Modes of Failure in Metal-on-Metal Total Hip Arthroplasty

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KEYWORDS

• Total hip arthroplasty • Metal-on-metal • Adverse tissue reactions • Corrosion • Cobalt-chromium

KEY POINTS

- When evaluating any patient with a painful total hip arthroplasty, a systematic approach is mandatory regardless of bearing type.
- In metal-on-metal hips, bearing malfunction can occur without the presence of symptoms.
- Metal corrosion and adverse local tissue reaction may occur because of problems with the articulation or any modular junction of the implant.
- Ion levels and cross-sectional imaging techniques (MRI, ultrasound) are beneficial in evaluating a metal-on-metal THA.
- Stratifying the MoM patient into low, moderate, or high risk can help the diagnostic and treatment algorithm.

INTRODUCTION: NATURE OF THE PROBLEM

Metal-on-metal (MoM) total hip arthroplasty (THA) made a resurgence because of its improved wear characteristics, promise of longevity, and lower dislocation rates in the early 2000s.[1,2] By 2006, 35% of primary THA in the United States were MoM articulations. It was estimated that more than 1,000,000 MoM articulations had been implanted worldwide since 1996.[3] Recently, adverse local tissue reactions (ALTRs) associated with these bearings has curbed enthusiasm for their use. New modes of failure associated with these bearings have been identified, in addition to the traditional failure mechanisms.

The evaluation of a failed MoM THA must begin systematically, and should be similar to the evaluation of any problematic THA. Traditional modes of failures, such as instability, infection, tendinitis, aseptic loosening, periprosthetic fracture, and referred pain, must be thoroughly evaluated as potential causes of pain before attributing the source of the problem to the metal bearing.[2,4,5] Once these issues have been ruled out, bearing-related problems, such as tissue necrosis, modular junction corrosion, skin hypersensitivity, and systematic cobaltism, should also be considered.

Histologically ALTRs appear as a lymphocytic inflammatory response that leads to vasculitis-induced necrosis of soft tissue and bone. The terms aseptic lymphocytic vasculitis-associated lesions (ALVAL), pseudotumor, and metallosis have all been used as umbrella terms in the literature to describe the soft tissue destruction caused by metal-metal junctions and articulations in THA.[1,2,4–10] The more commonly accepted term

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for these problems is ALTR. This article presents the evaluation and treatment of modes of failure unique to MoM THA.

EVALUATION OF PAINFUL METAL-ON-METAL TOTAL HIP ARTHROPLASTY: A DIAGNOSTIC ALGORITHM

The evaluation of a painful MoM THA is multifaceted, focusing on history and physical examination, radiography, laboratory values, and cross-sectional imaging. A thorough review of systems must be performed because systemic cobaltism has been reported.[11]

Patient History

A thorough patient history is essential in the evaluation of a patient with painful MoM THA.

- The location, duration, and severity of pain are essential to the evaluation.
- Exacerbating or alleviating factors should be noted.
- Signs or symptoms of infection must be delineated in the history, because this changes the diagnostic and treatment algorithm.
- The skin should be inspected for previous scars, dermal reaction, or signs of infection.
- One must also assess for potential hypersensitivity reactions, because these may manifest as past dermatitis in those patients with metal allergy to nickel jewelry.
- A complete review of systems may also unveil systemic issues caused by metallosis (**Boxes 1** and **2**).

Box 1
Questions to consider in the evaluation of a symptomatic MoM patient

Where is the pain?

How long has the pain occurred?

Was there a pain-free interval?

Is there start-up pain?

Is there thigh pain (stem or socket pain)?

Is there groin pain (socket pain)?

Do they have mechanical symptoms?

Exacerbating activities?

Alleviating activities?

Constitutional symptoms?

Instability events?

Box 2
Questions asked during a review of systems because of multiorgan toxicity of cobalt and chromium

Have you had any change in your vision?

Have you experienced any ringing in your ears, difficulty hearing, or dizziness?

Have you experienced recurrent rashes?

Do you have a tremor, difficulty remembering things, or numbness and tingling in your feet and hands?

Do you have shortness of breath?

Do you have mood swings, fatigue easily, or have gained weight lately?

Physical Examination

Physical examination remains important in the evaluation of any painful THA.

- The skin should be inspected for previous scars, dermal reaction, or signs of infection.
- Palpation should be performed to detect any areas of pain or a soft tissue mass.
- Complete neurovascular examination.
- Range of motion of the hip joint and abductor muscle strength testing should be routinely performed.
- Any gait abnormalities, such as a Trendelenburg gait, should be noted.
- Is the pain reproduced by supine or reverse straight leg raising (radiculopathy)?
- Is the pain reproduced by trochanteric palpation (trochanteric bursitis)?
- Is the pain reproduced by resisted hip flexion (iliopsoas tendonitis)?

Radiographic Evaluation

After a complete history and physical, evaluation of a painful MoM THA should proceed with standard radiographs examining implant type and component position, and signs of loosening or osteolysis. One must pay close attention to component malposition, because this has been shown to correlate with increased ion levels and wear. A high abduction angle leads to diminished bearing lubrication leading to increased ion release and soft tissue reactions.[12–17] Radiographic evaluation of the failed THA should include an anteroposterior view of the pelvis and a cross-table lateral view of the affected hip. Both the acetabular and femoral components should be examined closely for signs of loosening or ingrowth. Judet views may be necessary to evaluate for osteolysis or loosening.