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## Part II: Hard-on-hard Bearing Pairs

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**Abstract**

The present paper represents Part II of the extensive study focused on the lubrication of hip joint replacements. The main goal is to assess the fundamentals of lubrication considering both hard-on-soft (Part I) and hard-on-hard (Part II) bearing pairs. In addition, the effect of individual constituents contained in the model fluid is clarified. For this purpose, multiple model fluids of various composition were employed. In this part of the study, metal-on-glass contact representing hard bearing pairs was observed *in situ* using pendulum hip joint simulator in combination with thin film colorimetric interferometry method. The designed test consists of initial static loading/unloading phase for the determination of adsorption of molecules on rubbing surfaces. This period is followed by swinging of the pendulum and latest static part under constant load. Three groups of measurements were carried out while fourteen different lubricants were tested. Initially, the experiments were performed with albumin-based model fluid. In that case a substantial positive effect of hyaluronic acid was identified. In contrast, the fluids with  $\gamma$ -globulin as a base constituent showed improved lubrication conditions when phospholipids were added to the solution. Finally, considering the complex fluid, a combined effect of hyaluronic acid and phospholipids caused a better endurance of the lubricant film. The latest part of the paper aims on the comparison of film formation considering hard and soft pairs, highlighting some clear differences. In general, hard pairs exhibit clear decreasing tendency of the film during swinging motion while opposite behaviour was observed for soft pairs.

**Keywords**

Hip joint replacements; hard-on-hard pairs; lubrication; optical interferometry; synovial fluid

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