**Introduction:** Hip and knee wear simulators have been used by implant manufacturers and researchers for many years as a performance predictor and comparator for hip and knee implants. The clinical accuracy of these simulators in predicting wear depends heavily on the type of simulator as well as the methodology used. The joint lubricant used in the simulators is one crucial aspect that has been well studied in hip simulators [1-4, 6-8]. It was determined that lubricant protein concentrations that are outside the protein concentration range found in human synovial fluid will underpredict the wear of UHMWPE components. Low protein concentrations cause increased lubrication from transfer films forming on the acetabular insert. High protein concentration causes a laboratory artifact of lubricating protein precipitates. These observations led to the choice of 20 g/L total protein concentration (TPC) as the standard lubricant for hip wear simulation. The contact geometry and articulation of the knee joint differs significantly from the hip. The effect of lubricant protein concentration on the in vitro wear of a modern knee implant is currently unknown and is the purpose of this study.

**Materials and Methods:** Conventional polyethylene tibial inserts were tested against CoCr femoral knee components in different lubricant conditions (n=6). All tibial inserts were 9mm thick Triathlon design and made of conventional PE (N2 packaged γ-sterilized) and were matched with same size femoral components. Two million cycles of wear testing was performed on a six station knee simulator using gait kinematics. Loading and rotation are applied through a superiorly mounted femur (2700N max, +6/-7.5° I/E rotation) with tibial inserts and trays mounted below. 23° of flexion (loaded phase of gait) was applied through a ball and socket joint. The simulator has been previously described [5]. Two different dilutions of Alpha Calf (Hyclone Labs, Logan, UT) serum and deionized water were tested in this study, with protein concentration of 0g/L (water), 20g/L (50% dilution), and 40g/L (100% serum). Gravimetric wear measurements were performed on inserts and lubricant was changed every 0.5 million cycles (mc).

**Results:** Wear rates varied significantly between the three lubricant conditions. Tibial inserts tested with water lubricant wore at 4.8±0.8mm3/mc, inserts tested with 20g/L TPC lubricant wore at 27.5±8.0mm3/mc and inserts tested with 40g/L TPC lubricant wore at 22.3±0.24mm3/mc. Apart from the size of the wear area no significant difference could be seen visually between the three groups.

**Discussion:** Lubricant composition studies have been performed previously on hip wear simulation [1-4, 6-8]. Lubricant composition such as protein concentration and albumin to globulin ratio has proven to be very significant to wear in vitro. Due to protein degradation during testing lubricant turnover rate also has a significant affect on wear rates. A 20g/L TPC lubricant has been chosen as a standard in many wear simulator laboratories based on this research and is used commonly for both knee and hip wear simulation. The effect of protein concentration in knee wear cannot be assumed to be similar to that found in hip wear due to the differences in geometry and articulation. Fig. 1 shows knee wear versus protein concentration as found in the current study along with the previously generated data [1] for hip wear versus protein concentration. Although the scale is different due to the differences in material, geometry, and motion, the general trend is similar between the hip and knee wear. The maximum wear occurs at approximately the normal human synovial fluid TPC of 20g/L and gradually decreases with increased TPC. Lower than normal protein concentration causes near zero wear in both hip and knee simulation. This data suggests that despite the kinematic differences between the hip and knee wear simulation, the effect of total protein concentration on total wear is similar and is important to obtain consistent and relevant wear data. A total protein concentration of approximately 20g/L should be maintained in knee and hip wear simulation to accurately and consistently predict wear of polymeric components. Serum turnover rate was also shown to be important in previous studies [1] due to the denaturing of proteins in the lubricant throughout testing causing a decrease in the proteins available in the lubricant solution. While only alpha calf serum was used as the base in the current study, other researchers have verified that the type of serum used (alpha calf, bovine, or newborn calf) as well as diluant (water, saline, or hyaluronic acid) is significant in knee wear simulation [6] as was previously found in hip simulations [1-4, 8]. Therefore, it is important not only to start with the correct lubricant type, but lubricant dilution and lubricant turnover are critical to obtaining consistent and accurate wear results from the knee simulator.

**References:**
2. Wang et al., Biomat., 17 (1996) p865
5. Essner et al., 5th World Biomat Congr 1996 580