Structural Engineering Special Seminar

Engineered Testbeds for Prostate and Breast Cancer Metastasis to Bone

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Abstract: Unavailability of human samples at metastasis and failure of animal models necessitates development of in vitro humanoid models of metastasis to bone. We have developed a novel nanocomposite that utilizes amino acid modified nanoclays to mineralize hydroxyapatite (bone mineral). The materials and structure design of the nanoclay-hydroxyapatite polycaprolactone nanocomposite scaffold is closely guided by multiscale modeling of tissue growth on scaffold and scaffold degradation over real time. The engineered bone also exhibits a low Ca/P stoichiometry, characteristic of newly remodeling bone. Gene and protein expression studies confirmed the MET metastasis stage and demonstrated the development of the first in vitro models or testbeds of cancer metastasis to bone. A composite of biochemical, morphological, pathophysiological, and genetic changes to cancer cells at metastasis can be captured in the mechanical behavior of the cancer cells. The nanomechanical evolution of cells as metastasis stage was captured using a nanoindentation device. We observed significant softening of prostate cancer cells during MET and then further softening during the disease progression at the bone metastasis. This is the first study that reveals changes to nanomechanical properties of human cancer cells with correlation to cytoskeletal changes during progression of the disease at the bone metastatic site presenting mechanics as a biomarker. The testbed can be used for screening new anti-cancer drugs, thus reducing the large lab-to-bench costs and time for new anticancer drugs. The testbed is also a new tool for personalized medicine through use of patients own cells.

Bio: Dr. Kalpana Katti is a University Distinguished Professor in the Department of Civil and Environmental Engineering, and Director, Center for Engineered Cancer Testbeds at North Dakota State University. She joined NDSU in 1997 after receiving a Ph.D. from University of Washington in Materials Science and Engineering. At NDSU she has established a state-of-the-art materials characterization laboratory that houses advanced nanomechanical and infrared spectroscopic equipment as well as a Tissue Engineering Laboratory. She has served as PI on infrastructure development grants bringing new advanced electron microscopes with federal funding that have led to significant expansion of the Electron Microscopy facility at NDSU. She also spearheaded a new doctoral program in Materials and Nanotechnology at NDSU which is offered since 2006. Her research in the field of Nanomaterials and Biomaterials is nationally an internationally recognized and has led to several discoveries and made important contributions to the field.

Tuesday, April 9th, 10:00–11:00 am
1311 Yeh Student Center