

Two-stage revision knee arthroplasty for metallosis in a patient with rheumatoid arthritis: A case report

SAGE Open Medical Case Reports
Volume 11: 1–5
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DOI: 10.1177/2050313X231177752
journals.sagepub.com/home/sco



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Abstract

We report a successful case of two-stage revision total knee arthroplasty performed for treating painless metallosis after total knee arthroplasty with a metal-backed patella. A 63-year-old woman diagnosed with rheumatoid arthritis underwent left total knee arthroplasty with a metal-backed patella at 32 years of age. The patient did not have knee pain; however, knee joint swelling, a strange noise, and pigmentation were reported 4 years ago. Radiographs showed cloud and metal-line signs anteriorly and posteriorly at the femoral condyle. Therefore, a two-stage surgery was performed for infection prevention and ease of performing posterior synovectomy. The patient underwent initial synovectomy via a posterior approach, followed by anterior synovectomy and revision total knee arthroplasty. Synovectomy was performed well without perioperative infection or failure of wound healing. In cases with metallosis after total knee arthroplasty, the two-stage revision total knee arthroplasty should be considered, depending on the degree of synovial proliferation and the risk of complications.

Keywords

Metallosis, metal-backed patella, rheumatoid arthritis, total knee arthroplasty, two-stage revision surgery

Date received: 21 December 2022; accepted: 8 May 2023

Introduction

Metallosis is a known complication of metal-on-metal (MoM) total hip arthroplasty (THA) but is rare in total knee arthroplasty (TKA).¹ Abnormal MoM contact causes metal debris to infiltrate and accumulate in the surrounding tissues, leading to synovitis, implant loosening, and osteolysis, which require synovectomy or revision surgery.² Synovectomy and revision have been reported as one- or two-stage replacements; however, there are few reports of two-stage replacements.^{1,3} In addition, patients often complain of pain, and painless progression is rare.¹ Herein, we describe a case of painless metallosis after TKA complicated by rheumatoid arthritis, which required a two-stage synovectomy and revision TKA after a pain-free course.

Case presentation

A 63-year-old woman who had been treated for rheumatoid arthritis since the age of 20 years underwent left TKA (Miller-Galante I, Zimmer, Warsaw, IN, USA) at 32 years of age. She

was currently in low disease activity and was on 8 mg of methotrexate. Despite the absence of knee injury, she noticed swelling in the knee and noise from her left knee without pain for 4 years. Gradually, brownish pigmentation on the lateral side of the knee, local heat, limited range of motion, and instability were observed. Plain radiographs showed the loss of the space between the patellar component and femoral component and low-permeability areas from the suprapatellar capsule to the joint level, which extended like a cloud (Figure 1(a)–(c)). These were considered cloud signs or metal-line signs indicating metal debris.⁴ Magnetic resonance imaging

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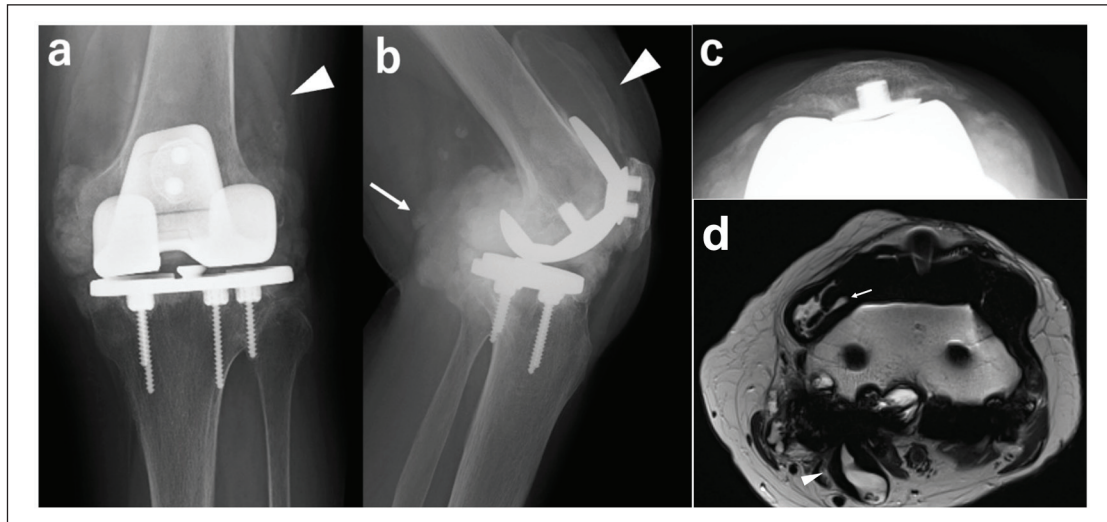


