



Case report

Unusual presentation of failed metal-on-metal total hip arthroplasty with features of neoplastic process

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ABSTRACT

Metal-on-metal (MoM) total hip arthroplasty (THA) is associated with increased incidence of failure from metallosis, adverse tissue reactions, and the formation of pseudotumors. This case highlights a 53-year-old female with an enlarging painful thigh mass 12 years status post MoM THA. Radiographs and advanced imaging revealed an atypical mass with cortical bone destruction and spiculation, concerning for periprosthetic malignancy. Open frozen section biopsy was performed before undergoing revision THA in a single episode of care. This case illustrates that massive pseudotumors can be locally aggressive causing significant femoral bone destruction and may mimic malignancy. It is important that orthopaedic surgeons, radiologists and pathologists understand the relative infrequency of periprosthetic malignancy in MoM THA to mitigate patient concerns, misdiagnosis, and allow for an evidence based discussion when treating massive pseudotumors.

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Introduction

Metal-on-metal (MoM) total hip arthroplasty comprised 31% of the total hip arthroplasty market in North America in 2007, but high failure rates associated with metallosis and adverse tissue reactions have resulted in most surgeons abandoning the use of MoM total hips [1]. Multiple issues surround the use of these implants including the generation of metal ions, trunnion wear, aseptic loosening, soft tissue necrosis, and the formation of pseudotumors. Pseudotumors have been found in symptomatic and asymptomatic patients with a prevalence of 1%–39% [2–4]. In the orthopaedic literature, there are no documented cases of degeneration of a pseudotumor into a true neoplasm. Occasionally, very large pseudotumors may have features concerning for malignancy because of their size, radiographic appearance, and cytopathology, as bone and soft tissue destruction can be common in both MoM

disease and neoplasms [5]. Unfamiliarity with pseudotumors may lead radiologists and clinicians to interpret these masses as worrisome for malignancy.

We present the following case to show an example of clinical, radiologic, and histopathologic findings of massive pseudotumor formation with significant metadiaphyseal medial calcar erosion, reactive bone formation, and features that mimic primary periprosthetic malignancy after MoM total hip arthroplasty.

Case history

Informed consent was obtained to publish de-identified information regarding the patient's care surrounding her revision left total hip arthroplasty.

This 53-year-old female underwent left total hip arthroplasty for idiopathic osteonecrosis at an outside hospital system in 2003, and was asymptomatic without further hip surgery for 12 years. While the patient was undergoing a hysterectomy in November 2014, her gynecologist noted that she had a large left thigh mass precluding positioning for her procedure. An outside orthopaedist was consulted for initial workup of a large thigh mass after MoM total hip arthroplasty.

Initial laboratory findings from the outside institution were remarkable for elevated inflammatory markers (erythrocyte sedimentation rate 55 mm/h, C-reactive protein 6.636 mg/dL) and

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elevated metal ion levels (cobalt 1.6 ppb, chromium 0.4 ppb). The patient's preoperative and postoperative MoM total hip arthroplasty radiographs are shown in Figures 1a-c and 2a and b, and reveal significant femoral calcar destruction extending into the metadiaphysis and cortical spiculation. Advanced imaging was obtained to further characterize the soft tissue mass and cortical destruction. Selected computed tomography images (Fig. 3a-e) show a 20-cm soft tissue mass proximal and distal to the left hip, with destruction of the medial proximal femur. Magnetic resonance images (MRI) shown in Figure 4a-f reveal thigh mass heterogeneity. The outside orthopaedist and radiologist were concerned for a primary neoplastic process, and the patient was referred to our tertiary center. On initial evaluation at our institution, the patient had increasing left hip pain and was partial weight bearing on a cane. The patient had a large palpable thigh mass with decreased hip range of motion. She denied any constitutional symptoms and an otherwise unremarkable medical history.

