Soft tissue reactions to metal-on-metal hip arthroplasty are due mostly to surface wear

The relationship of wear and tissue reaction is linked to joint size and orientation, not gender.

By Robert Trace

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MANCHESTER — Researchers reported that adverse soft tissue reactions following metal-on-metal hip arthroplasty are typically due to increased wear of the bearing surfaces, and patients with smaller femoral heads may be particularly susceptible to these complications.

In an independent center study, David J. Langton, MRCS, and colleagues in the Joint Replacement Unit at the University Hospital of North Tees in Stockton, England, reviewed 155 Birmingham Hip resurfacings (BHR, Smith & Nephew) performed between 2002 and 2009 (mean follow-up, 60 months). They also studied 420 articular surface replacements (ASRs) and 75 total hip replacements using ASR XL implants (both DePuy Orthopaedics) with S-ROM stems (DePuy Orthopaedics) with a mean follow-up of 35 months.

"During this period, we experienced several failures with patients complaining of worsening groin pain at varying lengths of time postsurgery," Langton said at the British Orthopaedic Association Annual Congress 2009, here.

Aspiration of the hip joints yielded a large sterile effusion in each failure case, according to the study abstract. Langton said that at revision, there were "copious amounts of green-grey fluid with varying degrees of necrosis."

There were 22 failures of this nature in patients with ASR implants (4.4%) and no failures in the BHR group.

This 51-year-old man with ASR resurfacing had a spontaneous fracture at 3 years associated with gross macroscopic metallosis. His whole-blood chromium and cobalt...
concentrations were 29 and 69 mg/liter, respectively.

Images: Langton DJ

Necrosis

Tissue specimens taken from revision surgery showed varying degrees of necrosis, aseptic lymphocyte-dominated, vasculitis-associated lesions, as well as consistently high numbers of histiocytes. Particulate metal debris was also common, he said.

Patients who had adverse reactions to metal debris (ARMD) had a mean femoral size of 45 mm, a mean acetabular angle of 27° and a mean inclination angle of 53°. Among the asymptomatic patients, those numbers were 49 mm, 20° and 48°, respectively.

Explant analysis

Median blood chromium and cobalt levels were 29 and 69 µg/L, respectively, in the ARMD group vs. 3.9 and 2.7 µg/L, respectively, in the asymptomatic patients — a significant difference, he said.

Explant analysis using a coordinate measuring machine also confirmed greater rates of wear than expected in the patients with ARMD. Maximum linear wear rates were greater than 100 µ in a number of cases. Wear scars on the retrieved components were consistent with rim loading and likely subluxation of the femoral head.

Lymphocyte proliferation studies involving ARMD patients showed no hyper-reactivity to chromium and cobalt in vitro, implying that these adverse clinical developments "are mediated by a toxic reaction or localized immune response," Langton said.

"Our overall results suggest that the reduced arc of cover of the fourth-generation ASR cup has led to an increased failure rate secondary to the increased generation of metal debris. This failure rate is 7% in ASR devices with femoral components less than or equal to 47 mm," the researchers wrote in their abstract.
Coordinate measuring machine heat maps of the retrieved femoral component are shown here. The red areas represent wear depths of at least 40 microns (tolerance of diagram is +/- 30 microns). This large wear scar is consistent with anterior rim loading with likely anterior subluxation.

"Important" paper

Denis Atkinson, president of the New Zealand Orthopaedic Association, called the study "an important paper" and asked what the most important take-home messages were.

"I think we can say that the most important points are that increased wear causes more complications, and all hip resurfacing systems are not the same," Langton said.

"Also, we found that it is an issue of joint size and orientation, rather than simply an issue of gender. Size does matter because men with femoral components less than 49 mm have a 10% incidence of ARMD," he said. However, overall, women have a number of factors against them: smaller mean joint size, increased femoral anteversion, greater changes in pelvic tilt, and the orientation of the native female acetabulum, which may lead the surgeon to place a cup with greater angles of inclination/anteversion.

While increased angles of cup inclination and anteversion may lead to the most rapid failure, "We have also begun to experience later failures in ASR cups placed with inclinations and anteversion angles that are too low. These have been seen in men and have been associated with femoral fractures," Langton said.

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Reference:


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