Introduction
The use of larger femoral heads in total hip replacements offers improved stability and range of motion along with less risk of dislocation and impingement. Large cups have been estimated to create more wear (with estimates as high as 9% increase in wear per 1 mm increase in diameter). However, wear simulator studies with XLPE cups have indicated that the wear should be so low that it will have no clinical significance. Therefore, clinical preference has been given to larger diameter balls paired with an XLPE cup, with severe wear conditions still being a concern. A ‘worst case’ scenario would combine a large diameter, roughened metal ball bearing on a XLPE cup. The historical control for simulator experiments has been either 28mm or 32mm polished CoCr balls bearing on 3Mrad UHMWPE cups. Little comparison has been made between wear rates of large roughened metal heads on XLPE cups and the ‘historical best case.’ This experiment compared:
- a ‘worst case’ scenario (36mm rough CoCr / 10Mrad XLPE),
- a ‘best case’ scenario (36mm smooth CoCr / 10Mrad XLPE),
- an ‘optimal case’ scenario (36mm smooth ceramic / 10Mrad XLPE),
- the ‘historical best case’ control (32mm smooth CoCr / 3Mrad UHMWPE).

Materials and Methods
Three groups of 36mm femoral balls (ceramic, abraded CoCr, and smooth CoCr) were paired with 10Mrad cross-linked polyethylene cups. A fourth group of 32mm smooth CoCr femoral balls was mounted against 3Mrad ultra high molecular weight polyethylene liners. All groups were mounted in an inverted position on a multi-channel hip simulator (Shore Western Manufacturing, Inc.). Tests ran to 5 million cycles in a lubrication fluid of 50% bovine calf serum. Approximately every half million cycles, cups were removed from the simulator, cleaned and weighed.

Results
Our historical control (32mm smooth CoCr/UHMWPE) provided the highest linear wear rates of 81 mg/Mc (Table 1: r > 0.99). Our so called ‘worst case’ big-ball scenario (abraded CoCr / XLPE) provided 2nd highest wear rate of 26 mg/Mc (Table 1: r > .94). This represented only 33% of the historical control. Our ‘best case’ 36mm smooth CoCr / XLPE cups provided low wear rates of 0.54mg/Mc. Our ‘optimal case’ had no observable wear.

Discussion and Conclusions
Our initial hypothesis revolved around the potential for high wear with a large abraded ball in a XLPE cup.
- Our ‘best case’ scenario with the large smooth CoCr balls produced a very encouraging 150-fold reduction in wear of XLPE cups relative to the control.
- Even more dramatic was our finding that ‘worst case’ conditions (the large abraded CoCr balls) still produced 5-fold reduction in XLPE cup wear compared to historical standard.
- As anticipated with our ‘optimal’ condition (large smooth ceramic balls), the wear of XLPE cups was not measurable, i.e., appeared to be a zero wear condition.
This data indicated that bias towards large abraded balls on XLPE cups is unnecessary. However, for surgeons who still have concerns about the sensitivity of XLPE cups to abraded CoCr femoral balls, ceramic balls remain the preferred choice for added protection.

References