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## CASE REPORT

# Oxinium femoral head damage generated by a metallic foreign body within the polyethylene cup following recurrent dislocation episodes



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## KEYWORDS

Total hip arthroplasty;  
Oxinium femoral head;  
Transtrochanteric approach;  
Dislocation

**Summary** Oxinium femoral heads are supposed to be more scratch-resistant thanks to their oxidized layer. However, damages to this thin layer can jeopardize implant's properties. Following revision total hip arthroplasty performed for recurrent posterior dislocations, the Oxinium femoral head initially implanted was observed to be dramatically damaged. A metallic foreign body from a trochanteric fixation wire was found within the polyethylene cup. Only few cases of damaged Oxinium femoral heads have been reported and all were related to either dislocation or reduction of THA. The aim of this report is to describe a non-reported mechanism of damaged Oxinium femoral head due to a broken trochanteric fixation wire device. Any broken metallic wire from a transtrochanteric approach should be carefully followed to detect migration within the polyethylene cup. If such a migration occurs, revision surgery should be rapidly scheduled. © 2013 Elsevier Masson SAS. All rights reserved.

## Introduction

Decreasing wear debris in total joint replacements is an ongoing challenge. New bearing surfaces are now available for surgeons. Among them, oxidized zirconium (Oxinium)

has shown *in vitro* [1] its superiority at decreasing ultra high molecular weight polyethylene (UHMWPE) wear in total knee arthroplasty (TKA) compared to cobalt-chromium (Co-Cr) component. For total hip arthroplasty (THA), an *in vitro* study has shown that Oxinium femoral heads produce less particles than Co-Cr heads when articulating with conventional UHMWPE and highly cross-linked polyethylene (HXLPE) [2]. Moreover, a recent study regarding clinical outcomes demonstrated that at 2-year follow-up the use of OX femoral heads is an interesting alternative to traditional Co-Cr femoral heads [3].

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Few case reports have been published regarding surface damage of Oxinium femoral heads. Evengelista et al. [4] reported surface damage to an Oxinium femoral head following an open reduction of an irreducible anterior THA dislocation, the surgery was performed through a posterior approach. Kop et al. [5] reported three cases of damaged Oxinium femoral heads against the acetabular metal-back following closed reduction. Jaffe et al. reported the same mechanism [6]. McCalden et al. [7] reported damage to an Oxinium femoral head following routine total hip replacement through a lateral approach.

Herein, we present a patient who suffered recurrent dislocation of a THA that combined an Oxinium head full polyethylene. After three early dislocations that had been treated with closed reduction, we decided to perform a revision THA. The purpose of this report is to highlight a dramatically damaged Oxinium femoral head due to a rare and specific complication of the transtrochanteric approach: a metallic wire that moved within the polyethylene cup.

