

Research Interests & Projects

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Wear Evaluation

In orthopaedic surgery, as well as restorative dentistry and other medical specialties, the failure of articulating surfaces due to wear and its biological consequences has been recognized to be a significant problem. Bearing surfaces may lose the ability to move freely, the shear forces caused by friction between surfaces may lead to shear failure of bearing surfaces and particulate wear debris may be released into surrounding tissues. This last effect is, many times, the most important one, since the biological response to the wear debris may induce a cascade of cellular responses and the release of cellular mediators which may then have an adverse effect on the bone and soft tissues surrounding the prosthesis or implant. Polyethylene debris, silicone rubber particles, poly(tetrafluoroethylene) wear products have been implicated in tissue damage and/or device failures clinically. In addition, bearing combinations that have the potential for the release of metallic particles or ceramic particles are also being tested and used clinically.

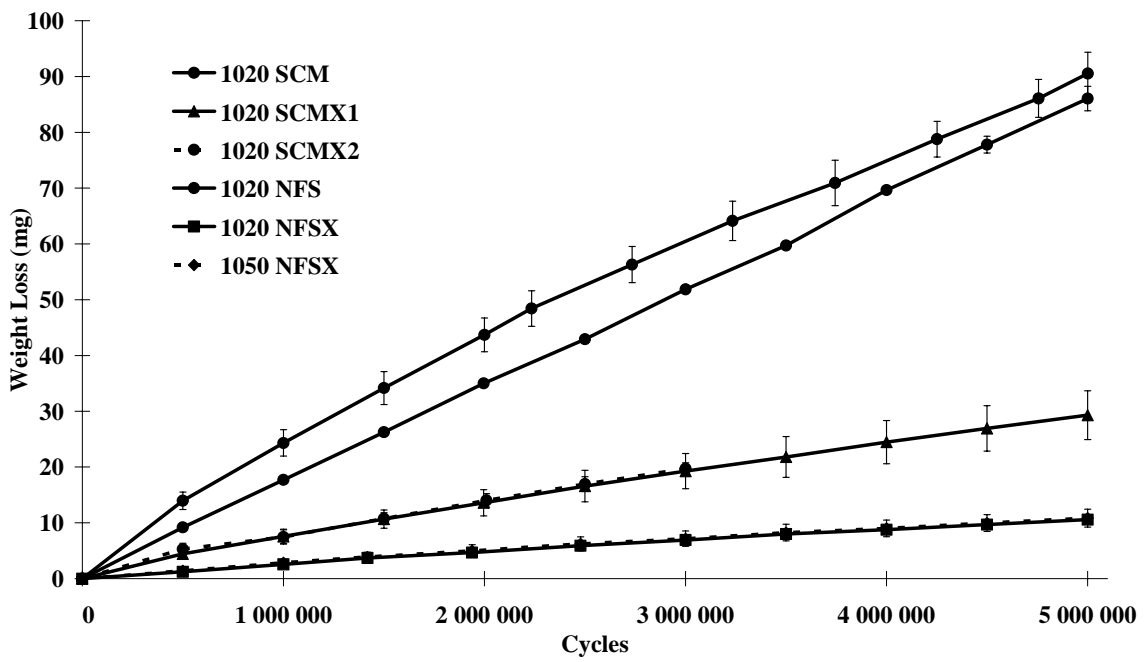
Since 1998, our research has centered upon the simulation of wear of hip prosthesis articulating interfaces. Some of the projects that have been carried out include:

- Comparison of two different polyethylene raw materials and molding processes on the wear of polyethylene articulating against cobalt alloy femoral heads.
- Evaluation of the wear properties of a new metal-on-metal (high carbon cobalt alloy, ASTM F1537, alloy 2; UNS R31538) hip prosthesis bearing system for possible clinical use.
- Evaluation of the effects of molding process and polymer crosslinking on the wear properties of polyethylene acetabular cups bearing against cobalt alloy femoral heads.
- Evaluation of the differences in wear rates between crosslinked polyethylene cups manufactured from ASTM F648 Type 1 polymer as compared to ASTM F648 Type 2 polymer.
- Evaluation of the effect of laboratory aging (oxidation) of polyethylene on its wear properties.
- Evaluation of the effect of roughened femoral heads on the wear of shelf-aged polyethylene cups sterilized in air.
- Comparison of a highly crosslinked polyethylene cups bearing against cobalt alloy heads to gamma-sterilized polyethylene cups bearing against zirconia ceramic heads.
- Evaluation of possible mechanisms for ceramic acetabular cup movement and impingement fracture in a ceramic-polyethylene-metal acetabular cup design.
- Pilot testing of a new concept in bearing surfaces in which ceramic femoral heads articulate against high-carbon acetabular cups.

New research interests in this area include the evaluation of the wear properties of synthetic lumbar and cervical disc replacement devices.



Eight-Station Hip Wear Simulator



Plot of Wear Data From Six Different Wear Studies

Our research facilities also include a bench-top reciprocating pin-on-disc wear screening device that allows the initial screening of articulating material combinations for potential use in weight-bearing applications. Some of the projects have included:

- Comparison of cobalt alloys ASTM 1537 Alloy 1 to Alloy 2 for wear properties bearing against themselves and in mixed-alloy combinations.
- Evaluation of the effect of sinter heat-treatment on the wear properties and metallurgical microstructure of ASTM F1537 Alloy 2.