Figure 1. Radiographs and magnetic resonance image. In the preoperative radiographs, the cloud sign (arrow) and metal-line sign (arrowheads) are observed (a: anterior–posterior view, b: lateral view). The space between the patella and femoral components has disappeared (c: axial view). Magnetic resonance image demonstrates fluid retention (arrow) and synovial hyperplasia (arrowhead) within the joint and posteriorly outside the joint capsule (d: magnetic resonance imaging T2-weighted axial image).

T2-weighted images showed fluid retention and synovial proliferation within the joint and outside the posterior joint capsule (Figure 1(d)). Arthrocentesis revealed that the joint fluid was black, and both smear and bacterial cultures were negative. In blood tests, the levels of white blood cells, C-reactive protein, and erythrocyte sedimentation rate were 6,400/ μ L, 0.11 mg/dL, and 18 mm/h, respectively, indicating only a mildly elevated inflammatory response.

After a diagnosis of metallosis was established, we decided to perform synovectomy and TKA revision in two stages. The Burks approach to the posterior joint revealed three perforations in the medial posterior articular capsule and black synovial lesions extending outside the joint (Figure 2(a)). Part of the capsule was resected, leaving just enough for the capsule to be closed, and a portion of the intra-articular lesion was also resected. Rehabilitation after synovectomy included range of motion (ROM) training of the knee joint, and weight-bearing gait was permitted. The bacterial culture of the synovial membrane was negative and histological examination showed metallic debris and multinucleated giant cells phagocytosing the metallic debris, supporting the diagnosis of metallosis (Figure 2(b) and (c)). Thirty-nine days after the initial surgery, revision TKA and intra-articular synovectomy were performed using the rectus-snip approach. Black synovium was observed mainly around the patellar component. The polyethylene of the patellar component was damaged and wholly detached, and wear of the femoral and patellar components was also observed (Figure 2(d)). On removing the implants, black synovial invasion and osteolysis were observed mainly at the medial condyle of the tibia. Revision TKA was performed using the Legion Revision System (Smith & Nephew, London, UK) with stem and augmentation cementing to reinforce the bone defects

caused by osteolysis. Black synovial lesions were wholly removed (Figure 2(e)). One-year postoperative radiographs revealed that the preoperative low-permeability area had disappeared (Figure 2(f) and (g)).

ROM training was started on the second postoperative day, and gait with a full load was allowed from the seventh day. Surgery was performed using the rectus-snip approach, and there was a concern about the quadriceps muscle weakness. Therefore, the knee brace was applied for 1 month postoperatively. At 6 months, the patient could walk without a cane and brace, and radiographs at 1 year showed no findings of component subsidence and osteolysis. The ROM was 0°–130° without pain and instability.

