INTRODUCTION:
The dual mobility bearing concept has over 30 years of clinical history [1], and the in-vitro wear performance of the system has been previously reported [2]. The dual mobility system mates a femoral head into a polyethylene liner which has an unconstrained articulation with a polished metal shell.

It is hypothesized that a higher percentage of wear occurs at the articulation between the femoral head and polyethylene liner; the smaller of the two bearings within the system. Burnishing on the inner diameter and the presence of machining marks on the outer diameter of previously tested components is suggestive of this.

METHODS:
The dual mobility hip (Restoration ADM, Stryker Orthopaedics, Mahwah, NJ) incorporates a femoral head (28 mm diameter) into a polyethylene liner (28 mm inner diameter & 48 mm outer diameter) that articulates against a metal shell (48 mm inner diameter). The dual mobility hip system was evaluated under three different conditions; standard conditions, when the only articulation is between the femoral head and liner (fixed outer bearing), and when the only articulation is between the polyethylene liner and metal shell (fixed inner bearing). All polyethylene components were sequentially crosslinked and annealed X3°, Stryker Orthopaedics, Mahwah, NJ) [3]. There were four samples per testing condition.

Wear rates for testing are shown in figure 3. The average wear rate for the dual mobility system under normal conditions is 1.2 mm/mc. When the system is reduced to only the 28mm bearing when the outer bearing is fixed the average wear rate is 1.0 mm/mc, and when reduced to only the 48mm bearing the wear rate is 9.6 mm/mc. The wear performance of the dual mobility system under normal conditions and when the outer bearing is fixed are not statistically different from each other (p=0.54), while there is statistical significance between normal conditions and when the inner bearing is fixed (p=0.03). Wear scars for the fixed bearing scenarios show burnishing primarily in one concentrated area; the area of contact through the load path. The dual mobility system under normal conditions shows signs of wear on the entire inner diameter of the polyethylene liner, with minimal signs of wear on the outer diameter of the liner.

DISCUSSION:
There have been reports of the outer bearing of a dual mobility hip liner becoming fixed due to fibrosis around the metal acetabular shell [5]. If this were to occur with the dual mobility system manufactured from sequentially crosslinked polyethylene, the wear rate would be comparable to a constrained 28mm bearing using the same polyethylene. Additionally, if any bearing of the dual mobility system were to become fixed for any reason, the wear rates would still outperform a constrained hip design using conventional polyethylene (figure 3).

Wear rates of the dual mobility system are similar to the wear results of the system when reduced to only having the articulation between the femoral head and polyethylene liner. These results strengthen our hypothesis that the larger portion of wear of the dual mobility system is at the 28mm inner bearing. The absence of burnishing on the outer diameter of the polyethylene liner in the dual mobility system under unconstrained conditions, combined with the presence of burnishing when the 48mm bearing is the only bearing suggests this bearing is responsible for only a small percentage of the total wear of the system. Furthermore, the design of the dual mobility hip increases stability and ROM with incorporation of the larger bearing [1,5,6], while still providing the wear performance of a smaller fixed 28mm bearing.

REFERENCES

Figure 1: Dual Mobility Hip System

The main objective of this study is to determine the wear characteristics of the dual mobility hip system when it is reduced to any one of the two available articulations, i.e. when the femoral head and polyethylene liner articulation is the only bearing and when the polyethylene liner and metal shell articulation is the only bearing.

A hip joint simulator (MTS, Eden Prairie, MN) was used for testing with the cups positioned anatomically (superior) and oriented at 50° of abduction. Testing was run at 1 Hz with cyclic Paul curve physiologic loading applied axially, at a maximum of 2450 N [4]. Component assemblies were lubricated using Alpha Calf Fraction serum (Hyclone Labs, Logan UT) diluted to 50% with a pH-balanced 20-nMole solution of deionized water and EDTA (protein level = 20 g/l). All inserts were weighed for gravimetric wear at every 0.5 million cycles. Dynamically loaded soak control specimens were used to correct for fluid absorption with weight loss data converted to volumetric data (by material density). Statistical analysis was performed using the Student’s t-test, where statistical significance is when p=0.05.