

Polyethylene Luxation in an Oxinium Fixed-bearing Unicompartmental Knee Replacement Leading to Metallosis: A Case Reports for an Early and a Late Presentation

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Learning Point of the Article:

Polyethylene (PE) luxation can cause metallosis in fixed-bearing unicompartmental knee replacement, and careful engagement between the PE and the tibial component is crucial to prevent early presentation. Prosthesis designs should consider a more surgeon-friendly engaging system and radiographs assessing the height of the PE should be carried out, especially in the posterior area. In metallosis and PE luxation, revision surgery with total knee arthroplasty is suggested, although evidence for strong recommendations is limited

Abstract

Introduction: Polyethylene (PE) subluxation is a rare complication after fixed-bearing unicompartmental knee replacement. We present two cases of PE luxation with a rapid onset of metallosis in a unicompartmental knee replacement made of Oxinium, one early presentation 3 months after surgery and the other case 6 years after.

Case Report: Case 1: A 84-year-old male underwent a fixed-bearing medial unicompartmental knee replacement in his left knee. Standard surgery was carried out with robotic assistance. Three months after surgery, he felt acute pain in the anterior portion of his knee. Radiographs showed that the PE was luxated anteriorly and a radiopaque “cloud” that blurs the vision of the implants suggesting metallosis. In the revision surgery, abundant blackish liquid and metallic-like debris were deposited in the synovial tissue and capsule around the knee. The tibial and femoral components presented extensive wear areas, suggesting extensive metal-to-metal contact. Both components were removed, and a posterior stabilized total knee prosthesis was placed. Case 2: A 50-year-old male patient underwent a fixed-bearing medial unicompartmental knee replacement. After 6 years, he complained of insidious pain in the posteromedial side of his knee. During the physical examination, significant joint effusion, a loss of extension, and a limited flexion were observed, with flexion reaching only up to 80°. The patient did not report systemic symptoms associated with metallosis, and no signs of systemic involvement were found. Radiographs show similar findings than in case 1, but the radiopaque “cloud” was limited to the knee. In the revision surgery, both components were removed. The tibial and femur components had extensive wear, especially in the posterior-central portion. A posterior stabilized total knee prosthesis was used.

Conclusion: Emphasis on careful engagement between the PE and the tibial component is a must, checking that no tissue or cement gets in the way of the anchoring system. Furthermore, prosthesis designs must look for models with a more friendly, engaging system to prevent early presentation. The radiographs assessing the height of the PE – especially in the posterior area – must be carried out. In the case of metallosis and PE luxation, we suggest performing a revision surgery with total knee arthroplasty; however, there is little evidence for a strong recommendation.

Keywords: Metallosis, oxinium, polyethylene luxation, fixed bearing unicompartmental.

Author's Photo Gallery



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Figure 1: Case N°1 left knee anteroposterior and lateral view after medial fixed bearing UKA.

Introduction

Unicompartmental knee arthroplasty (UKA) is an effective treatment for medial or lateral femorotibial knee osteoarthritis. Survival has been reported above 90% at 15 years of follow-up, being good outcomes linked to an adequate selection of the patient and the surgeon's volume [1].

The most UKAs used nowadays are the fixed and mobile bearing, both types have shown good outcomes in national registries, but each has its limitations. Wear of PE is more related to the fixed bearing; on the other hand, the mobile-bearing UKA has a luxation rate of PE up to 14% [2]. Van der List et al. [3] performed a systematic review of the causes of failure of medial UKA and did not report any case of PE luxation in the fixed-bearing UKA.



Figure 2: Case N°1 radiograph 3 months after UKA surgery. The PE is in the anterior knee compartment, and a radiopaque "cloud" is seen that compromises all knees and extends to the leg's posteromedial compartment, suggesting metallosis.

Metallosis is a complication of arthroplasty treatment, which has been observed more frequently in hip replacement, mainly when metal-on-metal parts of friction have been used. In knee replacement, metallosis is more infrequent and is generally associated with PE wear or luxation, which causes direct contact between the femoral and tibial components [4].

