The Journal of Arthroplasty Vol. 25 No. 1 2010

Editorial

Metal on Metal: Is It Worth the Risk?

There has been an explosion in the use of metal-on-metal bearings in the last 5 years throughout the world. This has mostly been driven by the use of metal bearings in resurfacing, although metal heads have also been used in conjunction with primary total hip arthroplasties. The move to metal heads has primarily been driven by a desire to use larger articulations to reduce dislocations, although smaller metal head combinations are also available and are used clinically. The questions to be addressed in this editorial are firstly to ask if metal bearings do confer a clinical advantage and secondly to look at the potential downside with the use of metal heads.

There are some suggested advantages of metal-on-metal bearing surfaces. Metal-an-metal articulation allows the use of a larger femoral head to reduce dislocation [1-3]. Larger bearings have been shown to decrease the revision rates at 7 years in the Australian Registry [4]. A well-functioning metal-an-metal articulation, either resurfacing or total hip, has no risk of fracture with unlimited activity. The 20 years of experience with the McKee-Farrar implant and the 7 years of experience with hip resurfacing suggest a possible 20-year survivorship of more than 80% [5-7]. As with other hard-an-hard bearings, there appears to be substantial positional sensitivity.

The rational choice of a bearing surface would be that which confers the best clinical survivorship. Small personal series can give some insights, but probably the best evidence for the success or failure of a bearing can be obtained by National Joint Registries. The Australian National Joint Registry in 2008 showed that the bearing surface with the highest risk of revision was metal on metal [4]. This was statistically worse than a metal-on-polyethylene bearing, which was the most successful bearing. This finding was true for both heads less than 28 mm and heads greater than 28 mm.

In Australia, hip resurfacing has a significantly higher rate of failure at 7 years than conventional total hip arthroplasties. This is particularly evident in patients older than 70 years and with smaller-sized resurfacing articulations. In the UK Registry, at 3 years, hip resurfacing is performing significantly worse than a conventional total hip arthroplasty [8]. There is little evidence in the literature to support the use of large head metal-on-metal bearings either in conventional hip arthroplasties or in the form of resurfacing.

Wear is an inevitable consequence of total joint arthroplasty. Metal-on-metal bearings do produce significantly less volumetric wear than metal-on-polyethylene bearings in laboratory experiments and probably in vivo. However, as the metal-on-metal bearings produce such small particles, there is some evidence that they produce many hundred times more particles than metal-on-polyethylene bearings. Large head metal-on-metal bearings have been postulated to decrease wear as compared with smaller head bearings. This has not been shown in the literature. Most studies show higher wear of large metal-on-metal bearings when compared with 28-mm heads. A few studies have shown equivalence between large bearing heads and conventional heads, but no studies have shown a decrease in wear with large metal-on-metal bearings.

The consequence of wear with metal-on-metal bearings appears to be different to that with more conventional bearings. There are many early reports of osteolysis in metal-an-metal total hip arthroplasties. These are often postulated to be due to hypersensitivity; but the mechanism is not important, whereas the presence of osteolysis is important. Park et al [9] reported a series of metal-on-metal hips with only a 2-to 4-year follow-up and reported a 5.6% osteolysis rate with a higher rate of metal hypersensitivity in patients with lysis than controls. Willer et al [10] reported 19 early revisions for persistent pain with so-called second-generation metal-on-metal implants. Only 5 of these revisions had no major radiographic changes around the implant. Histology at revision suggested a lymphocyte-dominated, immunologic-related response. Korovessis et al [11] also showed a high early revision rate with metal-on-metal bearings and a significant rate of osteolysis. All histology on retrieval showed extensive metallosis.

As well as extensive osteolysis, soft tissue changes are seen around metal-on-metal bearings. These changes have been classified as pseudotumors or ALVAL. The incidence of these soft tissue changes appears to be increasing. Revision of these cases is difficult.

Often, the abductors are stripped from the proximal femur with extensive soft tissue loss. There is associated bony necrosis around much of the proximal femur. Early revision with such destructive changes of bone and soft tissue presents a great challenge for reconstruction. These changes are occurring early and are often more severe than expected on x-ray. Revision is difficult; and the outcome of revision for failed metal-on-metal bearings with pseudotumor is poor, with a greater than 50% re-revision rate reported in the short term in one series [12].

Systemic effects of metal-on-metal bearings are being reported increasingly in the literature. In 2006, Hart et al [I3] reported a significant decrease in the total lympho cyte count in patients with metal-on-metal bearings. Of great concern was the decrease in the CD8+T cells that fight intracellular pathogens and malignancies. These findings have again been reported in 2009, with a decreased CD8+T cell count in young patients with metal-on-metal total hip arthroplasties [14]. The possible basis for this was explored by Ogunwale et al [I5] in 2009 when they showed a decreased proliferation of CD8+T cells in the laboratory when the cells were exposed to metal ions. A dose-dependent cytotoxicity on macro phages to cobalt nanoparticles has also been reported in 2009 [16].

DNA changes induced by synovial fluid from retrieved hips were reported by Davies et al [17] in 2005. All 6 samples retrieved from chromium-cobalt metal-on-metal bearings were able to induce DNA damage in the laboratory. Although these changes have not been related to clinically increased risk of cancer, the findings are of concern.

Chromosome aberrations have also been reported in peripheral blood in patients with metal-on-metal total hip arthroplasties. A statistically significant increase in chromosomal translocations and aneuploidy in peripheral blood lymphocytes at 6, 12, and 24 months was identified [18]. These changes were progressive with time.

There has been no conclusive proof supporting the use of metal-on-metal bearings. There has been a worrying increase in osteolysis, local soft tissue reactions, and tissue and bone necrosis around metal-on-metal hip arthroplasties. The potential long-term toxicity of metal on metal is unknown, but there are now numerous reports showing significant affects on organs away from the articulation. The lack of a clinical advantage with metal bearings and the significant downsides to the use of metal-on-metal mean that, in the authors' opinion, this bearing option should be used with great caution, if at all.

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0883-5403/09/2501-0001$36.00/0
doi:10.1016/j.arth.2009.11.004

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