THE UNIVERSITY OF ALABAMA AT BIRMINGHAM

CMBD

CENTER FOR METABOLIC BONE DISEASE

DIRECTOR'S NOTES

There are two current and very exciting planning activities at UAB that will have a major positive impact on the CMBD activities. One is the ongoing interdisciplinary planning for a comprehensive "bone and joint" institute at the new UAB "Southside Campus" (previously HealthSouth). This is being led by Thomas R. Hunt, III, MD, Professor and Director, Division of Orthopaedic Surgery. The second is the planning within the School of Medicine Strategic Plan for a program in Regenerative Medicine which includes, as a major component, bones and joints. I anticipate that these two concurrent planning efforts will accelerate the expansion of the CMBD programs.

The CMBD Visiting Expert/Speaker Program continues to be an active and highly visible program. It meets on the third Thursday of every month from 4:30-5:30 pm in Conference Room D of the West Pavilion Conference Center. Upcoming speakers include ***John P. Bilezikian, MD***, Columbia University College of Physicians and Surgeons (February 16, 2006); ***Sundeep Khosla, MD,*** Mayo Clinic (March 16, 2006); ***David W. Dempster, PhD***, Columbia University College of Physicians and Surgeons (April 20, 2006); and ***Lawrence G. Raisz, MD,*** University of Connecticut Health Center (June 15, 2006). Your attendance and participation is welcomed. In addition, on May 17, 2006 the CMBD will host an outstanding bone scientific symposium. The complete program will be in the April CMBD Newsletter.

Discussed below is an overview of the expanding experimental Biomechanics Core Facility directed by Alan W. Eberhardt, Ph.D., Associate Professor, Department of Biomedical Engineering.

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CHARACTERIZATION OF MECHANICAL PROPERTIES IN MOUSE BONES

The strength and stiffness of long bones, such as the femur or tibia, is influenced by extrinsic (structural) properties such as the cross-sectional moment of inertia, and intrinsic (mechanical) properties, including elastic modulus and yield strength. Biomechanical testing of bone offers quantitative information concerning both the extrinsic and intrinsic properties of bone. Two types of mechanical tests are commonly performed on long bones: three-point bending and nanoindentation.[1] Three-point bending is a conventional method to determine "whole bone" mechanical properties. Bending induces compressive and tensile stresses on the opposing sides of the long bone. Load-to-failure tests are generally performed using custom-made bending fixtures. From the force-displacement data, both extrinsic (peak force, flexural rigidity, etc.) and intrinsic properties (Young's modulus, yield stress, ultimate stress, energy absorbed) of the whole bone are obtained. Nanoindentation is a method used to measure hardness and elastic modulus from indentations on the bone surface at a nanometer (10^{-9}m) scale. By simultaneously tracking the load and indenter displacement data during load-unload sequences, nanoindentation has been used to distinguish the mechanical response of osteonal, interstitial and trabecular bone.[2]

Researchers from the Musculoskeletal Mechanics Lab (MML) in the Department of Biomedical Engineering have recently partnered with scientists in the Department of Physics to establish these methodologies for application to transgenic mouse models developed by CMBD faculty. Transgenic animal models have been used extensively to mimic bone pathologies such as osteoporosis,[3] in order to study the stimulatory and inhibitory effects of specific genes, growth factors and signaling pathways on bone formation, remodeling and regeneration. Ongoing activities include the measurement of bone properties in mouse femurs and tibiae of mice with osteoblast-specific knockout of the IGF receptor gene. In addition to radiographic, densitometric and histomorphometric techniques, three-point bending and nanoindentation are being used to assess the mechanical integrity of the bone in these animal models, providing additional tools to study unsolved questions related to bone pathologies and the efficacy of surgical techniques, like distraction osteogenesis.

[1]Chen et al. *Calcif Tissue Int* 2003;73:387-392; [2]Rho et al. *J Biomech* 2002;35:189-198; [3]Silva et al. *J Biomech* 2004;37:1639-1646.

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