Clinical Performance of Metal-On-Metal Hip Resurfacings

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Introduction: The current generation of hip resurfacings provides both patient and surgeons an option for providing a hip implant that is bone conserving for young and active patients. Performance of a resurfacing device depends on good design and materials. It also relies on good surgical technique for correct implant orientation.

The purpose of this study was to determine the *in vivo* wear of hip resurfacings from retrievals. All retrievals were "failures"; hence the components studied were worst cases. The wear effects of articulation on the edge of the acetabular cup were also investigated.

Methods: The wear of retrieved Birmingham Hip Resurfacing (BHR) heads and cups was assessed using a Taylor-Hobson Talyrond 290 roundness machine. Multiple roundness profiles were taken to locate the area of maximum wear on each component. Once the wear area was located, further roundness profiles were taken through the maximum wear area, from the edges of the components across the pole. Polar measurements were taken in two perpendicular axes. The unworn areas of the roundness profiles were fitted to a perfect circle. The maximum deviation of the profile from this circle was taken as the maximum linear wear. Components were also investigated using a Mitutoyo Co-ordinate Measuring Machine (CMM) to measure component dimensions.

Cups which showed the maximum area of wear crossing over the edge of the cup were classified as edge loaded. This was identified by roundness profiles at the equator of the cup and polar measurements through the worn area up to the rim of the cup. For all non-edge loaded pairs, the wear area on the cup was within the sphere of the cup.

In this study a total 50 BHR pairs were analysed. Patient information and X-rays were not provided in all cases.

Results: Of the 50 pairs analysed, 28 (56%) were classified as edge loaded, and 22 were not. The mean time *in vivo* for the edge loaded pairs was 3.36 years (range: 0.63 to 10.06), and 2.12 years (range: 0.37 to 5.84) for non-edge loaded pairs. The majority of the components had 42mm and 46mm diameters. There was no significant difference between the size distribution of edge loaded and non edge loaded pairs.

The edge loaded pairs display more linear wear than non-edge loaded components (Table 1). For the measured edge loaded components, no correlation was shown between time in vivo and maximum linear wear. X-rays for edge loaded joints displayed a generally more open cup orientation than those for non edge loaded pairs.

Results for non edge loaded pairs indicate that typically heads have greater linear wear than their corresponding cup (Figure 1). In 77% of the measured non-edge loaded pairs the head had greater linear wear than the cup.

Discussion: For non-edge loaded pairs the head typically has greater maximum linear wear than the corresponding cup. This may be due to the contact area on the cup being larger than on the head during normal gait. After the initial bedding in period, well orientated components exhibit a low wear rate.

It is well known that edge loading greatly increases the maximum linear wear of heads and cups. When the femoral head articulates over the edge of the acetabular cup the protective fluid film regime breaks down, leading to greater wear of the components. The edge loaded pairs have a far greater range of linear wear which may be as a result of the variation of the angles of the components *in vivo*. This is also influenced by large variations in kinetics, kinematics and perhaps component size. In metal-on-metal (MOM) joints excessive wear will lead to increased metal debris which may cause complications such as metallosis and metal sensitivity.

Edge loading may be caused by the high combined antiversion angle of both the head and cup, and the abduction angle of the cup. Impingement, causing subluxation of the hip joint, can also result in edge loading. The success of a hip resurfacing depends strongly upon articulation occurring within the sphere of the cup, which is reliant on good component orientation.

Conclusion: In cases where edge loading was not present, the wear of these components was satisfactory and comparable to that of successful first generation MOM implants.

	Non edge loaded		Edge Loaded	
	n	Mean ± STD	n	Mean ± STD
Head (µm)	22	5.28 ±2.41	28	47.31 ±64.87
Cup (µm)	22	3.50 ±1.83	28	54.04 ±89.29

Table 1: Linear wear data for *non edge* and *edge* loaded explants.

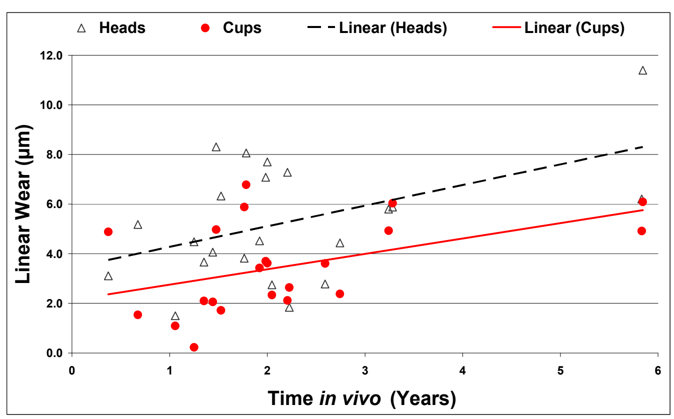

Figure 1: A graph of maximum linear wear and time *in vivo* for non edge loaded explants.