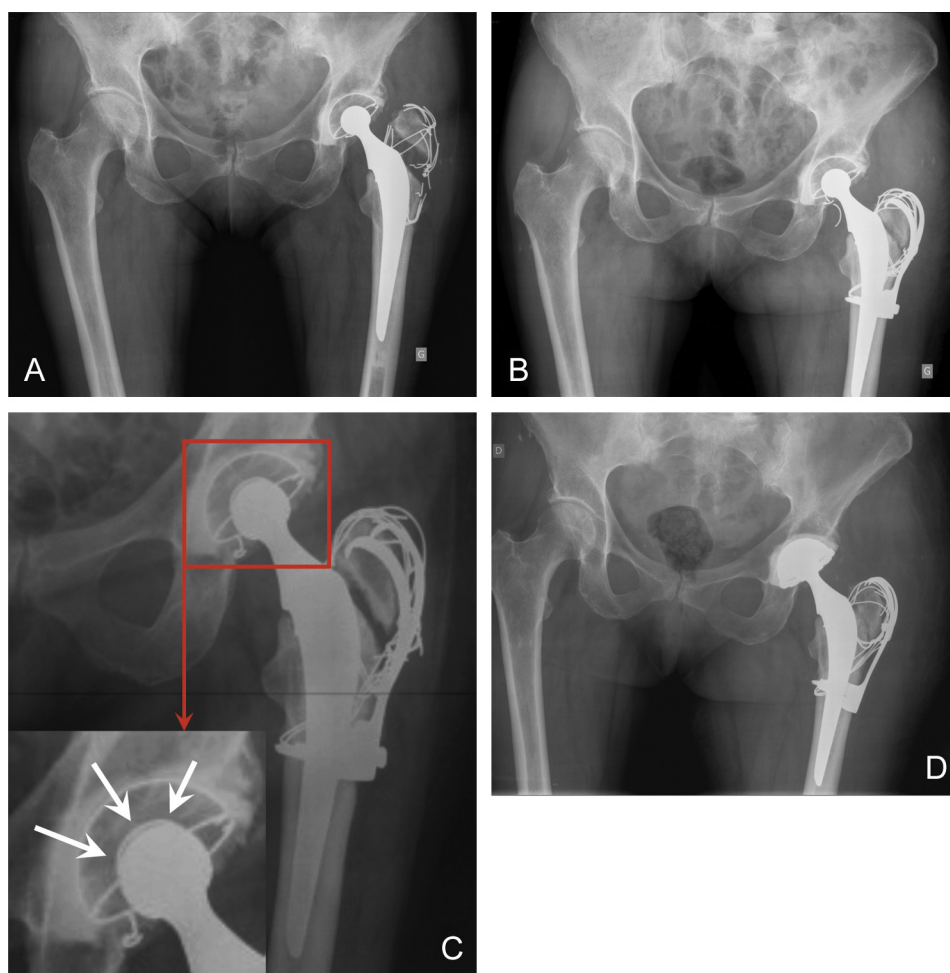
## Case report

A 74-year-old female underwent a left THA through transtrochanteric approach for hip osteoarthritis with wire

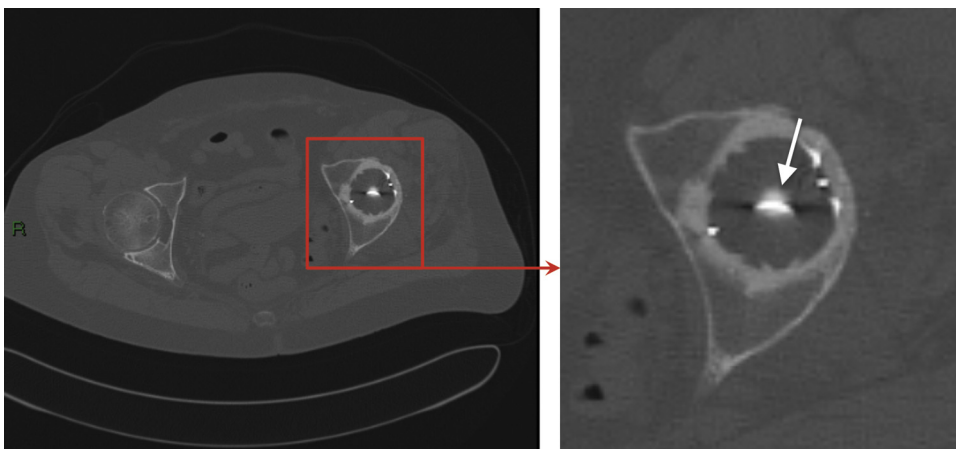
trochanteric attachment. The components consisted of cemented full highly cross-linked polyethylene cup (XLPE®, Smith & Nephew, Memphis, TN, 46 mm outer diameter and 22.2 mm inner diameter), a cemented CMK21® femoral stem (Smith & Nephew) and a 22.2 mm Oxinium femoral head. The postoperative course was uneventful.

Nine months later, a greater trochanter non-union was diagnosed (Fig. 1A) and surgery was scheduled as migration was greater than 1 cm and the patient sustained major limp. The surgery performed 12 months after the index procedure through the same approach consisted of fixation of the ununited greater trochanter using a trochanteric claw plate [8] (Fig. 1B).

Twenty-one months after the index THA (9 months after trochanteric re-attachment), she sustained a posterior THA dislocation. The reduction was successful under general anesthesia. Two further dislocations occurred at 21.5 and 22.5 months postoperatively, and were treated by closed reduction under general anesthesia. A metallic foreign body was present on the AP X-ray after the treatment of the trochanteric non-union, but it was extra-articular, underneath the cup. This foreign body probably moved within the cup after the first dislocation as seen on the post-reduction X-rays (Fig. 1C). A CT-scan confirmed the presence