We report two cases of PE luxation in a fixed mobile UKA made of Oxinium (Oxidized Zirconium, OZ) that lead to metallosis.

Case Report

Case 1

An 84-year-old male patient underwent a fixed-bearing medial UKA in his left knee fixed-bearing medial UKA (Journey I,

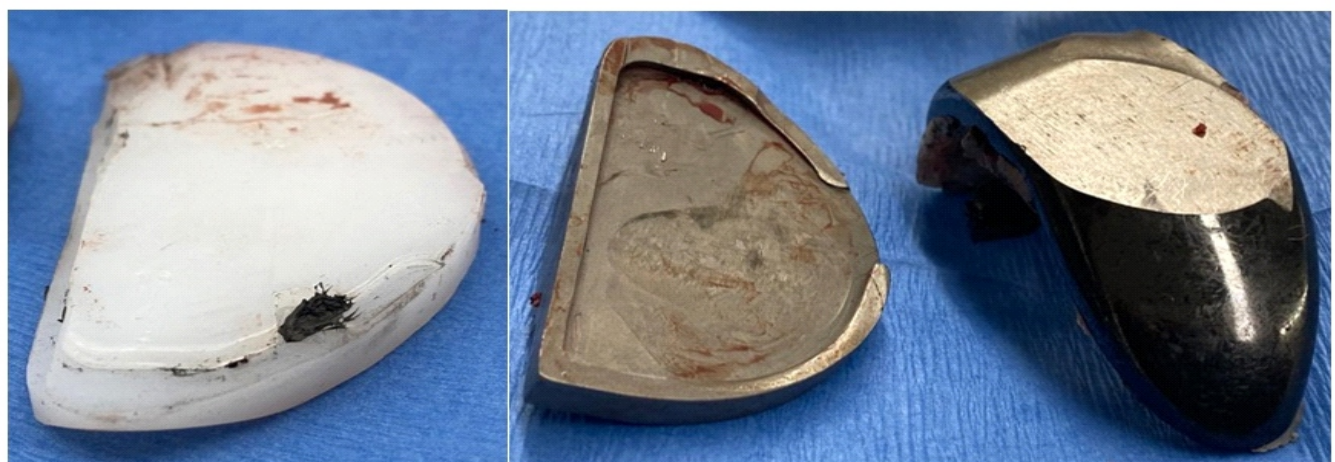


Figure 3: PE and tibial and femur components. The tibial component – in the middle – shows extensive wear, especially in the posterior aspect, and destruction of the engagement system of the PE.



Figure 4: Case N°2 anteroposterior view after successful bilateral fixed bear UKA.



Figure 5: Case N°2 anteroposterior and lateral view after 6 years of medial fixed bear UKA. An extensive radiopaque cloud is shown that compromises the entire knee, and the PE can be seen in the anterior compartment of the knee.

Smith and Nephew Inc., Cordova, TN, USA) (Fig. 1). Standard surgery was carried out with robotic assistance (NAVIO System, Blue Belt Technologies, Plymouth, MN), no complications were observed, and the patient was discharged 2 days later. He initiated standard rehabilitation, using two canes, weight-bearing as tolerated, and a full range of motion was encouraged.

Three months after surgery, he requested an urgent consultation due to the acute onset of pain, while descending a stair, in the anterior portion of his left knee that compromises his ability to walk and knee flexion. A physical exam showed a swelling in the anteromedial compartment and a locked knee at 30° of flexion. Radiographs showed that the PE was luxated anteriorly and a radiopaque “cloud” that blurs the vision of the implants suggesting metallosis. Moreover, the radiopaque cloud extends to the posteromedial portion of the leg (Fig. 2). The patient did not report systemic symptoms associated with metallosis, and no signs of systemic involvement were found. The presence of metallosis suggests that the polyethylene (PE) could have been partially dislocated (subluxated) since the time of surgery, and the completion of its dislocation occurred when the patient experienced acute pain. This subluxation contributed to the accelerated wear that led to metallosis within a span of <3 months.

