

Metallosis Following Bipolar Hemiarthroplasty Due to Polyethylene Wear: A Case Report

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Abstract

Metallosis following bipolar hemiarthroplasty is an uncommon complication that can result from wear of the concealed polyethylene bearing within the bipolar head. We report the case of a 54-year-old man who presented with six months of progressive right hip pain, four years after bipolar hemiarthroplasty for a transcervical fracture of the femoral neck. Laboratory investigations showed no evidence of infection. Radiographs and computed tomography demonstrated eccentric positioning of the femoral head within the bipolar cup, with peri-trochanteric and acetabular osteolysis and a contained supra-acetabular bone defect measuring approximately 2×2 cm. During revision surgery, extensive blackish discoloration of the periprosthetic tissues consistent with metallosis was observed. Examination of the retrieved bipolar head demonstrated complete wear-through of the inner polyethylene liner, resulting in direct metal-on-metal articulation between the inner and outer metal components and generation of substantial metallic debris. A two-stage revision was performed. Extended trochanteric osteotomy was required for femoral stem extraction, followed by extensive debridement and placement of an antibiotic cement spacer. After eight weeks, iliac crest bone grafting was performed for the acetabular defect and the patient underwent conversion to cementless total hip arthroplasty. Histopathological examination confirmed metallosis. At follow-up, the patient was pain-free and independently mobile. This case highlights that concealed polyethylene wear within a bipolar head can progress to direct metal-on-metal articulation, metallosis, osteolysis, and prosthetic failure. Eccentric positioning of the femoral head in a painful bipolar hemiarthroplasty should prompt careful evaluation for polyethylene bearing failure, even when inflammatory markers are normal. Early recognition and appropriate staged revision can facilitate management of extensive metallosis and bone loss.

Categories: Orthopedics

Keywords: aseptic osteolysis, bipolar hemi-arthroplasty, metal-on-metal, polyethylene wear, total hip arthroplasty revision

Introduction

Bipolar hemiarthroplasty is commonly performed for displaced femoral neck fractures, particularly in elderly and physiologically compromised patients. Its dual-bearing design consists of an inner polyethylene liner that articulates with the femoral head and is enclosed within a larger metallic outer shell that articulates with the native acetabulum. This design is intended to provide a low-friction bearing and reduce acetabular cartilage wear [1].

Wear of the concealed inner polyethylene liner is a recognized but uncommon complication of bipolar hemiarthroplasty. Because the inner bearing is not directly visible on conventional radiographs, progressive wear may remain clinically unsuspected until substantial damage has occurred. Complete wear-through of the polyethylene liner can result in direct metal-on-metal contact between the inner femoral head and the outer bipolar shell. This abnormal articulation generates metallic debris and may produce extensive metallosis, periprosthetic osteolysis, bone loss, aseptic loosening, and eventual prosthetic failure [2,3].

We report a case of extensive metallosis and periprosthetic bone loss caused by complete wear-through of the concealed polyethylene liner four years after bipolar hemiarthroplasty. The case highlights the importance of recognising eccentric femoral head positioning in a painful bipolar hemiarthroplasty can be due to accelerated polyethylene wear which can lead to extensive metallosis. Excellent results with timely surgical intervention in such situations has been reported in the past [4].

Case Presentation

A 54-year-old man presented with a six-month history of insidious, progressively worsening pain in the right hip. The pain was aggravated by movement and significantly restricted his daily activities. He had undergone right bipolar hemiarthroplasty four years earlier for a transcervical fracture of the femoral neck. He had no other significant medical history.

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On examination, the previous surgical scar was well healed. Hip movements were painful and restricted. Laboratory investigations, including inflammatory markers, showed no evidence of infection (Table 1). Plain radiography demonstrated eccentric positioning of the femoral head within the bipolar cup (Figure 1). Plain radiography demonstrated osteolysis around the proximal end of the femoral stem (Figure 1). Computed tomography (CT) further demonstrated osteolytic changes around the proximal femoral stem, eccentric position of the femoral head in the bipolar cup, along with a contained supra-acetabular bone defect (Figure 2).