The patient's index operative report confirmed a 52-mm M2a acetabular component (Biomet, Warsaw, IN) with a 32-mm inner diameter cobalt-chromium acetabular liner. A 32-mm cobalt-chromium head ball without an adaptor sleeve and a titanium Bi-Metric femoral component (Biomet, Warsaw, IN) were used. The diagnosis of failed MoM hip with massive pseudotumor formation was established, but because of the size of the mass, bone loss, and imaging, malignancy could not be definitely ruled out. In January 2015, the patient underwent open biopsy, resection of the proximal thigh mass, and revision of both acetabular and femoral components through the prior posterior approach. Intraoperative frozen sections were sent to pathology, and were remarkable for necrosis and acute inflammation without evidence of malignancy. The final pathology revealed fibrous tissue, organizing blood, sheets of amorphous eosinophilic fibrin, and necrotic tissue with associated acute inflammation without evidence of tumor (Fig. 5). Intraoperatively, the implants were well fixed in the femur and acetabulum. There was significant erosion of the greater trochanter, and an intraoperative periprosthetic fracture occurred during removal of the femoral stem. The greater trochanteric fragment was stable with digastric muscle attachment, and fixation was not required. The patient was revised to a multihole porous metal acetabular shell and a modular tapered stem with ceramic on polyethylene articulation (Biomet G7/Arcos, Warsaw, IN; Fig. 6a-d).

The patient's postoperative course was uneventful. She followed up at routine intervals and progressed well with physical therapy and was full weight bearing by 6 weeks. At 18 months follow up, the patient was able to ambulate 2-3 blocks without ambulatory assistance and required a rail for assistance with stair ambulation. She has mild occasional pain and is pleased with her left hip. The trochanteric fragment healed uneventfully.

Discussion

More than 1 million contemporary MoM bearings have been used in total hip arthroplasty since 1996 [6], with proposed benefit of increased stability and improved wear performance. However, significant concerns emerged when national registry data reported 2 to 3-fold increase in revision rates with MoM implants [7,8]. Adverse local tissue reactions (ALTR) were originally described as a complication of MoM bearings themselves, but metal debris from fretting corrosion of the head-neck taper in modular total hips have also been shown to contribute to ALTR and potentially aseptic lymphocyte-dominated vasculitis associated lesion [9].

Large MoM heads have been shown to increase the risk of trunnionosis because of increased stress and torque on the head-neck taper by enhancing the effect of mechanically assisted