Revision surgery was indicated. After the arthrotomy, abundant blackish liquid and metallic-like debris were deposited in the synovial tissue and capsule around the knee. The remaining polyethylene (PE) was extracted from the knee through the anterolateral portal. The tibial and femoral components presented extensive wear areas, suggesting extensive metal-to-metal contact, especially in the posterior and central parts (Fig. 3). The anchoring mechanism of the PE to the tibial component

was destroyed. Both components were removed, a wide synovectomy was performed, and a posterior stabilized total knee prosthesis was placed. The patient has evolved positively. Two months after the surgery, he presented with full extension, flexion greater than 110°, and walking without assistance.

Case 2

A 50-year-old male patient underwent a successful fixed-bearing medial UKA (Journey I, Smith and Nephew Inc., Cordova, TN, USA) (Fig. 4). After 6 years, he complained of an insidious onset of pain in the posteromedial side of his left knee. The pain progressively increased until it compromised his quality of life and limited the knee extension. Radiographs show similar findings than in case 1, but the radiopaque “cloud” was limited to the knee (Fig. 5), miming an arthrogram. The patient did not report systemic symptoms associated with metallosis, and no signs of systemic involvement were found.

Revision surgery was indicated. The PE was removed from the anterior compartment, an extensive synovectomy was performed, and both components were removed. The tibial and femur components had extensive wear, especially in the postero-central portion. A posterior stabilized total knee prosthesis was used.

Discussion

Luxation of PE is an infrequent complication in fixed-bear UKA. In this case report, we present two cases, one less than 3 months after the initial surgery and the second 6 years after, in a high-volume center of UKA, with the senior authors (RN and JD) with more than 10 years of experience in this surgery. In both cases, the luxation led to extensive metallosis. The

radiographs after failure are similar to other reports of Oxinium metallosis, in which an arthrogram-like is seen [5].

In case N° 1, the early presentation could be related to a defect in the design of the insert-tibial component fixation system or a technical error. Three mechanisms are used to lock the PE to the tibial component: Linear, peripheral, and central. The first consists of a tongue-groove design, the second relies on a press-fit anchor with chamfered edges, and the latter uses a pin that transfixes both the PE and the tibial trial [6]. In the fixed UKA, the peripheral anchor is the most common mechanism, which uses the Journey I used in these cases. The insert must be positioned from anterior to posterior, looking to engage in the posterior aspect of the tibial component first and then pressing the anterior portion distally to achieve anterior engagement. A careful revision before placing the insert must be done, explicitly avoiding tissue or cement remains to interpose in the anchoring area of the PE to the tibial component. In this case, the tibial component and insert wear did not allow us to analyze if there was a design problem. Future prosthesis designs must look for models with a more surgeon-friendly engaging system that can give a better feeling of fit between the PE and the tibial component to perform a safety procedure, as other authors have previously recommended [6]. In this case, the engaging system fits posteriorly, which means that beyond the surgeon's perception during the placement of the PE, there is no direct mechanism to visually confirm the complete engagement of the attachment. Moreover, two cases (0.5%) of UKA that needed revision due to a defect in the locking system were described by Epinette et al. [7].

On the other hand, the late presentation of PE luxation has been related to PE wear, and several risk factors have been proposed in the literature [8, 9, 10]. Component malalignment and excessive varus or valgus of the lower extremities cause an excess load on the prosthesis, leading to aseptic loosening and heterogeneous PE wear [11]. The latter could lead to the latter PE luxation. Moreover, anterior cruciate knee ligament (ACL) tear after UKA can lead to excessive wear to the posterior aspect of the insert due to anterior tibial translation, increasing the risk of anterior luxation. Sanchis-Alfonso et al. [10] reported a traumatic luxation of the insert in a fixed-bearing UKA after 7 years of surgery; nevertheless, the authors highlighted the close relation of the luxation to excessive wear in the posterior aspect of the insert. The same author noticed that ACL deficiency, a narrow flexion gap, incongruent contact between the tibial and femoral components, and malalignment could trigger the posterior wear in PE.