Laboratory parameter	Patient value	Unit	Reference range	Interpretation
Hemoglobin (Hb)	13	g/dL	13–17 g/dL	Within normal range
Total leukocyte count (WBC)	8000	cells/μL	4,000–11,000 cells/μL	Within normal range
Neutrophils	50	%	40–70%	Within normal range
Lymphocytes	25	%	20–40%	Within normal range
Platelet count	1.5 lakh	cells/μL	1.5–4.0 lakh cells/μL	Within normal range
Erythrocyte sedimentation rate (ESR)	10	mm/h	0–15 mm/h	Within normal range
C-reactive protein (CRP)	2	mg/L	<5 mg/L	Within normal range

TABLE 1: Preoperative laboratory investigations

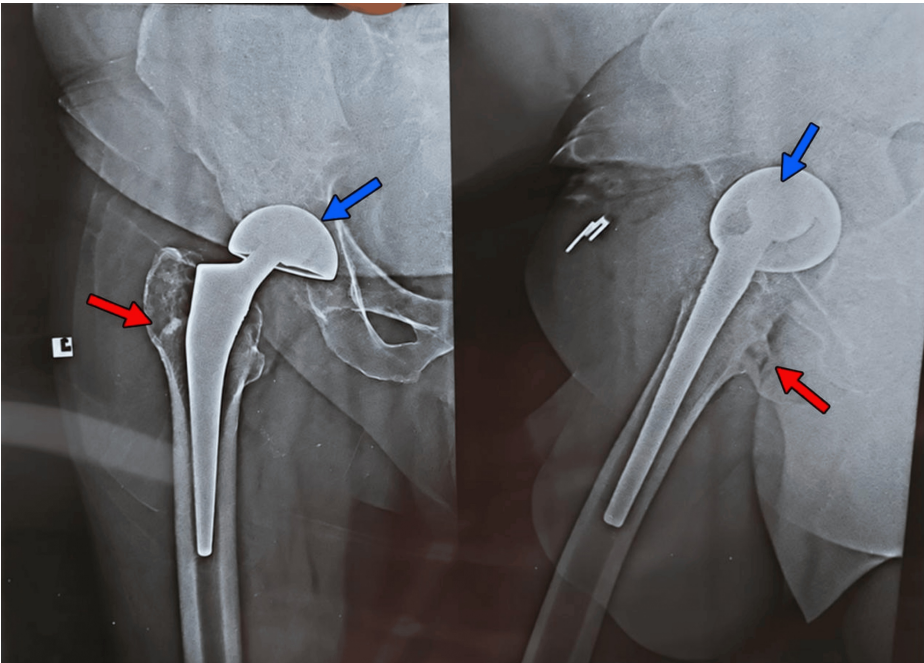


FIGURE 1: Anteroposterior and lateral radiographs of the right hip showing eccentric position of the inner femoral head with in the bipolar cup (blue arrow) and osteolysis around the proximal femoral stem (red arrow).



FIGURE 2: Coronal CT scan showing eccentric position of the femoral head (green arrow) and contained supra-acetabular defect (orange arrow).

In view of the patient's progressive symptoms, eccentric femoral head positioning, and radiological evidence of osteolysis, revision surgery was planned. Intraoperatively, extensive blackish discoloration of the periprosthetic tissues consistent with metallosis was encountered (Figure 3). The bipolar head was separated and examined. The inner polyethylene liner showed complete wear-through, resulting in direct metal-on-metal contact between the inner femoral head and the outer metallic bipolar shell (Figure 4). This unintended articulation was identified as the source of the extensive metallic debris.



FIGURE 3: Retrieved bipolar head assembly after removal, showing complete wear-through of the polyethylene liner within the cup with a resulting metal-on-metal articulation between the inner and outer heads.

