Introduction: Bovine serum is the most widely used lubricant in wear and joint simulator testing of prostheses. However, recent studies have raised serious questions about the chemical stability of bovine serum and its subsequent effect on the outcome of hip simulator wear test of UHMWPE [1-3]. Because of frictional heating generated at the articulating interface during testing, the protein constituents in serum deteriorate with time [1]. The degradation product was insoluble precipitates that are generally absent in synovial fluid in vivo. These insoluble precipitates, if trapped at the ball/cup interface, act like a solid lubricant which may artificially shield the polyethylene from wear [1-3]. The present investigation factors that affect the degradation of bovine serum and consequently the wear rate of UHMWPE.

Materials and Methods: 32 mm ID and 60 mm OD UHMWPE acetabular cups were machined from a GUR4150 rod and then sterilized by gamma-irradiation at 2.5 Mrads in air. Wear tests were conducted on these cups against CoCr femoral heads (Ra: 0.015 μm) using a multi-station hip joint simulator (MTS, Eden Prairie, MN) under various lubrication conditions. All tests were carried out at 1 Hz under physiological loading (2450 N maximum load). Bovine serum is the most widely used lubricant in wear and joint simulator testing, 3]. Because of frictional heating generated at the articulating interface during testing, the protein constituents in serum deteriorate with time [1]. The degradation product was insoluble precipitates that are generally absent in synovial fluid in vivo. These insoluble precipitates, if trapped at the ball/cup interface, act like a solid lubricant which may artificially shield the polyethylene from wear [1-3]. The present investigation factors that affect the degradation of bovine serum and consequently the wear rate of UHMWPE.

Results: Fig. 2 shows the final precipitate concentration and the wear rate as a function of the lubricant volume used in testing. The precipitate concentration was seen to decrease significantly as the lubricant volume increases while the wear rate showed the opposite trend. Fig. 2 shows the precipitate concentration and the wear rate as a function of the serum type at a constant lubricant volume of 400 ml. The precipitate concentration and the wear rate showed the opposite trend. Fig. 2 shows the precipitate concentration and the wear rate as a function of the serum type at a constant lubricant volume of 400 ml. The precipitate concentration and the wear rate showed the opposite trend.

Discussion and Conclusions: The degradation of serum has a significant effect on the wear of UHMWPE during joint simulator testing. Serum degradation index which is defined as the ratio between the precipitate concentration and the initial protein concentration can be used as a quantitative indicator of the severity of serum degradation. A higher quantity of serum per chamber and a higher initial protein content resulted in a higher degradation index. The wear rate of UHMWPE was severely affected by the degradation index, i.e., the higher the degradation index, the lower the wear rate. In order to minimize the artifact due to serum degradation, say a degradation index < 5%, the alpha-fraction calf serum of ca. 400 ml volume is recommended. Regular bovine serum and small chamber sizes should be avoided. In addition, mounting the components in an anatomical position may help reduce the effect of precipitate entrapment at the articulating interface.