All factors mentioned above play a role, leading to heterogeneous wear of the PE that causes a more significant reduction in its posterior height and loss of the fixation system

to the tibial component, progressing with different degrees of subluxation until a complete luxation of the insert occurs. This will inevitably cause metal-to-metal contact and debris, triggering the immunological response and tissue deposition. These factors explain the luxation in the second case reported in this article.

Lunenburg et al. [12] suggested replacing the PE in cases of significant loss of height during serial radiographs with controls, showing an increased prosthesis survival and at least an equivalent good functional outcome to a UKA revised to a total knee. This indication could be possible in those patients to prevent luxation and subsequent metallosis due to posterior wear of the insert.

Treatment after PE luxation in fixed-bear UKA lacks guidance because it is a rare scenario; evidence relies on case reports and expert opinion. Luyet et al. [6] performed a revision to an all-PE tibial component, in which the tibial component and the PE are a single piece. This prevents insert luxation, but this type of UKA has less stiffness contributing to medial pain, loosening, or subsidence [13]. On the other hand, Greco et al. [8] performed a revision to a primary knee arthroplasty like our case. We had two options on the table; nevertheless, the extent of the compromise of the other knee compartments made us decide to use a total knee. Another reason was that the survival of a total knee is significantly longer than an all-in PE UKA [13]. No report was found that a patient needed a more constrained total knee design or the use of stems.

Metallosis has been associated with local and systemic problems. Periarticular pseudotumor and severe osteolysis have been reported in hip replacement [14]; nevertheless, metallosis after knee replacement has a lower incidence than hip replacement [10]. During revision surgery, it is paramount to perform a subtotal synovectomy and remove all macroscopic comprised tissue to avoid progression of the osteolysis due to the immunological response [6, 8]. Few cases in the literature have reported the extraarticular extent of metallosis in the knee, and only one case with Oxinium [5]. The ceramic-coated prosthesis has been developed to reduce the incidence of type 4 allergic responses in patients with metal hypersensitivity. It has been associated with less wear, increasing implant survival [15]. Despite the ceramic layer, the metal core is softer than cobalt chromium and, if exposed, leads to plastic-like deformation, fast wear, and metallosis [8]. This fast wear is evident in the first case and has raised concerns in other studies that reported Oxinium components exposure [5].

Systemic symptoms can be grouped into three categories: Neurotoxicity, cardiotoxicity, and thyroid toxicity, related to cobalt serum concentration [4]. We did not find a case of systemic symptoms of metallosis in a patient with Oxinium

implants. The screening of ions in serum and urine has been proposed to evaluate the systemic compromise of metallosis, but it is not a widespread exam [4]. Nevertheless, until the last follow-up, both patients did not complain of these symptoms. There were signs of extra-articular metallosis in the radiograph (Fig. 2), the reason why there is concern about the eventual systemic compromise. However, there was no evidence of a direct relationship between systemic symptoms and extra-articular compromise of metallosis in an oxinium prosthesis [4].

Conclusion

PE luxation and metallosis are infrequent complications in UKA. Emphasis on careful engagement between the PE and the tibial component is a must, checking that no tissue or cement gets in the way of the anchoring system. Moreover, to prevent early presentation, prosthesis designs must look for models with a more surgeon-friendly engaging system. On the other hand, follow-up for long-term episodes requires attention to knee stability, specifically ACL status. Moreover, radiographs

assessing the height of the PE – especially in the posterior area – must be carried out. In the case of metallosis and PE luxation, we suggest performing a revision surgery with total knee arthroplasty; however, there is little evidence for a strong recommendation.

Clinical Message

The clinical message of this article highlights the infrequent complications of PE luxation and metallosis in fixed-bearing UKA. Careful attention should be given to the engagement between the PE and the tibial component during surgery, ensuring that no tissue or cement obstructs the anchoring system. Prosthesis designs with a more surgeon-friendly engaging system should be considered to prevent the early presentation of complications. Long-term follow-up should focus on knee stability, particularly the ACL status, and regular radiographic assessments of PE height, especially in the posterior area. In cases of metallosis and PE luxation, revision surgery with total knee arthroplasty may be recommended, although further evidence is needed to support this approach.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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