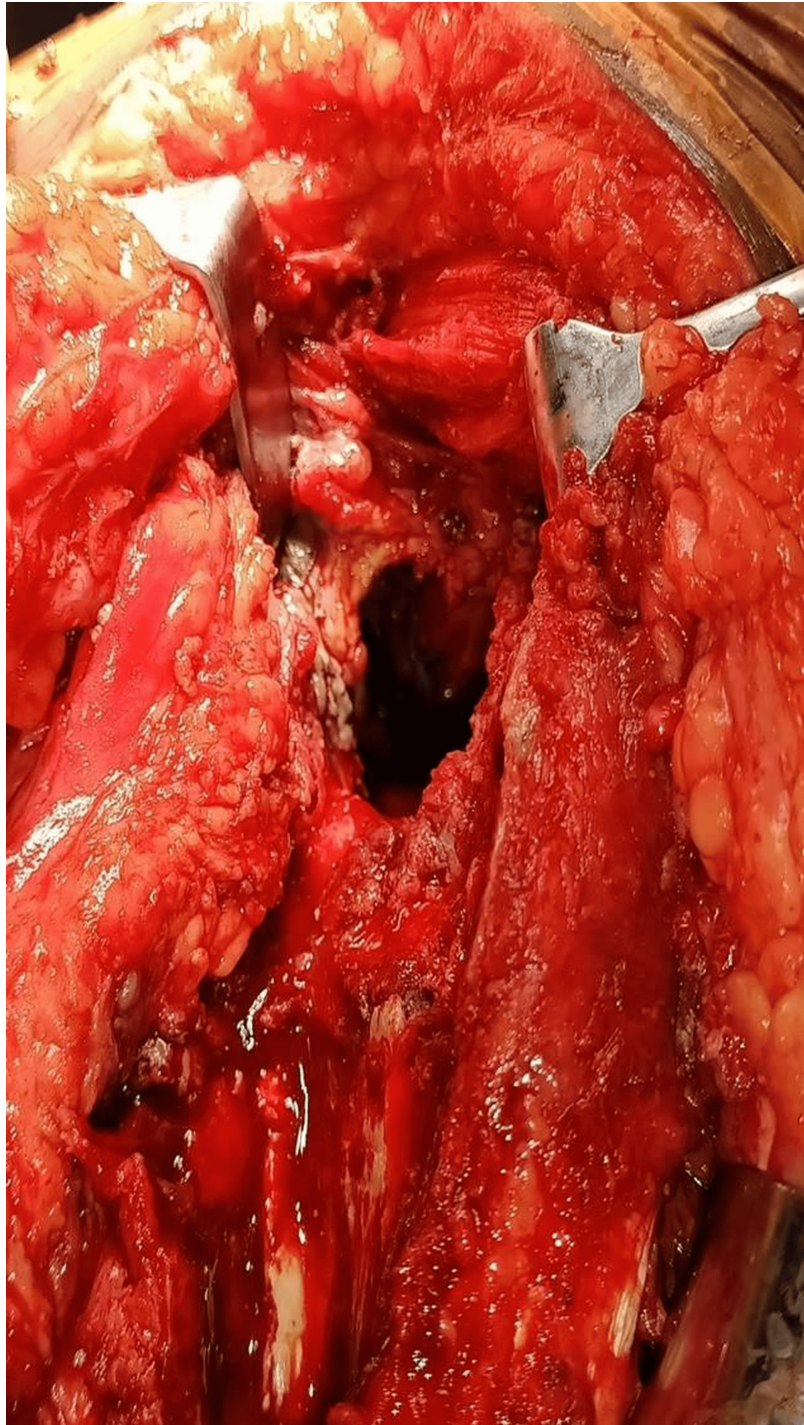


FIGURE 4: Acetabular bone defect visualised at the postero-superior wall following removal of the bipolar prosthesis.

The femoral stem was difficult to extract because of its fixation and surrounding bone loss. An extended trochanteric osteotomy was therefore performed to facilitate controlled removal of the stem. Extensive debridement of the metallosis tissue was carried out, and an antibiotic-loaded cement spacer was inserted as the first stage of revision (Figure 5).

