BIO ENGINEERING SEMINAR

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MMCR, Mechanical Engineering

Progenitor Cell Mechano-Biology Supporting Valvulogenesis

Sharan Ramaswamy

Assistant Professor, Department of Biomedical Engineering
Florida International University, Miami.

Congenital heart defects occur in 8 out of 1000 live births in the US (www.aha.org), with several cases presenting with anomalous heart valves. Available valve therapies have major limitations. For example, mechanical valves are commonly used, but require long-term anti-coagulant therapy, which is dangerous for young children. Homografts or bio-prosthetic valves are occasionally used but are prone to calcification, leading to regurgitation. In the pediatric population, repetitive valve replacement surgeries are required, because available prosthetic valves do not accommodate somatic growth. Thus, current prospects in treating valve defects in children are faced with several concerns. In theory, the ability to grow a valve *in vitro* using stem cell progenitors and appropriate scaffolding materials, i.e., a tissue engineered heart valve for subsequent implantation could potentially overcome all the shortcomings of existing treatment strategies. Despite this appeal however, much remains to be understood in terms of the mechanical environments needed to condition growing valves, but which nonetheless have been shown to be essential for the creation of functional valve tissues. In addition, the biological responses to mechanical stimuli are likely to be progenitor cell-specific. Here, we present two adult stem cells, i) the periodontal ligament cell (PLCs) and ii) bone marrow derived mesenchymal stem cells (BMSCs) which we have investigated for heart valve tissue engineering purposes. We reveal their unique responses to valve–relevant mechanical stresses and their suitability in promoting the heart valve phenotype.

About the speaker:

Sharan Ramaswamy completed his PhD in 2003 at the University of Iowa, focusing on cardiovascular mechanics under the direction of Professor KB Chandran. After completing his PhD, Dr. Ramaswamy engaged in research at the interface of cartilage tissue engineering and magnetic resonance imaging microscopy as a means to assess tissue development non-invasively. In early 2007, Dr. Ramaswamy took up a research faculty appointment in the department of Bioengineering/McGowan Institute of Regenerative medicine at the University of Pittsburgh. Since December 2009, he has been an Assistant Professor in the Department of Biomedical Engineering at Florida International University, Miami, FL.

His primary research goal is to integrate the various areas of his training into the synthesis of viable tissue engineered heart valves (TEHV). This goal fragments into multiple areas of study that raises several scientific questions that he and his laboratory are trying to answer, again in the context of TEHVs. These include: progenitor cell mechanobiology through multi-scale, experimental and computational approaches, noninvasive monitoring of engineered tissues using MRI-based methodologies, and cardiovascular biomechanics of TEHVs, such as governing leaflet dynamics of scaffold assembled valve constructs. Dr. Ramaswamy is a Fellow of the American Heart Association and its Council on Basic Cardiovascular Sciences.