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Currently there are two generally accepted mechanisms for lubricant film formation in artificial hips; which are fluid film and boundary lubrication. Engineers tend to prefer the fluid film mechanism as this combines classical elastohydrodynamic lubrication (EHL) theory with a simple fluid rheology. However the more chemically-minded favour boundary lubrication mechanisms, which focus on film formation by proteins or phospholipids adsorbing on the implant surfaces. Both approaches ignore important aspects of the problem; the fluid film theories do not encompass chemical contributions from the various large and surface active molecules contained in the synovial fluid 'soup'. The surface chemistry protagonists ignore fluid hydrodynamic and kinematic effects. In both cases the fluid is considered to be single-phase with the chemical and physical properties averaged in time and space.

This talk reviews the evidence for lubrication mechanisms in artificial joints. It will begin by outlining the tribological conditions of artificial joints and the chemical and physical properties of synovial fluid. The evidence for boundary lubrication mechanisms is then presented which includes implant retrieval studies, tribological testing of model synovial fluid solutions and model surface studies. The talk will conclude by presenting new experimental results on protein-flocculation and gel-film formation. In this mechanism lubricant films are formed by local concentration of protein molecules developing in the inlet region of the contact due to shear-flow aggregation. Thus the mechanism includes chemical, rheological and kinematic aspects to develop a spatially localised theory of lubricant film formation in artificial hip joints.