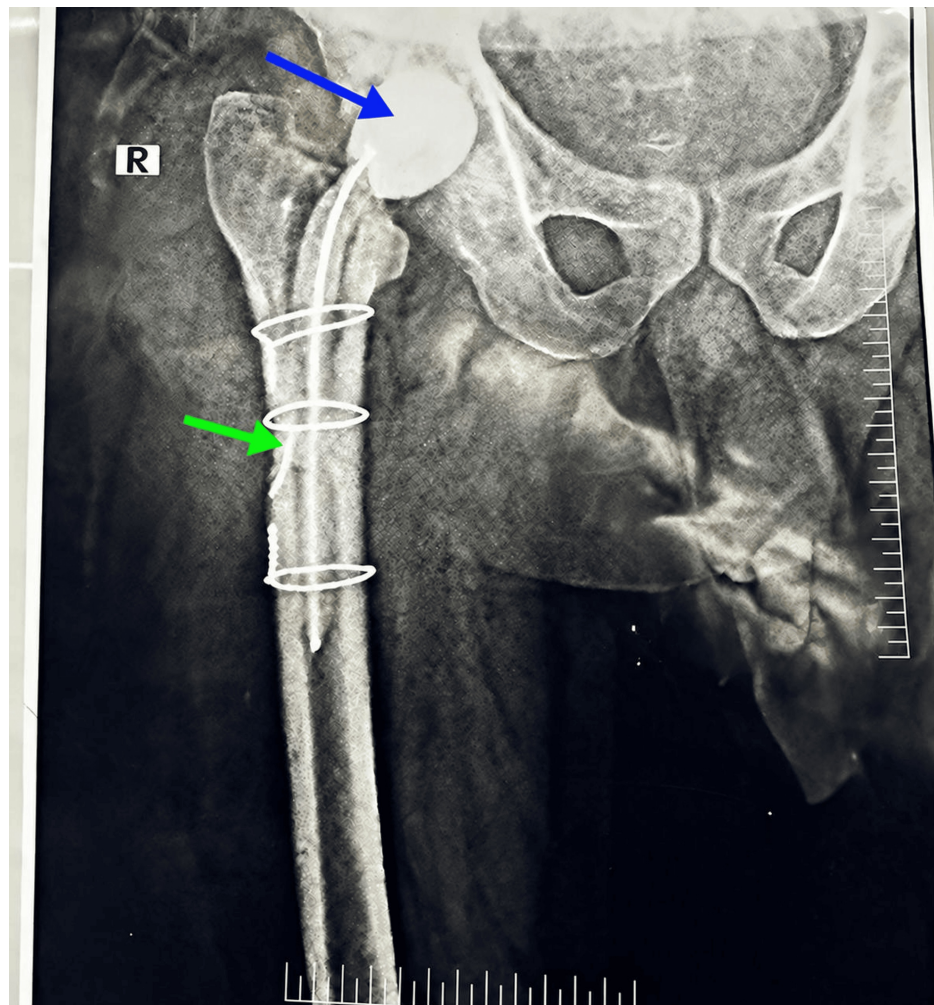


FIGURE 5: Postoperative radiograph following stage 1 surgery showing antibiotic bone cement spacer (blue arrow) and extended trochanteric osteotomy with cerclage wires in situ (green arrow).

After eight weeks, the patient underwent the second stage of reconstruction. The contained supra-acetabular defect was reconstructed using iliac crest bone grafting, followed by conversion to a cementless total hip arthroplasty (Figure 6). The final implants were positioned satisfactorily, with restoration of hip stability and limb length.

