Metal-on-Metal Hip Resurfacing Implants Revised Due To Pseudotumours Are Associated with Increased Wear and Edge-Loading

Introduction: Pseudotumours (soft-tissue masses relating to the hip joint) following metal-on-metal hip resurfacing arthroplasty (MoMHRA) have been associated with elevated serum and hip aspirate metal ion levels, suggesting that pseudotumours occur when there is increased wear. This study aimed to quantify in vivo wear of implants revised for pseudotumours and a control group of implants revised for other reasons of failure.

Materials and Methods: A total of 30 contemporary MoMHRA implants in two groups were investigated in this Institutional Review Board approved study: (1) 8 MoMHRA implants revised due to pseudotumour; (2) 22 MoMHRA implants revised due to other reasons of failure (femoral neck fracture and infection). The linear wear of retrieved implants was measured using a Taylor-Hobson Roundness machine. The average linear wear rate was defined as the maximum linear wear depth divided by the duration of the implant in vivo. Mann-Whitney non-parametric tests were used to calculate the level of statistical significance for the differences in the non-normally distributed linear wear and wear rate between the implant groups. The incidence of edge-loading in each group was compared using the Fisher’s exact test.

Results: In comparison with the non-pseudotumour implant group, the pseudotumour implant group was associated with (Figure 1): (1) significantly higher median linear wear rate of the femoral component: 8.1 μm/year (range 2.75 - 25.4 μm/year) vs. 1.79 μm/year (range 0.82 – 4.15 μm/year), p=0.002; and (2) significantly higher median linear wear rate of the acetabular component: 7.36 μm/year (range 1.61 - 24.9 μm/year) vs. 1.28 μm/year (range 0.18 - 3.33 μm/year), p=0.001. Similarly, differences were also measured in absolute wear values. The median absolute linear wear depth divided by the duration of the implant in vivo was measured using a Taylor-Hobson Roundness machine.

Discussion: Significantly greater linear wear rates of the MoMHRA implants revised due to pseudotumour support the in vivo elevated metal ion concentrations in patients with pseudotumours. This study provides the first direct evidence to confirm that pseudotumour is associated with increased wear at the MoM articulation. Thus, soft-tissue pseudotumour, a clinical complication with a high revision burden, may represent a local biological reaction to increased wear debris burden, generated by excessive MoMHRA implant wear. Furthermore, edge-loading with the loss of fluid film lubrication may be the dominant wear generation mechanism in patients with pseudotumour. Further in vivo investigations are required to evaluate the risk factors of edge-loading as a mechanism responsible for increased wear in MoMHRA patients.

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Wear on the acetabular cup components in the pseudotumour group always involved the edge, indicating edge-loading of the bearing (Figure 2). In contrast, edge-loading was observed in only one acetabular component in the non-pseudotumour group of implants. The deepest wear was observed well within the bearing surface for the rest of the non-pseudotumour group. The difference in the incidence of edge-loading between the two groups was statistically significant (Fisher’s exact test, p=0.03).

Figure 1: Boxplots showing differences in the linear wear rates of the a) femoral head and b) acetabular cup components between the two implant groups.

Figure 2: Roundness profiles of a) edge-loaded and b) non-edge loaded acetabular cup components. The maximum wear area (shaded in yellow) is located at the edge of the cup for the edge-loaded (a), while the maximum wear area occurs well within the cup in the non-edge loaded cups (b).