Discussion

Metallosis after TKA has been reported in 97 cases, which is rare compared with that after THA, and the metal-backed patella is responsible for 40% of these cases.¹ The metal-backed patella comprises metal parts covered with thin polyethylene, which is subject to a high risk of wear and tear. The thin polyethylene that initially covers the surface delaminates from the metal part, and when this layer is lost completely, metal wear occurs.⁵ The revision cases of Miller–Galante I, which was used in this case, have been reported. Kobori et al.⁶ reported that 53% of the cases in which this prosthesis was used resulted in revisions, of which 40% (15 knees) were metal-backed patellae, nine of which had metallosis. Effenberger et al.⁷ reported a low survival rate of 59.5% at seven years postoperatively and an increase in revision at five years postoperatively. In this case, the prosthesis was used for as long as 31 years, but the complete detachment of the polyethylene and wear of the femoral and

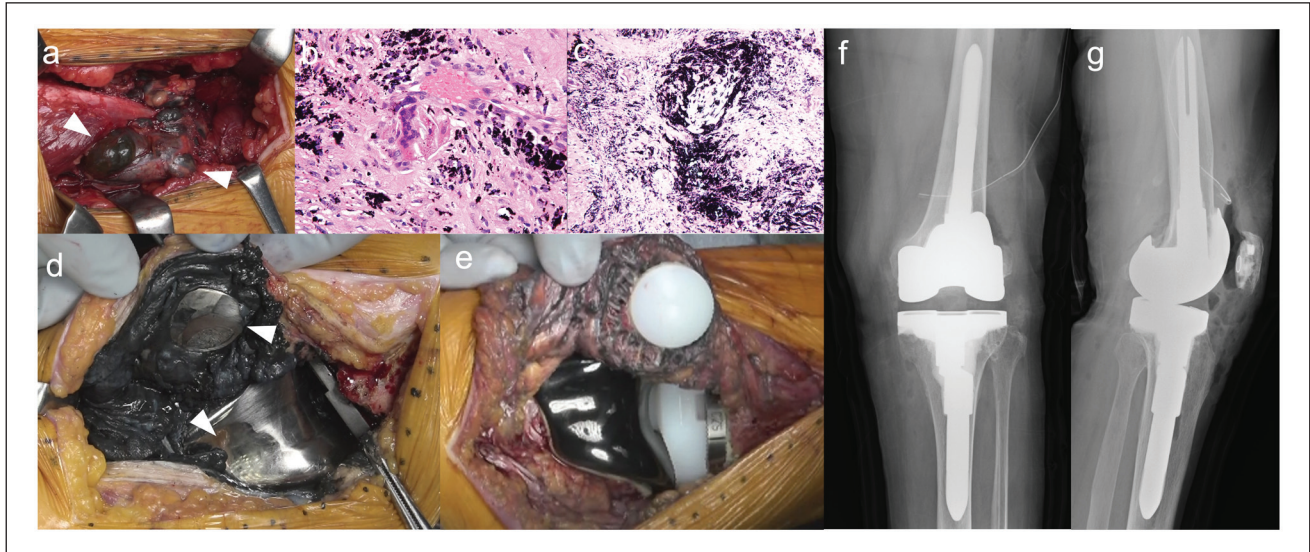


Figure 2. Pathological assessment and surgical finding. Approach to the posterior joint revealed three perforations in the medial posterior articular capsule (a) Black synovial lesions extended outside the joint (arrowheads). Pathological assessment of the synovium (hematoxylin and eosin stain, b: 10 \times , c: 40 \times). The lower magnification image indicates the deposition of metallic debris in the synovial tissue (b). Multinucleated giant cells phagocytosing the metallic debris are observed under higher magnification (c). Synovial lesions due to metallosis are observed mainly around the patellar component (d). Wear of the femoral and patellar components is observed (arrowheads). A photograph after revision arthroplasty, black synovial lesions were removed (e). One-year postoperative radiographs (f: anterior-posterior view; g: lateral view).

patellar components were observed, suggesting that the metal-backed patella was the cause of the metallosis. There were reports of cases in which tibial polyethylene failed, resulting in the dislocation of polyethylene and metallosis,^{8,9} suggesting that polyethylene failure and dislocation may induce significant metallosis. In cases of metallosis, as the number of particles produced increases, the foreign body reaction persists, granulomas form, and osteolysis occurs.¹⁰ Early surgical removal of the metallic fragments and particles is necessary to avoid osteolysis.¹ Especially in inflammatory diseases, such as rheumatoid arthritis with bone fragility, bone loss due to osteolysis is a significant problem, requiring adequate synovectomy to prevent the progression of osteolysis.

