Metal Ion Levels and Component Positioning After Surface Replacement of the Hip. Early Results

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Introduction: Large diameter metal-on-metal bearings made from high-carbon, cobalt-chrome-molybdenum alloys have been increasingly used for both conventional total hip and surface replacement in recent years due to increased stability and reduced wear. The potential effects of elevated levels of metal ions remain a concern. Hip simulator testing (1) has predicted that large diameter components with a reduced clearance should reduce the volume of wear debris generated and the level of metal ion levels in-vivo. A prospective, multi-centre metal-ion study was undertaken in patients who received an articular surface replacement (DePuy ASR, DePuy International Ltd, Leeds, UK), the design of which was optimised to produce low levels of wear in line with lubrication theory.

Materials and Methods: Patients were recruited in 4 centres and included irrespective of clinical outcome. Whole blood samples were analysed using high resolution ICP-MS (Element2, Thermo Electron, Bremen, Germany). All values are given in ug/l. Cup inclination angles were measured from standard A/P radiographs. A total of 89 patients were recruited into the study (66 male, 23 female). Mean age at implantation was 59 years (range 31-69). Median cup diameter, 60mm (range 46-68).

Results: The number of patients available for study were, 75(0m), 62(3m), 65(12m), 50(24m). The 24 month median ion levels were 1.56ug/l and 1.65ug/l respectively for Cr and Co (Figure 1). This group comprised 40 males and 10 females.

The data is skewed by 6 patients who have either Co or Cr levels >10ug/l after 24 months implantation (Figure 2). Four of the 6 outliers were implanted with a high inclination angle (>55deg). These comprised 3/10 females and 3/40 males. Two of the outliers have since been revised. A detailed analysis (Figure 3) shows that ion levels were low for inclinations ≤55deg, with no Cr value and only 2/42 cobalt values exceeding 10ug/l. This is in contrast with inclinations >55deg when 4/8 Cr and Co exceeded this level. The mean ion levels in this study for cups implanted at ≤55deg was 2.3ug/l and 2.5ug/l for Cr and Co respectively. In contrast, of the 8 components implanted at >55deg the mean values were 12.6ug/l and 24.1ug/l for Cr and Co respectively. The mean pre-operative levels of 1.03ug/l and 0.65ug/l respectively.

High ion levels at 24 months could be predicted by intermediate levels after 12 months. Conversely those levels below 10ug/l had stabilised after 12 months in-situ.

Discussion: Comparison of ion levels in large diameter metal/metal bearings across studies is compounded by differences in measurement method, laboratory and fluids sampled (whole blood, serum, etc). Patient data sets can also be complicated by excluding patients (2,3) or comprising only a single centre (2,3,4). This study comprised all patients who were enrolled pre-operatively except those who failed to attend a specific follow-up or whose samples were known to have been contaminated. The correlation between high cup inclination and the rim wear of components has previously been reported (5). A recent study (6) reported similar results, with ion levels increasing significantly when inclination angles exceeded 50 deg. Large diameter metal/metal bearings can produce very low blood ion levels. However in agreement with other studies, mal-positioning of components, specifically inclination angles outside the accepted normal range, may lead to significantly elevated ion levels.