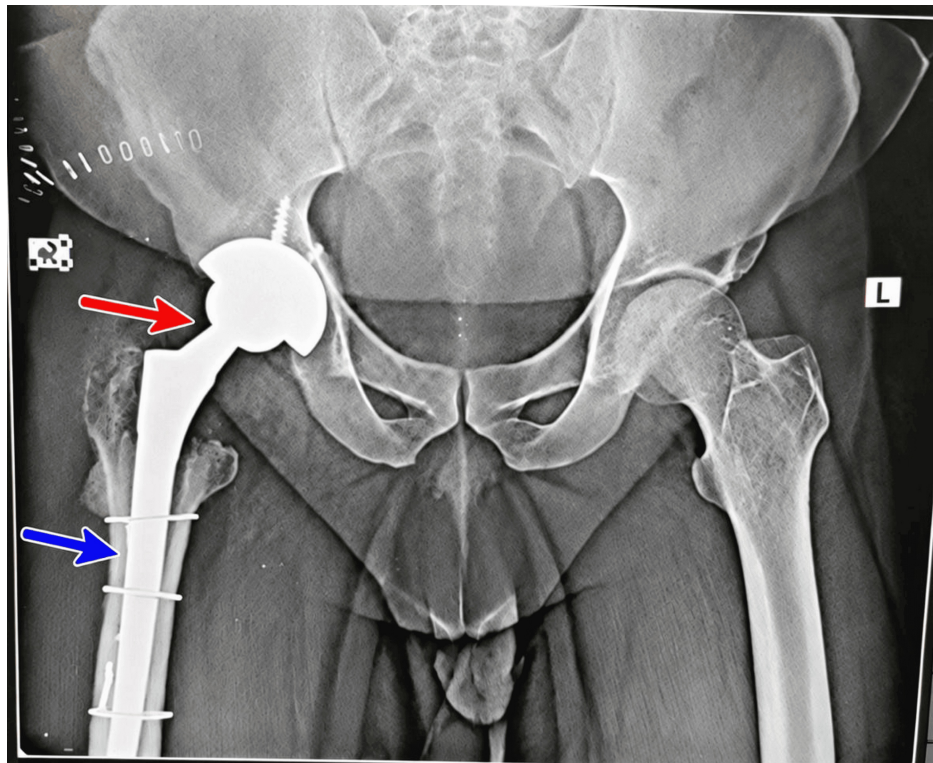


FIGURE 6: Postoperative anteroposterior pelvic radiograph following definitive cementless total hip arthroplasty showing uncemented total hip replacement (red arrow) and healed extended trochanteric osteotomy with cerclage wire in situ (blue arrow).

Histopathological examination of the excised periprosthetic tissue confirmed metallosis (Figure 7). At follow-up, the patient was pain-free, independently mobile, and had satisfactory clinical and radiological results.

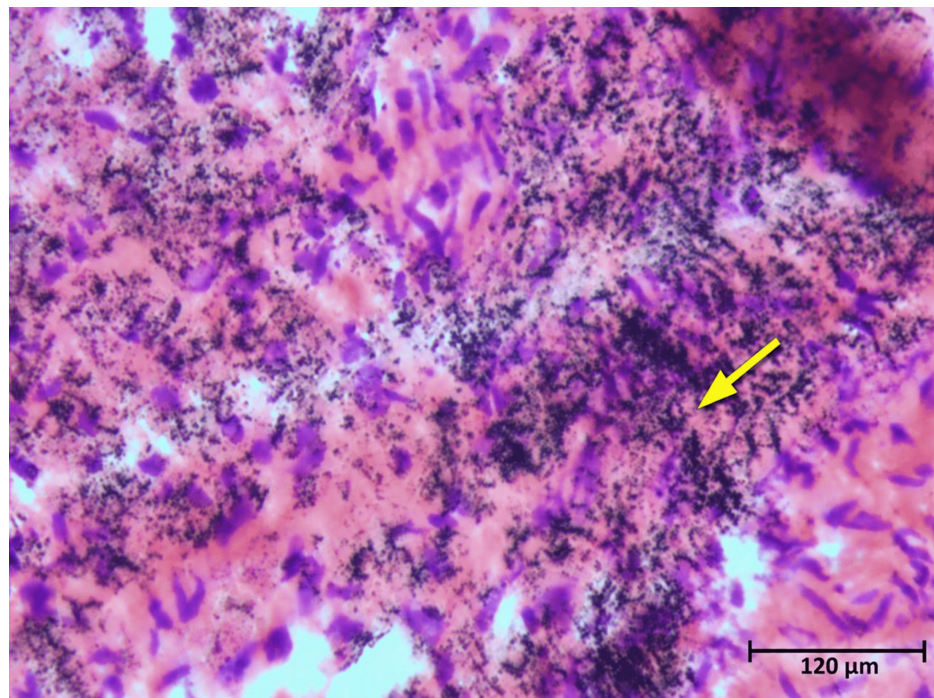


FIGURE 7: Microscopy image (hematoxylin and eosin staining, 40x) showing synovial tissue surrounding the hip joint and metallic particulate debris (yellow arrow).