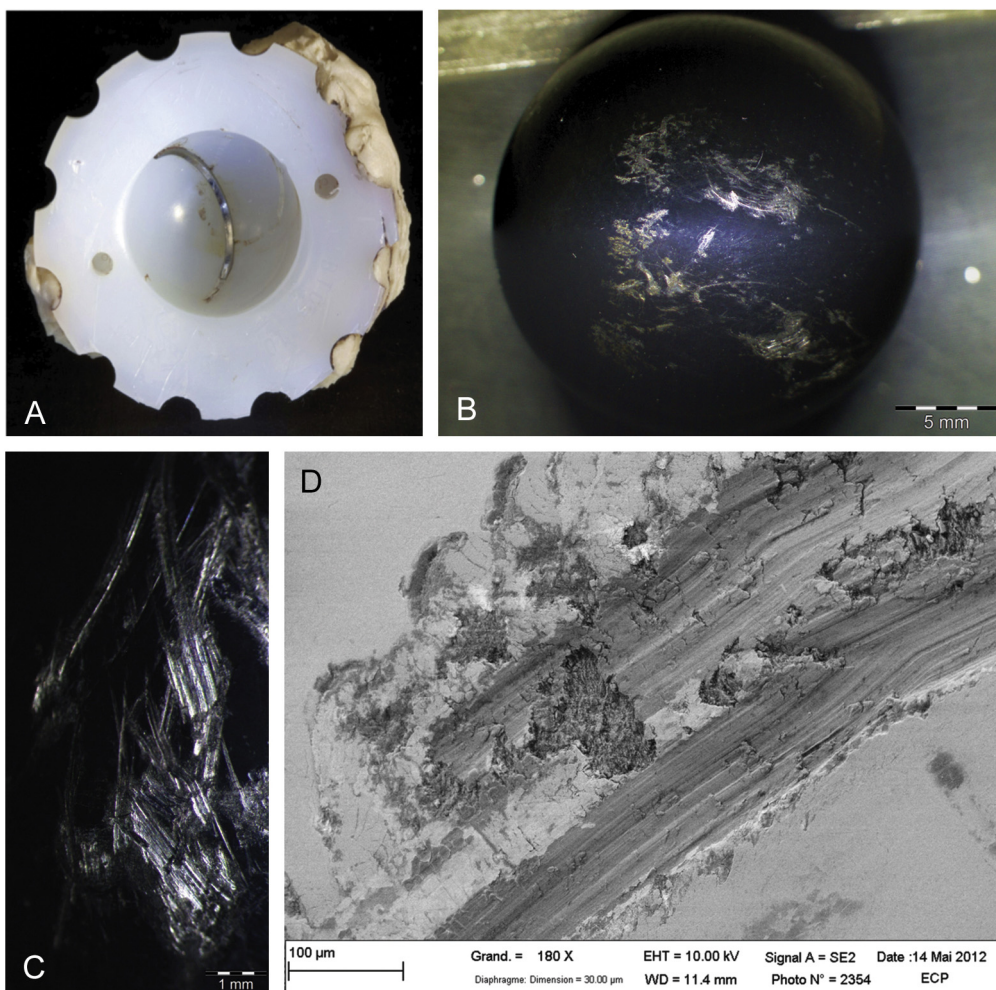
**Figure 1** Surgical history of the patient. Greater trochanter non-union (A), trochanter plate for treatment of the non-union (B), AP X-ray after the third closed reduction, note the metallic wire (white arrows) found in the cup (C), revision THA with dual mobility (D).



**Figure 2** CT-scan performed after the third episode of dislocation. Note the presence of the metallic wire within the PE liner in this upper view (white arrow).

of the metallic wire within the cup (Fig. 2). At revision, the Oxinium femoral head was found to be macroscopically damaged due to a metallic wire in the cup. The patient was revised through a transtrochanteric approach 23 months

after the index procedure. The metallic wire observed on the AP X-ray was found within the PE liner (Fig. 3A). During revision, it was observed that the Oxinium femoral head was macroscopically damaged. The acetabular cup was removed



**Figure 3** Picture of the PE liner with the metallic wire (A, magnification:  $\times 1$ ); damaged Oxinium femoral head pictured at magnification 1 (B), with stereo-microscopy (C, magnification:  $\times 10$ ) and with scanning electron microscopy (D, magnification:  $\times 180$ ).

**Table 1** Key findings of reported case of damaged Oxinium femoral head. The main mechanism is a contact with the metallic acetabular shell during dislocation/reduction and when analyzed, the depth of the scratches is always deeper than 10  $\mu\text{m}$ .

Authors	Case reported	Damage mechanism	Scratch depth
Evangelista et al. [4]	1	Contact with the metallic acetabular shell	Non-reported
Kop et al. [5]	3	Same	100 $\mu\text{m}$ or lower
McCalden et al. [7]	1	Same	Non-reported
Jaffe et al. [6]	4	Same	14 $\mu\text{m}$ to 55 $\mu\text{m}$
Current case	1	Metallic wire between articulating surfaces	10 $\mu\text{m}$

and replaced by a cemented dual mobility acetabular cup (ASTON-Medical, Saint-Étienne, France) [9,10]. The Oxinium femoral head was replaced by a 22 mm Co-Cr head (Smith & Nephew) (Fig. 1D). No macroscopic metallosis was observed at the time of revision.

