



ILLINOIS INSTITUTE OF TECHNOLOGY



Mechanical, Materials And Aerospace Engineering Department

MMAE SEMINAR

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E-1 BUILDING – CRAWFORD AUDITORIUM
3:30 – 4:30 PM**

Tribological Challenges in Orthopedics

MARKUS WIMMER AND MATTHIAS HONL

Department of Orthopedic Surgery, Rush University Medical Center



Markus Wimmer, PhD



Matthias Honl, MD

Tribology, derived from the Greek terms for rubbing (τριβειν) and science (λογος), has been defined as “the science and technology of interacting surfaces in relative motion”. Tribology comprises scientific and technical aspects of friction, wear and lubrication and has made its appearance in many scientific branches, including orthopedics. Tribology plays a dual role for many technical systems; on the one hand tribological processes are needed to manufacture technical parts with defined characteristics, on the other hand wear and friction during operation cause loss of material and energy. In this lecture we will address both issues as related to orthopedics.

Excessive polyethylene wear debris, which causes osteolysis (“bone thinning”) and potential loosening of the prosthesis, has spawned the resurgence of hard/hard bearings in total hip arthroplasty. Metal-on-metal (MOM) hip joint bearings are considered as one of the alternatives in this respect. In order to control and minimize wear of MOM bearings, an in depth understanding of the acting wear mechanisms is essential. For this purpose, retrieved components were inspected using light microscopy, scanning electron microscopy, energy dispersive X-ray spectrometry and X-ray photoelectron spectroscopy. Further, subsurface analyses were carried out with a transmission electron microscope. Reviewing all those - sometimes surprising - observations provides the clues to the acting wear mechanisms. Based on those, counterintuitive actions for wear reduction are now being suggested.

In surgical applications, plain water jets can be used for the dissection of soft tissues. The major advantage of the water jet (WJ) is the selectivity in cutting: structures of higher tissue resistance remain undamaged while softer tissues are dissected; in brain tissue, for example, all vessels with a diameter larger than 20 μ m are left intact after the passage of a jet stream with a pressure up to 5 bar. Very hard materials such as bone or bone cement cannot be penetrated by a WJ at acceptable pressures. In industry, cutting power can be increased by the addition of abrasive particles, such as garnet, corundum or quartz sand to the jet stream. For medical application, the abrasive particles must be bio-compatible: The abrasives must be water-soluble and pharmacologically safe. Possible abrasives are disaccharides, sugar alcohols, amino acids, and salt. Several specific applications of WJ are shown and discussed, stressing the future potential of this technology in the surgical field.