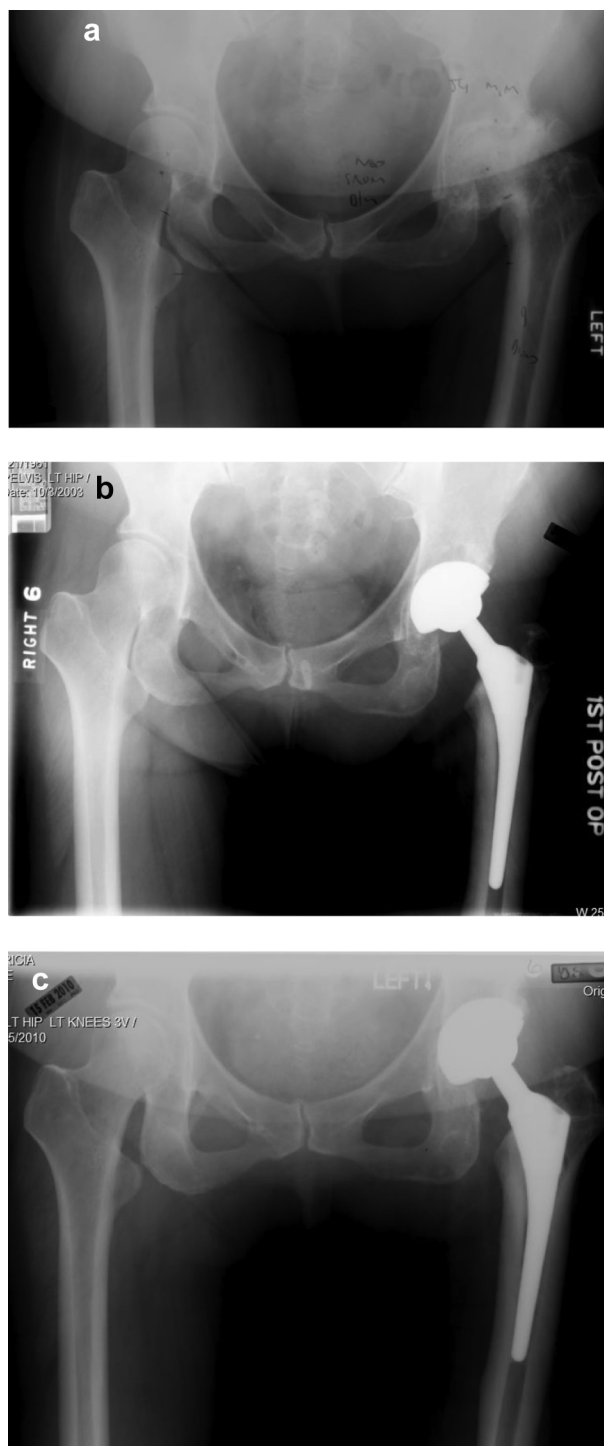


Figure 1. (a) Preoperative anteroposterior (AP) pelvis radiograph 05/2003 showing severe degeneration of the left hip. (b) Postoperative AP pelvis radiograph 10/2003 with appropriately placed acetabular and femoral components. (c) AP pelvis radiograph 2/2010 without interval change with well-placed acetabular and femoral components.

crevice corrosion between dissimilar metals contributing to ALTR [10,11]. ALTR have been described as periarticular fluid collections, soft tissue masses (pseudotumors), medial calcar erosion, and can cause gluteal muscle necrosis [12].

The presentation of this patient's failed MoM total hip arthroplasty case is remarkable in that the massive size of the

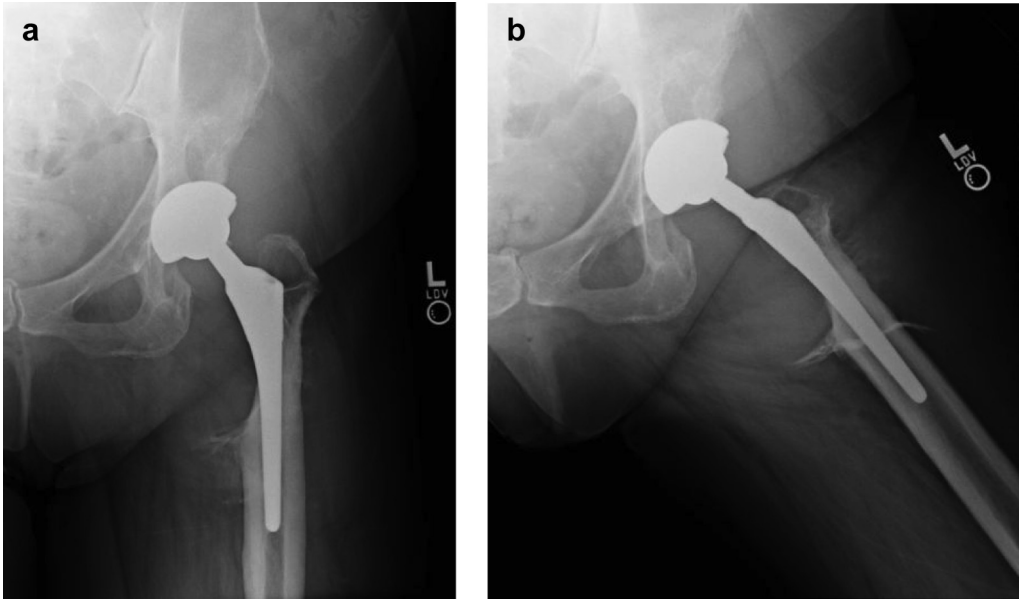


Figure 2. (a, b) AP and lateral radiographs of the left hip from December 12, 2014 showing severe metadiaphyseal femoral cortical bone loss with spiculation with retained MoM hip arthroplasty.

