

Orthopaedic Surgery: what do I need to know: Imaging MOM Implants and Complications

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Target audience: Radiologists and imaging scientists interested in assessing adverse tissue reactions around implants.

Outcome/Objectives:

1. To become familiar with different patterns of abnormal synovial response around implants
2. To become familiar with protocols using standardized and newer sequences which optimize tissue contrast and provide accurate diagnoses

Purpose: There is a high prevalence of adverse tissue reactions around implants in both symptomatic and asymptomatic patients and MRI is the most accurate means by which to assess synovial response and bone loss (*CORR 2005; 437:138-144; AJR 2012;199(4):884-93*).

- Metal on metal (MOM): modes of adverse reaction (*J Arthroplasty 2012;27(8 Sup):20-5*)
 - Cell mediated: DTH reaction driven by lymphocyte reaction; CD4 helper T cells activate macrophages and produce interleukins which activate eosinophils, resulting in local tissue damage : ALVAL; adverse local tissue reaction (ALTR)
 - Foreign body reaction due to metallic debris; macrophage related (increased risk with abnormal radiographic measurements)
- MOP/COP: Tribocorrosion: corrosion (electrochemical reaction between slightly different metallic composites) and wear (mechanical degradation process due to offset geometry) around modular THA
 - May be modular neck head junction, modular stem or at trunnion
- Infection: lamellated synovial response with edema (*Radiology 2013;266:256-60*)
- Recent data suggest that ASTM testing recommendations are limited (*AJR 2014;203(1):154-61*)

Methods and Results: (*JBJS(A) 2013, 95(10):895-902.*)

- Assessment of 73 hips (68 pts) both symptomatic and asymptomatic RSA demonstrated that synovitis was present in a similar proportion in each group
- Coefficient of repeatability between two MR radiologists was 0.25cm³ for osteolysis and 1.8cm³ for synovitis

MRI as a biomarker for ALTR: (*CORR 2014;472(2):471-81*)

- 70 MOM hips in 68 pts with preoperative 1.5T GEHC MRI using an optimized protocol including the MAVRIC prototype
- 13 MRI variables assessed including synovial volume and osteolysis
- All patients underwent revision arthroplasty with intraoperative assessment and tissue biopsy (loosening 11; malalignment 4; infection 1; **unexplained pain 54**) (*Nat J Regist*)
- Random forest decision trees (machine-based decision analysis tool) were calculated to categorize observations by majority vote and provide a mechanism for ranking predictor importance
- Sensitivity/specificity of 90%/86% for ALVAL of ≥ 5 and 94%/87% for predicting intraoperative damage (HIGHER than that reported for serum metal ion levels)

Discussion:

- MRI is highly sensitive and specific in identifying patients with failing MOM arthroplasties secondary to high ALVAL scores and predicting intraoperative tissue damage
- MRI classification and predictive modeling provides an objective tool to identify at-risk patients and aid toward timely revision
- May be used as surveillance tool for both symptomatic and asymptomatic patients with MOM devices as well as corrosion effects from other constructs

- MOST ACCURATE TEST TO DETECT ADVERSE SYNOVITIS AND BONE LOSS
- ALTRs occurs with ALL bearing constructs in both symptomatic and asymptomatic patients
- Maximum synovial thickness is highly correlated with a diagnosis of ALVAL in patients with a modular head-neck and neck-stem implant
- Radiographic measurements, clinical symptoms or serum ion levels alone do not predict the presence and extent of wear-induced synovitis
- New phase contrast measurements may quantify load in soft tissues
- Additional clinical applications will be shown, including imaging around fracture hardware (AVN), nerve impingement, component malalignment (*JBJS(B) 2012;94(9):1209-1*), loosening

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