Mechanical Engineering

Department Seminar

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Clare Rimnac is the Wilbert J. Austin Professor of Engineering and Chair of the Department of Mechanical and Aerospace Engineering at Case Western Reserve University in Cleveland, Ohio, USA. She also holds secondary appointments in Biomedical Engineering and Orthopaedics. Prof. Rimnac received her B.S. in Metallurgy and Materials Science from Carnegie-Mellon University in 1978, and her M.S. in 1980 and Ph.D. in 1983 in Metallurgy and Materials Engineering from Lehigh University. Prior to her faculty appointment at CWRU in 1996, she was a Scientist in the Department of Biomechanics at The Hospital for Special Surgery in New York City. Prof. Rimnac's research is primarily funded by the NIH and is directed towards orthopaedic biomechanics, with a focus on implant retrieval analysis, mechanical behavior and modeling of materials used in total joint replacements, and damage and fracture behavior of bone tissue.

Engineering the natural history of total joint replacements

11:00 AM Friday, September 25h, 2009
Room 245, 110 Cummington Street

Refreshments served at 10:45 AM

Total joint replacements for the hip and knee are typically composed of a metallic component articulating against a plastic (ultra high molecular weight polyethylene) component. A significant long-term complication in total joint replacement is loosening, which has been linked to the biological response invoked by debris generated from wear of the polyethylene component. New, highly crosslinked formulations of polyethylene that are very resistant to the generation of wear debris have been introduced into clinical use. Clinical findings support that wear is greatly reduced in total hip replacements using highly crosslinked polyethylenes. However, structural fracture of these devices is a concern, due to a reduction in ductility and static and cyclic fracture resistance of these materials. Thus, there is a need to be able to prospectively predict the propensity for fracture for current and new component total hip and total knee replacement designs that make use of both traditional and highly crosslinked polyethylene formulations.

A comprehensive approach has been taken to determining and influencing the "natural history" of polyethylene components in total joint replacements, through: 1) evaluation of in vivo performance of retrieved polyethylene components to identify factors affecting wear damage and fracture; 2) identification of failure mechanisms leading to wear damage; 3) determination of static and cyclic mechanical properties of polyethylene; and, 4) prediction of the effects of changes in design variables on structural performance. Progress and findings in these ongoing areas of investigation will be presented.

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