The use of alternative bearing surfaces for total hip arthroplasty has become popular to minimize wear and increase longevity, especially in young patients. Oxidized zirconium (Oxinium; Smith & Nephew, Memphis, Tennessee) femoral heads were introduced in the past decade for use in total hip arthroplasty. The advantages of oxidized zirconium include less risk of fracture compared with traditional ceramic heads. This case report describes a patient with a history of bilateral avascular necrosis of the femoral head after chemotherapy for acute lymphoblastic leukemia. Nonoperative management of avascular necrosis failed, and the patient was treated with bilateral total hip arthroplasty. The patient was followed at regular intervals and had slow eccentric polyethylene wear during a 10-year period. After 10 years, the patient had accelerated wear, with femoral and acetabular bone changes as a result of Oxinium and ultra-high-molecular-weight polyethylene wear during a 6-month period. This article highlights the unusual accelerated bone changes that occurred as a result of Oxinium wear particles. [Orthopedics. 2016; 39(1):e155-e158.]

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Extensive Bone Reaction From Catastrophic Oxidized Zirconium Wear

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abstract

The use of alternative bearing surfaces for total hip arthroplasty has become popular to minimize wear and increase longevity, especially in young patients. Oxidized zirconium (Oxinium; Smith & Nephew, Memphis, Tennessee) femoral heads were introduced in the last decade for use in total hip arthroplasty. The advantages of oxidized zirconium include less risk of fracture compared with traditional ceramic heads. This case report describes a patient with a history of bilateral avascular necrosis of the femoral head after chemotherapy for acute lymphoblastic leukemia. Nonoperative management of avascular necrosis failed, and the patient was treated with bilateral total hip arthroplasty. The patient was followed at regular intervals and had slow eccentric polyethylene wear during a 10-year period. After 10 years, the patient had accelerated wear, with femoral and acetabular bone changes as a result of Oxinium and ultra-high-molecular-weight polyethylene wear during a 6-month period. This article highlights the unusual accelerated bone changes that occurred as a result of Oxinium wear particles. [Orthopedics. 2016; 39(1):e155-e158.]

Case Report

A 35-year-old man had been treated with chemotherapy at 17 years of age for acute lymphoblastic leukemia. Treatment was complicated by avascular necrosis of both hips, shoulders, and knees. Nonoperative management was unsuccessful, and the patient underwent bilateral total hip arthroplasty, with the right side treated first. An anterolateral approach to the hip joint was used. The components included an uncemented Reflection (Smith & Nephew) acetabular cup with a Reflection microstable ultra-high-molecular-weight polyethylene liner (Smith & Nephew) in combination with a Synergy (Smith & Nephew) porous coated femoral stem with an Oxinium femoral head for both sides. Postoperative recovery was uneventful for both procedures (Figure 1A). The patient had regular follow-up, and screening radiographs showed slow eccentric wear, mostly affecting the left side. The patient was asymptomatic (Figures 1B-C).
Ten years after the initial THA, the patient presented to the outpatient department with new-onset pain and reduced range of motion in the right hip. Initially, radiographs showed increased eccentric polyethylene wear on the left side, with slow centric wear on the right side. In addition, both sides showed extensive osteolysis, which is commonly seen as a result of polyethylene wear (Figure 1D). A plain radiograph 6 months after initial presentation showed high-intensity deposits, with extensive cystic lesions around the right proximal femur and acetabulum and eccentric wear of the femoral head (Figures 1E-F).