Discussion

Polyethylene wear is a well-recognized cause of osteolysis and aseptic failure following hip arthroplasty. Wear particles can induce a macrophage-mediated foreign-body response, resulting in progressive periprosthetic bone loss and component loosening.

The present case is unusual because the polyethylene bearing responsible for the wear was the concealed inner liner of a bipolar hemiarthroplasty. Unlike an acetabular polyethylene liner in total hip arthroplasty, the inner bearing of a bipolar prosthesis is not directly visible on routine radiographs. Progressive wear can therefore remain clinically occult until the femoral head becomes eccentrically positioned or substantial osteolysis develops. Similar cases of eccentric polyethylene liner wear in bipolar hemiarthroplasty have been reported and emphasize the importance of radiographic surveillance in symptomatic patients.

In our patient, complete wear-through of the inner polyethylene liner resulted in direct metal-on-metal articulation between the inner femoral head and the outer bipolar shell. This mechanism produced extensive metallic debris and blackish discoloration of the periprosthetic tissues, confirming clinically significant metallosis. Metallosis has been described as a consequence of catastrophic polyethylene failure when the metallic femoral head articulates directly with the metallic shell [5,6].

The extensive metallosis in this case was associated with both peri-trochanteric and acetabular osteolysis, including a contained supra-acetabular defect. Previous studies of hip metallosis have demonstrated a strong association between metallic debris and periprosthetic osteolysis. In a series of 31 hips undergoing revision for metallosis, acetabular osteolysis was observed in 77.4% of cases [5].

An important feature of our case was the absence of laboratory evidence of infection despite extensive intraoperative metallosis. This emphasizes that normal inflammatory markers do not exclude significant mechanical failure or metallosis in a painful arthroplasty. The combination of progressive pain, eccentric femoral head positioning, and radiographic osteolysis should therefore prompt consideration of polyethylene bearing failure and metallosis.

Cross-sectional imaging was particularly useful in our patient because CT demonstrated the extent of the acetabular and peri-trochanteric bone loss and identified the contained supra-acetabular defect. Accurate assessment of bone loss is important when planning revision surgery because extensive osteolysis may influence the choice of reconstruction and the need for bone grafting.

The revision procedure was challenging because of the extensive metallosis, bone loss, and difficulty in

removing the femoral stem. An extended trochanteric osteotomy as described by Miner et al. [7] allowed controlled extraction of the femoral component and adequate access for debridement. A staged approach was used, with extensive debridement and antibiotic cement spacer placement followed by definitive reconstruction eight weeks later. The acetabular defect was reconstructed using iliac crest bone grafting before conversion to cementless total hip arthroplasty.

Previous literature indicates that revision in the setting of metallosis and catastrophic polyethylene failure can achieve meaningful clinical improvement, although extensive wear-related bone loss may have implications for long-term implant survival [8,9]. In our patient, staged reconstruction allowed management of the metallosis and bone defect, with satisfactory clinical recovery and independent mobility at follow-up.

This case highlights an uncommon but important failure mechanism of bipolar hemiarthroplasty. Eccentric positioning of the femoral head within the bipolar shell in a patient with a painful hemiarthroplasty should raise suspicion of concealed polyethylene liner wear. Early recognition may allow intervention before complete liner failure, metal-on-metal articulation, extensive metallosis, and major bone loss develop [10].

Conclusions

Concealed polyethylene liner wear is a rare but potentially serious complication of bipolar hemiarthroplasty. Complete liner wear-through can result in direct metal-on-metal articulation, extensive metallosis, osteolysis, bone loss, and prosthetic failure. In a painful bipolar hemiarthroplasty, eccentric femoral head positioning should raise suspicion of polyethylene bearing failure even when inflammatory markers are normal. Early recognition with appropriate imaging and careful revision planning is important. In cases with extensive metallosis and bone loss, staged revision with thorough debridement, appropriate management of bone defects, and definitive conversion to total hip arthroplasty can provide satisfactory clinical outcomes.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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