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TAPER WEAR CONTRIBUTES ONLY A THIRD OF THE TOTAL VOLUMETRIC MATERIAL LOSS IN LARGE HEAD METAL ON METAL HIP REPLACEMENT

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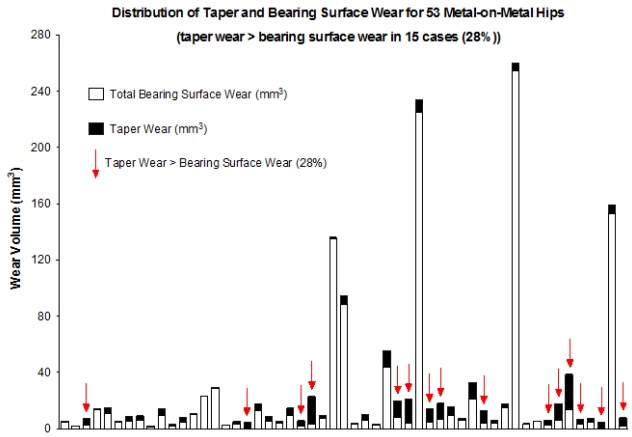
Abstract: It has been speculated that high wear at the head-stem taper may contribute to the high failure rates reported for stemmed large head metal-on-metal (LH-MOM) hips. In this study of 53 retrieved LH-MOM hip replacements, we sought to determine the relative contributions of the bearing and taper surfaces to the total wear volume. Prior to revision, we recorded the relevant clinical variables, including whole blood cobalt and chromium levels. Volumetric wear of the bearing surfaces was measured using a coordinate measuring machine and of the taper surfaces using a roundness measuring machine. The mean taper wear volume was lower than the combined bearing surface wear volume ($p = 0.015$). On average the taper contributed 32.9% of the total wear volume, and in only 28% cases was the taper wear volume greater than the bearing surface wear volume. Despite contributing less to the total material loss than the bearing surfaces, the head-stem taper junction remains an important source of implant-derived wear debris. Furthermore, material loss at the taper is likely to involve corrosion and it is possible that the material released may be more biologically active than that from the bearing surface.

Introduction: There have been several reports of higher failure rates for stemmed large head metal-on-metal (LH-MOM) hip replacements when compared to the same bearing used as a resurfacing[1,2]. This has been attributed to wear at the head-stem taper junction[1,2]. However, the contribution of the taper to the total material loss remains poorly understood[3]. The purpose of this study was to quantify the volumetric wear of both the bearing and taper surfaces and investigate any associations with blood metal ion levels.

Hypothesis: We hypothesised that in LH-MOM retrievals, volumetric wear of the taper surfaces would be greater than that at the bearing surfaces.

Methods: This was a retrospective study of 53 consecutively collected stemmed LH-MOM retrieval cases. The series included several contemporary designs. We recorded all relevant clinical data, including pre-revision whole blood cobalt and chromium ion levels. Volumetric wear of the bearing surfaces was measured using a coordinate measuring machine and of the taper surface using a roundness measuring machine.

Results: The mean volumetric wear of the combined bearing surfaces was significantly higher than the volumetric wear at the taper ($p = 0.015$). The mean contribution of the taper to the total wear volume was 32.9%, again significantly less than the mean contribution of the combined bearing surfaces ($p < 0.0001$). In only 15 (28%) of the 53 cases was the volumetric wear greater at the taper surface compared to the combined bearing surfaces (Figure 1). Whilst total bearing surface wear was significantly correlated with both cobalt and chromium levels ($p < 0.0001$), taper wear was only significantly correlated with cobalt ($p = 0.03$) and not chromium ($p = 0.46$).



Discussion and Conclusions: The bearing surfaces were the predominant source of wear debris in the majority of cases. However, the taper contributed on average one third of the total material loss, and in approximately a third of cases was greater than that at the bearing surface. Mechanical wear at the bearing surface releases particulate debris. In contrast, the mechanism of material loss at the taper junction is likely to involve corrosion resulting in the release of metal ions. Therefore, although contributing less to the total volume, the material lost from the head-stem taper junction may be more biologically active.

Clinical Significance: The taper junction is an important source of implant-derived metal debris and is likely to contribute to the higher revision rates reported for stemmed LH-MOM hip replacement.

Key Refs: [1]Smith et al, 2012, [2]Langton et al, 2012, [3]Matthies et al, 2011.