

Magnetic Resonance Imaging findings in symptomatic versus asymptomatic subjects following metal-on-metal hip resurfacing implants

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Introduction. Metal-on-metal (MOM) hip resurfacing is an increasingly used alternative to conventional total hip arthroplasty. Despite overall good results, MOM hip resurfacing can be associated with an adverse local tissue response (ALTR) (1), which may manifest as synovitis or osteolysis. The purposes of this prospective, observational study were to review patterns of osteolysis and synovitis in symptomatic and asymptomatic subjects following MOM hip resurfacing and to correlate the MRI findings to demographic data, serum ion levels, component alignment and histology.

Methods. All methods were approved by the local Institutional Review Board with informed consent of subjects before enrollment in the study. *Patient cohort:* Patients were divided into asymptomatic, symptomatic with mechanical symptoms and symptomatic with unexplained pain. Demographic data was collected on gender, age, body-mass index (BMI) and the length of time since arthroplasty placement. Blood results of chromium (Cr) and cobalt (Co) ion levels were recorded. Acetabular component alignment was measured from radiographs and components were categorized as "safe" or "non safe", according to the zones of Lewinnek et al (2). *MR Image Acquisition:* All scanning was performed using clinical 1.5 Tesla clinical scanners (GE Healthcare, Waukesha, WI) and a 3 element shoulder coil (MedRad, Indianola, PA) or 8 channel cardiac coil (GE Healthcare, Waukesha, WI). Standard of care 2D FSE scanning was performed in three planes with the parameters: TE: 26-34 ms, TR: 4033-4500 ms, ETL: 18; BW: ± 100 kHz, FOV: 22 cm, NEX: 4-5, acquisition matrix: 512x352, slice thickness: 4 mm (3). A MAVRIC SL sequence (4) was performed in the coronal plane with the parameters: TE: 21-43 ms, TR: 4000-6000 ms, BW: ± 125 kHz, FOV: 22 cm, NEX: 0.5, acquisition matrix: 512x256, slice thickness: 4 mm. *Image Analysis:* Images were evaluated for volume of synovitis and osteolysis via manual segmentation. *Histologic/ operative correlation:* A subset of patients underwent revision surgery to a conventional total hip arthroplasty. Histology and operative records were reviewed for the presence of an adverse local tissue response. *Statistical Analysis:* A Wilcoxon rank sum test was performed to compare synovial volume of the symptomatic and asymptomatic groups. The Spearman correlation coefficient (r) was calculated between synovitis and demographic data, ion levels and radiographic data in the three groups. Statistical significance was taken at $p < 0.05$.

Results. 74 MOM hip resurfacings were scanned in 69 subjects (34M, 35F), comprising 22 asymptomatic hips, 20 mechanical symptomatic hips and 32 unexplained symptomatic hips. There was no significant difference in demographic data between the three groups. Synovitis was detected in 15 (68%) asymptomatic hips, 12 (75%) mechanical hips and 25 (78%) unexplained hips. The mean volume of synovitis was $5.0 \pm 6.9 \text{ cm}^3$ in the asymptomatic group, $10.2 \pm 15.9 \text{ cm}^3$ in the mechanical group and $31.0 \pm 47.3 \text{ cm}^3$ in the unexplained group. The presence or volume of synovitis did not differ significantly between the symptomatic and asymptomatic groups ($p=0.10$). Osteolysis was detected in 2 (10%) of the mechanical hips (mean volume $0.06 \pm 0.2 \text{ cm}^3$) and 4 (12.5%) of the unexplained hips (mean volume $2.7 \pm 10.1 \text{ cm}^3$). Osteolysis was not detected in the asymptomatic hips. Synovitis volume significantly correlated to length of implant placement ($r=0.35$, $p=0.049$), serum Cr ($r=0.35$, $p=0.05$) and serum Co ($r=0.75$, $p<0.001$) in the unexplained group.

The 13 subjects who underwent revision surgery were classified into two groups: ALTR or non-ALTR. The volume of synovitis on MRI was significantly higher in the ALTR group ($p=0.01$), as were levels of serum Cr ($p=0.045$) and Co ($p=0.01$). In the ALTR group there was a significantly higher proportion of females ($p=0.048$) and subjects with implants in the "non safe" zone ($p=0.03$).

Discussion. The results of this study confirm the utility of MRI as an assessment tool in patients with hip resurfacing arthroplasty. MRI is the most suitable non-invasive means by which to screen symptomatic and asymptomatic patients for the presence of synovitis. MRI can differentiate individuals with a normal pseudocapsule from those patients with synovitis, which, in combination with clinical findings and serum ion levels, will help to guide patient management. The finding of a high volume of synovitis on MRI should alert the clinician towards the need for close patient monitoring and possible revision surgery, particularly in the setting of elevated serum ion levels, female sex and abnormal component alignment.

References. 1. H.C. Amstutz, M.J. Le Duff, *Orth Clin Nth Am*, 42, 207 (2011) 2. G.E. Lewinnek et al. *JBJS*, 60, 217 (1978). 3. H. G. Potter et al., *JBJS Am* 86-A, 1947 (2004). 4. K.M. Koch et al., *Magn Reson Med*, 61, 381 (2009). **Acknowledgements.** Institutional research support was provided by General Electric Healthcare.

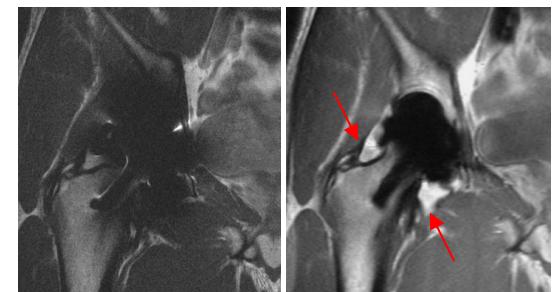


Figure 1 Coronal FSE (left) and MAVRIC SL (right) images demonstrate synovitis, seen only on the MAVRIC image (arrows).

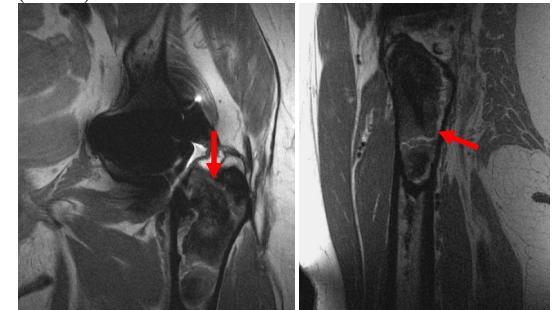


Figure 2. Coronal (left) and sagittal (right) FSE images demonstrate osteolysis replacing the normal high signal intensity marrow of the femur (arrows).

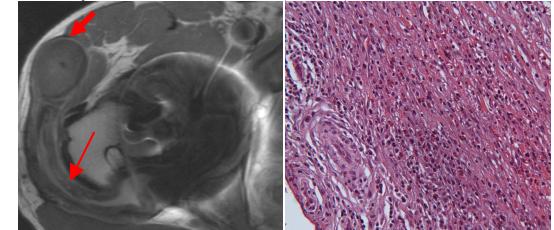


Figure 3. Axial FSE image (left) demonstrates synovitis decompressing into the trochanteric bursa (thin arrows) and adjacent extracapsular disease (thick arrow). Corresponding histology demonstrates a heavy lymphocytic infiltrate, consistent with ALTR.