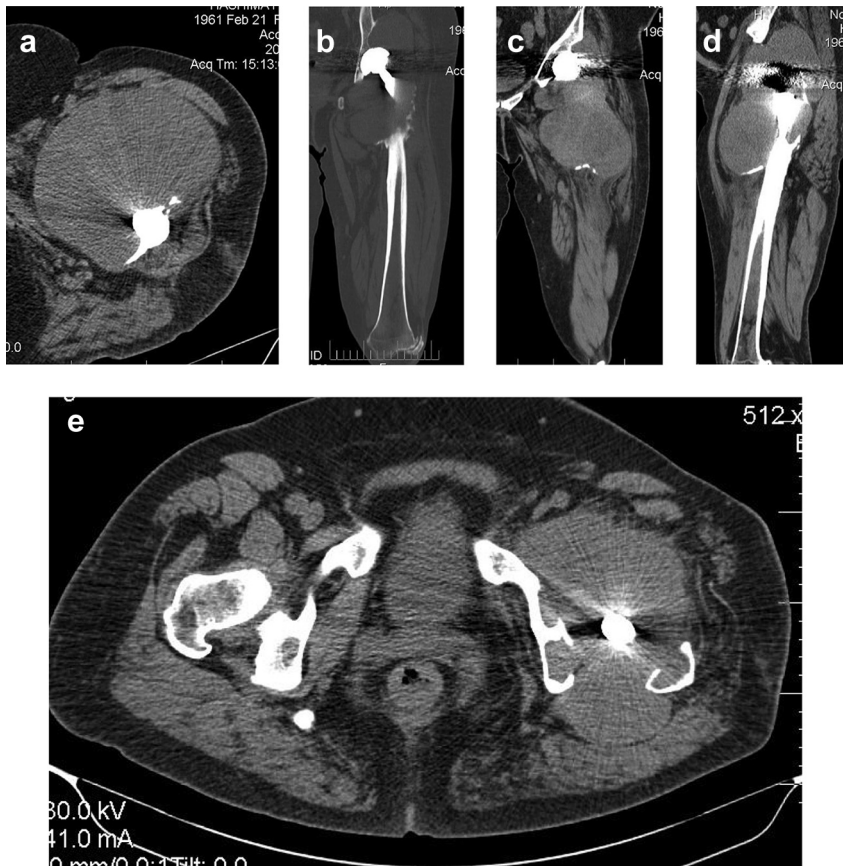


Figure 3. (a-e) Axial and coronal computed tomography (CT) images from December 22, 2014 showing the large soft tissue mass surrounding the left hip with severe cortical destruction of the proximal femur.