In this case, resection of the posterior synovial lesion from the anterior region was considered challenging; therefore, an anterior and posterior approach to synovectomy was necessary. In contrast, a one-stage anterior and posterior synovectomy might prolong the operative time and increase the risk of infection and soft tissue damage. Generally, prolonged surgery in patients with rheumatoid arthritis is a risk factor for surgical site infection and delayed wound healing.¹¹ Patients with rheumatoid arthritis are reported to have a higher risk of prosthetic joint infections (PJI) than patients with osteoarthritis.^{11,12} In treatments for rheumatoid arthritis, glucocorticoid was a risk factor for PJI, but results were controversial regarding biologic agents being a risk for PJI,^{11–13} and further study is needed. Hsu et al.¹⁴ and Moretti et al.¹⁵ reported good outcomes after a two-stage surgery for

popliteal synovitis and synovial cysts caused by metallosis. In the present case, the inflammatory synovium also extended beyond the posterior capsule, and the two-stage surgery was effective because the inflamed synovium had to be fully resected.

The revision rate of TKA in patients with rheumatoid arthritis is higher than in the osteoarthritis group, but a decreasing trend in the revision rate among patients with rheumatoid arthritis has been reported.¹² Osteoporosis is obviously a risk for periprosthetic fractures.¹⁶ However, bone fragility in rheumatoid arthritis patients is improving due to the development of pharmacological treatment for osteoporosis,¹⁷ which may be one of the reasons for the decrease in revision surgeries. In addition, metallosis after TKA following falls in rheumatoid arthritis patients has been reported.¹⁸ The polyethylene liner failure induced metallosis in the short term, suggesting that it may be related to increased inflammation in the background of rheumatoid arthritis.

The metallosis after TKA is commonly associated with pain,¹ and cases wherein the patients do not feel pain, as in this case, are rare. Adverse local tissue reactions, a general term for conditions including metallosis, a complication after MoM THA, should be considered in the case of groin pain in the absence of fractures and implant loosening, and it can cause pain even in the absence of implant loosening due to osteolysis.¹⁹ Although the cause of pain due to metallosis after TKA is unknown, it is important to be careful when a patient has passed without experiencing pain, as in this case.

According to Sahan et al.,¹ the longest reported time from primary TKA to metallosis occurrence is 26 years. To our knowledge, the postoperative period in this case was the longest among patients of revision TKA for metallosis. The postoperative period, in this case, was 31 years, and the lack of pain may have been related to the more extended period. Therefore, TKA cases with metal-backed patella should be examined for the development of metallosis, and the need for revision of the patellar component should be considered, even in the absence of complaints.

Conclusion

Painless metallosis after TKA is a rare complication that may occur over the long term. Therefore, adequate synovectomy is necessary to prevent the progression of osteolysis, and the surgical approach should be based on the extent of synovial growth and the risk of complications.

Acknowledgements

The authors thank their colleagues in the pathology department for the preparation of pathology specimens.

CRedit authorship contribution statement

T.K. contributed to conceptualization, data curation, and writing original draft; Y.M. contributed to writing, reviewing, and editing; M.K. contributed to writing, reviewing, and editing; T.A. contributed to writing, reviewing, and editing; T.I. contributed to writing, reviewing, and editing; N.M. contributed to writing, reviewing, and editing; D.C. contributed to writing, reviewing, and editing; K.H. contributed to writing, reviewing, and editing; N.Y. contributed writing, reviewing, and editing; and T.A. contributed Writing, reviewing, and editing. All authors approved the final version of the manuscript.

Data availability statement

All data generated or analyzed during this study are included in this published article.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Ethical approval

Our institution does not require ethical approval for reporting individual cases or case series.

Informed consent

Written informed consent was obtained from the patient(s) for their anonymized information to be published in this article.

Patient consent

Written informed consent for the publication of this report was obtained from the patient by the corresponding author.

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