical Engineering

SEMINAR

BIOMEDICAL ENGINEERING
TEXAS A&M UNIVERSITY

MAGICAL NANOSEEDS TO GROW BONE

Monday, Sept. 2
1037 Emerging Technologies Building
9:10 a.m.

Akhilesh K. Gaharwar, Ph.D.
Assistant Professor

Department of
Biomedical Engineering

Texas A&M University

With an aging U.S. population, the occurrence of injuries and degenerative conditions are subsequently on the rise. As a direct result, there is an increase in demand for therapies that are able to repair damaged tissues and produce replacement organs. In particular, there is a great need for new bioactive materials that can direct stem cell differentiation and facilitate the formation of functional tissues. Several types of bioactive material that have clinical relevance have been reported for musculoskeletal tissue engineering in the last few years including bioactive glasses, hydroxyapatite, tricalcium phosphate and bioglass. Difficulties persisting with many of these known materials include lack of osteoinductive properties, poor processing abilities, and insufficient degradation.

Here, we present bioactive nanoparticles based on synthetic silicate, which is cytocompatible and promotes in vitro osteogenic differentiation of human mesenchymal stem cells (hMSCs) in the absence of any osteoinductive factor such as bone morphogenetic proteins-2 (BMP-2) or dexamethasone. Synthetic silicates are made up of simple or complex salts of silicic acids, and have been used extensively for various commercial and industrial applications, such as food additives, glass and ceramic fillers, and anti-caking agents. To our knowledge, this is the first study showing that silicate nanoplatelets can induce osteogenic differentiation of hMSCs. The impetus for introducing this material for biological applications is due to the urgent unmet needs for bioactive materials for therapeutic applications, in the field of regenerative medicine. We believe that these highly bioactive nanoplatelets may be utilized to develop devices such as injectable tissue repair matrixes, bioactive fillers, or therapeutic agents for stimulating specific cellular responses in bone-related tissue engineering.

Akhilesh K. Gaharwar

Dr. Gaharwar received his Ph.D. in biomedical engineering from Purdue University; his M.Tech in materials science from the Indian Institute of Technology-Bombay; and his B.E., in metallurgical engineering from the National Institute of Technology–Nagpur. His research spans diverse fields, including materials science, chemistry, stem cells biology and microfabrication of polymeric biomaterials and nanocomposites. Specifically, his laboratory is developing biomimetic nanomaterials with native interface tissue-like gradient in physical and chemical properties; integrating advanced micro- and nano- fabrication technologies to mimic native interface tissue architecture; and directing stem cell behavior to obtain regionalized tissue constructs in vitro and in vivo. This integrated approach brings together a range of seemingly disparate disciplines that will address some of the complexity associated with engineering functional tissue interfaces in a manner that is otherwise not possible. Current projects are focused on designing "bioactive" nanomaterials for regenerating damaged tissue interfaces; developing vascularized network; and devising new therapeutic strategies, especially in musculoskeletal applications.