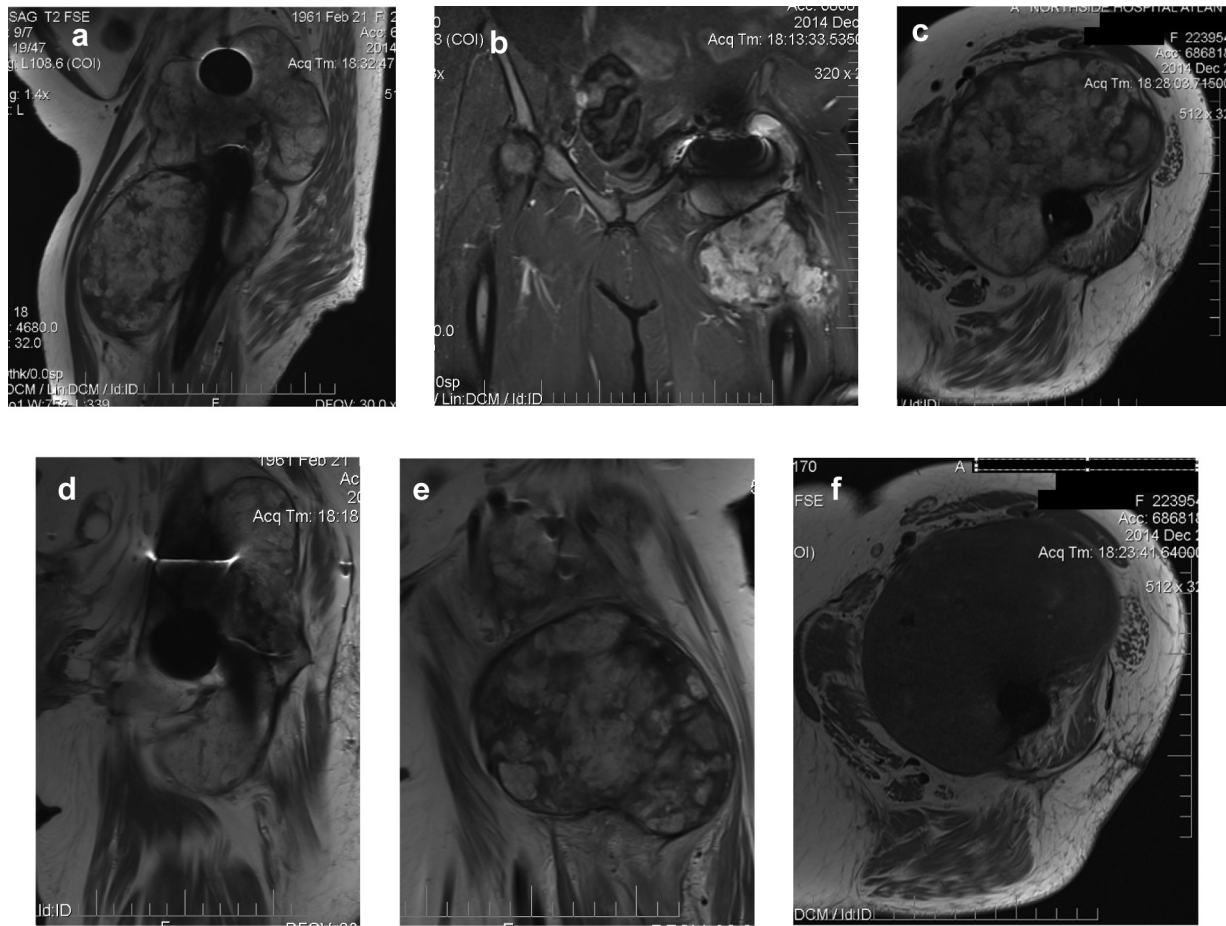


Figure 4. (a-f) Axial, coronal, and sagittal CT imaging from December 26, 2014 illustrating the large soft tissue mass with heterogeneity. The mass extends proximal and distal to the hip joint.

pseudotumor and radiologic findings were concerning for a neoplastic process. Radiographs of the hip revealed cortical spiculation and a significant amount of calcar destruction extending into the metadiaphysis, which can be seen with local malignant neoplasms. The MRI radiology report also states that sarcomatous degeneration cannot be ruled out. Because of the potential for a neoplastic process, an intraoperative frozen section was performed to rule out malignancy. The large necrotic and vascular mass was removed and permanent cytopathology definitely ruled out malignancy.

The authors propose that the mechanism of the formation of this massive pseudotumor and significant medial femoral bone erosion is from a lymphocyte-dominated cytotoxic reaction to metal debris that has been well reported in the literature. In particular, the Biomet M2a acetabular shell (32 mm inner diameter metal liner) with articulation of the cobalt-chromium head ball contributed to the metal debris as well as the head-taper junction of dissimilar metals (cobalt-chromium, titanium). It has been reported that the Biomet M2a releases less cobalt than other manufacturers because of its titanium adaptor sleeve for the trunnion [13]; however, this patient had a 32-mm +6 cobalt-chromium head ball without a taper adapter and corrosion was found intraoperatively at the head-taper junction. Bosker et al [14] has also confirmed the high incidence of head-taper corrosion of M2a-trunnions. This particular pseudotumor also caused a significant amount of metadiaphyseal calcar erosion that is more extensive than most reports in the literature, and is commonly a

late finding in failed MoM hips [2]. Mandanat et al reported on medial calcar erosion typically being seen in modular neck style stems, but confirmed that medial calcar erosion can also be seen in nonmodular neck stems associated with synovial

