ANALYSIS OF FAILED EX VIVO 36MM METAL-ON-METAL PINNACLE HIPS

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Introduction
Metal-on-metal (MoM) total hip replacement (THR) has undergone a renaissance with it accounting for 35% of procedures in the US in 2009 [1]. Most MoM THR are 28 or 32mm in diameter but recently bearing sizes have been increased to 36mm diameter to reduce dislocation rates and improve lubrication. All devices employ cobalt chromium molybdenum as the material. The truest test of any such device is when it is implanted in the body. Recently there have been an increasing number of reports of adverse reactions related to wear debris from MoM hip resurfacings. All MoM devices have been affected by the publicity. Is this a fair situation?

Method and Materials
From a cohort of 640 patients, each implanted with a Corail Pinnacle® 36mm MoM THR, 19 pairs of femoral heads and matching acetabular cups were obtained at revision surgery (figure 1). All 19 patients who were revised reported pain. Patient details available included blood metal ion concentrations. Acetabular cup positions were measured using EBRA software. 120 patients have also attended for metal ion analysis following MoM THR. Taper damage should be considered as another potential source of metallic debris alongside that which may originate from the articulating surfaces.

Results
From the articulating surfaces, a range of wear volumes per component were measured, from 1 to 18mm³ (figure 2). The paired head plus cup wear volumes ranged from 3 to 23mm³. Femoral head wear rates were usually greater than cup wear rates, means of 0.21mm³/month and 0.06mm³/month respectively being measured. Of the explants, 14 pairs were found to have low bearing surface wear rates of <3mm³/year (figure 3). In each of these cases, significant damage was identified at the internal taper junction of the femoral heads (figure 4). Roughness values of the articulating surfaces were typically in the range of 0.010 to 0.030µm Ra, so that the implants were operating under mixed lubrication. Articulating surface roughness measurements showed little increase over unworn areas. In total, 28 patients have been revised or listed for revision due to Adverse Reactions to Metal Debris (ARMD) [5]. This represents an overall failure rate of 4.3% at mean 3.5yrs (range 1.8-5yrs). Blood Cobalt (Co) and Chromium (Cr) concentrations were generally low. Median cup inclination/anteverision angles in the ARMD cases were 46° and 11°.

Conclusion
To the authors’ best knowledge this is the first time that the ex vivo wear volumes and wear rates of these modern 36mm MoM THR have been reported. It is also one of the first papers to report on taper wear. The low wear of the articulating surfaces corresponded with the relatively unchanged values of surface roughness. Mechanical failure at the head/stem interface appears to be a critical factor in the development of adverse reactions following MoM THR. Taper damage should be considered as another potential source of metallic debris alongside that which may originate from the articulating surfaces.

References