The patient underwent extensive evaluation for aseptic loosening, periprosthetic joint infection, and metallosis. Blood markers (white blood cell count, C-reactive protein level, and erythrocyte sedimentation rate) and metal levels (cobalt and chrome) were normal on multiple occasions, and joint aspirations were negative for infection. Technetium 99m bone scan was negative for both periprosthetic joint infection and aseptic loosening (Figure 2A). Magnetic resonance imaging (Figures 2B-C) showed an extensive bone reaction with cystic lesions in the proximal femur and acetabulum, although there was no soft tissue reaction to metallosis. Computed tomography showed extensive bone reaction, with cortical expansion and cystic lesions in both the proximal femur and acetabulum, and a flattened Oxinium femoral head (Figure 2D). The patient was scheduled for a 2-stage procedure. The first stage involved extracting all of the implants and assessing the bone quality for further reconstruction. During the first stage, the soft tissues were intact, but extensive bone destruction involving the proximal third of the femur was noted (Paprosky type IIIa), with black material surrounding the implant (Figure 3A). Similar features were present around the acetabulum, and the defect was classified as Paprosky type IIIa. Intraoperative samples were sent for culture and histologic
examination. All implants were extracted and showed central wear of the ultra-high-molecular-weight polyethylene acetabular liner, with the Oxinium head articulating with the titanium acetabular socket, resulting in superior wear of the Oxinium head (Figures 3B-D). An antibiotic-impregnated spacer was used to keep the soft tissue at appropriate length. All samples were negative for microbial growth, and histologic examination did not show an aseptic lymphocyte vasculitis-associated lesion, as is seen with metal-on-metal wear. During the second stage, a tumor prosthesis was used to replace the proximal femur and acetabulum. The patient had an uneventful recovery and was doing well at the last follow-up.

**Discussion**

Oxidized zirconium was introduced in 2003 as an articular surface in total hip arthroplasty and has shown mid-term results equivalent to those with cobalt-chrome. The use of Oxinium in ultra-high-molecular-weight polyethylene articulation is advertised as a longer-lasting alternative to current articular surfaces, with reduced wear properties. Oxinium is produced by heating zirconium alloy in air, and the outer 5 μm of the head is oxidized to form the hard zirconium oxide. The outer layer achieves more than twice the hardness of cobalt-chrome alloy, but the unoxidized deep layer remains half as hard as cobalt-chrome. If the outer layer wears off, the deep layer is exposed and undergoes accelerated wear when articulating against a hard metal surface.

Various authors have reported damage to the Oxinium femoral head after dislocation and closed reduction, resulting in extensive damage to the Oxinium head. In patients with unsuccessful or repeated closed reduction, most authors recommend replacement of the zirconium head or regular follow-up. In the current case, accelerated wear of the Oxinium femoral head was not related to damage caused by dislocation or trauma. Initial osteolysis occurred as a result of slow polyethylene wear debris generated between the 2 intended articulating surfaces (Oxinium and ultra-high-molecular-weight polyethylene) over a 10-year period. This resulted in articulation of the Oxinium femoral head with the metal acetabular cup, with damage to the oxidized layer and catastrophic Oxinium head wear over 6 months. In vivo studies showed that oxidized zirconium femoral heads produce up to 61% less polyethylene wear and 45% fewer particles than standard ultra-high-molecular-weight polyethylene. However, they reported no significant reduction in wear compared with the cobalt-chrome femoral heads, indicating that oxidized zirconium heads should improve implant longevity. In a randomized control trial, Morison et al. showed that a combination of Oxinium and cross-linked polyethylene resulted in approximately 3 times less wear than standard ultra-high-molecular-weight polyethylene. However, they reported no significant reduction in wear compared with the cobalt-chrome and cross-linked polyethylene combination.

An interesting finding in this case was the extensive bone reaction that resulted from zirconium deposition from the accelerated wear of the zirconium femoral head articulating with the metal shell. This resulted in rapid, extensive bone destruction in both the acetabulum and the proximal femur over 6 months. Damage from zirconium debris was limited to the effective joint space and did not result in the soft tissue reaction that is commonly found with metal-on-metal articulations. Zirconium metal debris is macroscopic, is visible on radiographs, and stimulates an inflammatory response that is characterized by wear debris granulomas rather than an aseptic lymphocyte vasculitis-associated lesion reaction.

**Conclusion**

This case highlights the extensive bone reaction and destruction caused by deposition of zirconium debris resulting from accelerated wear of a zirconium head in the absence of hip dislocation. In contrast to other reports, in the current case, wear debris was not tolerated and resulted in severe pain. Although zirconium debris seems to be nontoxic to soft tissue, it causes extensive local bone reaction and destruction (Figures 1-2). Patients with an Oxinium femoral head should be assessed for accelerated polyethylene wear. If it is present, these patients should be
considered for early revision before Oxinium femoral head wear occurs to prevent extensive bone destruction as a result of zirconium deposition.

**References**