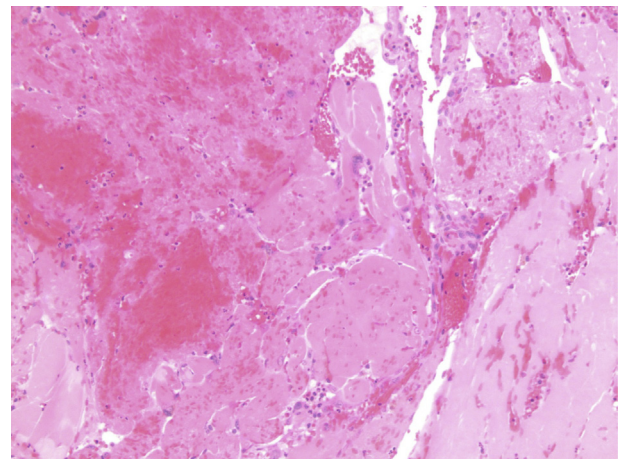


Figure 5. Histopathologic specimen showing aggregates of organizing fibrin encircled by benign endothelial cells, sheets of amorphous eosinophilic fibrin and blood clot showing focal organization with macrophage infiltration and ingrowth of granulation tissue. Necrosis and acute inflammation were also noted focally, but these were not conspicuous features (hematoxylin and eosin, 100×).



Figure 6. (a, b) Immediate postoperative AP pelvis and lateral left hip radiograph from January 26, 2015 with revision hip implants and greater trochanteric fracture. (c, d) Postoperative AP and lateral left hip radiographs with healing of the greater trochanter fracture and stable revision left hip arthroplasty implants in appropriate alignment without the evidence of hardware failure.

thickening >3 mm. This patient had a proliferative synovium and medial femoral metadiaphyseal erosion that is a late finding and may represent the natural course of large pseudotumors that remain untreated for extended periods of time. Because the severe

proximal femoral bone loss compromised most of the femoral component's ongrowth surface, the Bi-Metric stem could not be retained because of eminent loss of osseointegration. It is the authors' preference in many MoM revisions to maintain the stem

and accept taper corrosion, as long as the structural integrity of the trunnion is maintained. This is typically performed by using a titanium sleeve adapter and a ceramic femoral head. This often avoids the morbidity associated with femoral component removal [15].

Classically, pseudotumors have been described as granulomatous nonseptic and nonneoplastic masses resulting from a circumscribed fibrous exudate. The prevalence of pseudotumor formation after MoM total hip arthroplasty is 1%–39% [2–4]. There has been no published data of neoplastic degeneration of pseudotumors in the orthopaedic literature. In contrast, periprosthetic primary malignant neoplasm are rare in the setting of hip arthroplasty with an incidence of 1.43/100,000 [16]. Malignant fibrous histiocytoma is the most common periprosthetic soft tissue malignant neoplasm. Despite the relative increased incidence of pseudotumor formation and the rarity of malignant neoplasm, patients are often concerned on the discovery of a periprosthetic mass. Unfamiliarity with pseudotumors may lead radiologists and clinicians to interpret masses as worrisome for malignancy. There have been reports of the misdiagnosis of pseudotumors as spindle cell sarcoma on cytopathology [5].

Summary

This case illustrates several issues surrounding MoM hips and large pseudotumor formation. Despite the relative infrequency of malignancy, concern in this case was generated by the size of the mass, bone destruction, and MRI findings, which then mandated malignancy be ruled out with open frozen section biopsy before reconstruction. It is important that orthopaedic surgeons familiarize themselves with these circumstances to mitigate undue patient concerns regarding a thigh mass, and allow for an evidence-based discussion with fellow radiologist and pathologist when treating massive pseudotumors. This case also highlights the fact that the patients with MoM hips who do not undergo surveillance can sustain significant bone loss and soft tissue destruction that may resemble a malignant process with extensive medial femoral metadiaphyseal bone loss. The Food and Drug Administration has recommended routine surveillance of asymptomatic patients with MoM implants every 1–2 years, and a thorough workup for symptomatic patients if symptoms are present for greater than 3 months after MoM arthroplasty [17]. The reconstruction of patients with late presentation of massive pseudotumor and bone loss may result in complications such as

periprosthetic fracture, as in the case. The importance of routine surveillance and early intervention cannot be overstressed in failed MoM hips.

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