Analysis of the Oxinium femoral head (Fig. 3B, C, D) showed that the deepest damage was 10  $\mu\text{m}$  and the mean width was  $75.5 \pm 40.86 \mu\text{m}$  (InfiniteFocus™ Topomicroscop and Alicona InfiniteFocus™ software). Moreover, energy dispersive X-ray spectrometry revealed metal transfer from the metallic wire to the Oxinium femoral head.

## Discussion

THA dislocation is a well-known complication after primary THA. The transtrochanteric approach decreases the risk of early dislocations compared with a posterior approach although there is no significant difference over the long term [11]. However, metallic wires used to fix the greater trochanter can break and move within soft tissues and rarely within the socket. To our knowledge, this is the first case of a damaged Oxinium femoral head due to a foreign metallic body trapped in the PE liner. Whereas fracture of trochanteric fixation wires is well known, their migration within the cup remains rare [12]. Previous reported cases of damaged Oxinium femoral heads [4–7] (Table 1) were due to contact between the femoral head and the metallic acetabular shell. Interestingly, Burnell et al. [13] reported damaged Oxinium femoral components of a knee replacement. Previous attempts at coating metallic heads [14,15] using diamond-like coating or ion coating had led to poor results due to coating damage resulting in polyethylene wear and osteolysis. However, with the Oxinium technology, the oxidized layer is not a coating but a surface transformation related to thermal treatment in oxygen [2].

It is obvious that after the first dislocation, the metallic wire migrated within the PE cup and damaged the femoral head. A better analysis of the X-ray could have prevented this damage and the dislocations by making the revision earlier. However, with the same density and the same curved-shape, it was difficult to see the migrated wire. An earlier CT would have been helpful. For the revision surgery, a cemented dual mobility socket was used to restore the hip stability. Indeed, such a socket has been shown to provide a pain-free and mobile hip, while dramatically decreasing the risk of redislocation following revision for recurrent THA dislocation [10].

The potential intra-articular migration of wires [16] and multifilament cables have been well described in the

literature including the consequences of femoral head surface damage and consequent osteolysis [17–19]. When Oxinium femoral heads are damaged, the production of wear particles remains at a lower level compared to damaged Co-Cr femoral heads on conventional UHMWPE or HXLPE [2,20]. However, the wear rate is still elevated compared to an undamaged, out-of-the-package Oxinium femoral head, thereby jeopardizing the implant's longevity. Moreover, as the Oxinium layer is approximately 4  $\mu\text{m}$  to 5  $\mu\text{m}$ , a scratch deeper than these values make the scratch area like a Metal-on-Polyethylene bearing surface. Our deepest scratch was 10  $\mu\text{m}$ . Interestingly, Jaffe et al. [6] tested wear rates of retrieved damaged femoral head in hip simulator. They showed a dramatically 50-fold increase wear rate compared to an undamaged Oxinium femoral head. Lastly, according to the previous cases, the mechanism leading to the damage of the femoral head was always a contact between the metallic acetabular shell and the femoral head during dislocation(s) or reduction maneuvers. Thus, when a dislocation occurs, it is likely that the Oxinium femoral head is markedly damaged and the surgeon should be aware of this issue. In the current case, the acetabular component was a full XLPE socket and the Oxinium femoral head has been damaged due to a migrated metallic wire within the socket. Therefore, although expected to be more resistant, a metallic foreign body can dramatically damage an Oxinium femoral head. Such a risk for damaged femoral head should make surgeons consider performing a revision THA.

## Conclusion

In vivo, the use of Oxinium on both conventional and highly polyethylene seems to be a promising alternative to metal, although at this point no significant decreased wear has been reported [21]. Indeed up to 6-year follow-up, wear seems more influenced by the polyethylene manufacturing process rather than the material of the femoral head [22]. However, when a foreign metallic body is inserted between the Oxinium femoral head and the polyethylene cup, both the femoral head and the cup can be dramatically damaged and the implant's longevity is jeopardized. Therefore, we recommend performing a revision surgery in such a case.

## Disclosure of interest

Emmanuel Gibon, Caroline Scemama and Bertrand David declare that they have no conflicts of interest concerning



this article. Moussa Hamadouche declares consultancy from Smith&Nephew, Medacta, Mathys.

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