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Deepak Vashishth, Professor and Department Head, Department of Biomedical Engineering

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Research Center Affiliation:

- Center for Biotechnology and Interdisciplinary Studies»

General Areas of Research:

· Tissue Engineering
· Musculoskeletal Mechanics
· Biophysical Regulation of Cell Function
· Orthopedic Biomechanics
· Biotechnology
· Biomedical Engineering
· Computational Biomechanics
· Functional Tissue Engineering
· Biomaterials
· Bioengineering

Research Activities:

Using funds obtained from the National Institutes of Health (NIAMS, R01 AR49635; NIA R01 AG20618) and the Whitaker Foundation, over the course of the last fifteen years, my laboratory and I have investigated the modifications of the extracellular matrix (ECM) of bone and their relationships to fracture and biology of bone with the specific purpose of improving the prediction of fracture risk and developing treatment modalities to reverse bone fragility. Because bone's ECM and its modification are determined by events at molecular, cellular and tissular levels, my research spans these natural length scales in bone. Using approaches from the fields of mechanics, material science, biochemistry and cell biology we create and use experimental model systems to investigate the mechanics and biology of bone fragility associated with aging, osteoporosis and diabetes. At the molecular level, we have identified the age-related accumulation of advanced glycation end-products (AGEs) in the type I collagen of bone and are currently investigating the mechanisms by which it accumulates and modifies the energy dissipation characteristics of bone. In particular, studies are ongoing on naturally aged and Insulin-like Growth Factor-I (IGF-I) deficient and osteocalcin knock-out mice to determine if IGF-I and osteocalcin play a role in controlling the AGEs accumulation in bone. At the cellular level, we work with adult human mesenchymal stem cells (hMSCs) and

osteoclasts to study factors affecting bone quantity and its interaction with bone quality. The acquisition of bone is investigated from a mechanobiology perspective in which the role of mechanics in determining stem cell fate is of interest. Octeoclasts or the principal bone resorbing cells are being investigated to ascertain whether the modification of bone quality by mechanical damage or by protein modification enhances bone resorption affecting the amount of bone. At the tissue level, the effect of AGE, non-collagenous matrix proteins, mechanical damage and multiaxial cyclic loading on bone fracture are being investigated. Using a compbination of fracture mechanics approach, multiphoton confocal imaging, laser microdissection and proteomics we investigating the biomolecular basis of osteoprotic and diabetic fractures.