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Title: **Bearing Surface Changes Of Retrieved MOM Hips Predict Factors Associated With Failure**

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**Introduction**: Metal-on-metal (MOM) total hip arthroplasty using large diameter femoral heads offer clinical advantages however the failure rates of these hips is unacceptably high. Retrieved hips have undergone a wide range of changes at their bearing and taper surfaces and there is no agreement regarding the cause of failure.
Detailed visual inspection is the first step in the forensic examination of failed hip components in order to report on the changes that have occurred at the bearing surface and may help explain the mechanisms of failure.

**Objectives**: The aim of this study was to determine if there was a correlation between the results of detailed inspections of the bearing surfaces of retrieved hips and the volumetric wear at these interfaces.

**Methods**: Detailed, non-destructive macroscopic and stereomicroscopic examinations of the bearing surfaces (cup and head) of 100 retrieved MOM-THA hip implants were performed by a single experienced examiner using quantitative assessment to document the severity of 8 established damage features:
1. Light scratches
2. Moderate scratches
3. Heavy scratches
4. Embedded particles
5. Discolouration
6. Haziness
7. Pitting
8. Visible wear scar
Each surface was considered in terms of zones comprising of quadrants and subquadrants, split in to the polar and equatorial regions of the cup and head. Each zone was scored on a scale of 0 to 3 by determining the percentage of the surface area of the zone that exhibited the feature in question: a score of 0=0%, 1<25%, 25%<2<75%, 3>75%. The sum of the scores of each zone was used for the assessment of each damage feature.
The volume of wear at the surfaces of each hip was measured with a Zeiss Prismo coordinate measuring machine (CMM).
Simple linear regression models were used to assess the univariable associations between the inspection scores and material loss. Multiple linear regression models were subsequently used to assess the simultaneous contribution of the inspection scores, found significant in univariable analyses, on the volume of wear.
All statistical analysis was performed using Stata/IC version 12.1 (StataCorp, USA) and throughout a p value < 0.05 was considered statistically significant.

**Results**: Visible wear scar, moderate scratches, discolouration and haziness scores were all significantly positively correlated with cup (R^2 = 70%, 23%, 72% and 33% respectively) and head (R^2 = 73%, 34%, 67% and 47% respectively) wear volumes.
Visible wear scar and discoloration scores were significant predictors in multivariable analysis (p<.01) for both surfaces, together explaining 77% and 79% of the variance in cup head wear volumes respectively.

**Conclusions**: This is the first study to have investigated the associations between the results of the detailed visual inspection of a large number of retrieved MOM bearings and factors associated with failure.
This study demonstrates the importance of detailed visual inspections in retrieval analysis, suggesting that they may help in predicting the severity of bearing surface wear but are not a substitute for complex metrology. The strong associations with surface discolouration and moderate scratching may support a mechanism of wear accelerated corrosion as a mechanism of material loss of the bearing surface.