# TRIBOLOGY OF LARGE DIAMETER HEAD TOTAL HIP DEVICES

Abstract

by

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Total hip arthroplasty (THA) has become an extremely successful surgical procedure in the past 50 years. It has greatly improved the quality of life of patients. However, there remain clinical concerns. As industry has sought to address these clinical concerns, understanding of performance has increased, and design tradeoffs have been made. Total hip arthroplasty constructs are sophisticated tribological bearings, made of materials such as Cobalt-Chrome and Ceramic. Advances in materials and design have afforded the offering of hard-on-hard bearings such as Metal-on-Metal (MOM) and Ceramic-on-Ceramic (COC) devices to the market. These sophisticated tribological bearings require advanced mathematical models and experimentation techniques to better understand and predict performance.

In an attempt to more fully understand the behavior of these engineered THA bearing surfaces, wear of the bearings has been assessed both through *in vitro* wear simulation testing and analysis of retrievals. Clinical assessment of these devices has been performed, including work to understand if factors beyond wear of the bearing

(i.e. corrosion) play a role in their performance. Additionally, efforts have been made to understand the contact mechanics of these bearings, noting that careful selection of design parameters, such as material, diameter, clearance, and surface roughness is needed in the design of the bearings in order to balance the magnitude and distribution of the contact pressure between the articulating surfaces.

While these investigations have led to significant understanding of the performance of these devices, there remain many unanswered questions regarding these devices. One such open topic is further understanding of the fluid film lubrication of the bearing and the effect of bearing diameter on the optimization of clearance. The primary goal of a THA design is to restore quality of life with a product that performs well in the patient by producing minimal wear and long term survivorship. This work provides insight into appropriate clearances and other design parameters to be considered. It also assesses the tools available to aid in the design of these tribological systems. Finally, it proposes a method of correlation of wear factor as a function of film parameter as a potential future tool that can aid in the design of these devices.