Arthroplasty Today 8 (2021) 211–215

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Case report

Tibial Osteolysis After Long-Term Isolated Polyethylene Patellar Resurfacing

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ARTICLE INFO

Article history:
Received 28 January 2021
Received in revised form
10 March 2021
Accepted 11 March 2021
Available online xxx

Keywords:
Osteolysis
Patellar resurfacing
Patellofemoral arthroplasty
Total knee arthroplasty

ABSTRACT

Isolated patellar resurfacing served as an early treatment for patellofemoral arthritis but was abandoned because of erosion of the native femoral trochlear groove over time. We present the case of a large native tibial osteolytic lesion 20 years after isolated patellar resurfacing with a cemented polyethylene component. The patient had severe tricompartmental arthritic changes. The patellar component was very worn, and the resultant particle debris produced a large cavitary lesion in the proximal tibia. Osteolysis is a rare complication in patellofemoral arthroplasty, and, to our knowledge, this is the first reported case of native tibial osteolysis after isolated patellar resurfacing. The patient was treated with initial curettage and bone grafting of the lesion followed by total knee arthroplasty with a tibial cone and stemmed tibial fixation.

Introduction

We present a case of tibial osteolysis 20 years after an isolated patellar resurfacing with a cemented polyethylene component. Patellar resurfacing has been described as a treatment option for patellofemoral arthritis, typically as a result of posttraumatic degenerative changes [1–4]. The patellar component can be either polyethylene or metal. Historically, the metal prosthesis was fabricated from vitallium, as described by McKeever [1]. The long-term results of isolated patellar resurfacing with a polyethylene component have sparsely been studied, with favorable short-term patient satisfaction, but poor long-term outcomes [2,4,5]. Most commonly, failure was related to wearing of the cortical bone in the femoral trochlear groove, which led to the development of a metallic trochlear component to articulate with the patella, the modern-day patellofemoral arthroplasty [2,4,5].

Osteolysis after total knee arthroplasty is typically associated with wear from the tibiofemoral bearing surface or backside wear [6]. Particulate debris particles are released and activate a cellular response that leads to bone resorption. The biologic activity of particles generated from the patellofemoral articulation are comparable to that of particles generated from the tibiofemoral bearing surface [7]. Osteolysis, characterized as a radiolucency with a sclerotic border, typically occurs around the margins of the patellar implant [6,8]. To our knowledge, this is the first reported case of long-term results of isolated patellar resurfacing with polyethylene wear resulting in a large native tibial osteolytic lesion. Informed consent was obtained for the preparation of this case report.

Case history

A 65-year-old Caucasian male underwent isolated patellar resurfacing with a cemented polyethylene component approximately 20 years ago for posttraumatic patellofemoral joint arthritis of the right knee after a motor vehicle collision. He gradually developed increasing right knee pain with weight bearing over several years. He delayed treatment of this pain until recently and now requires the assistance of a walker to ambulate. He has a history of chronic obstructive pulmonary disease, hypertension, hypercholesterolemia, and a 40-pack-year history of smoking cigarettes. His body mass index is 27.35 kg/m^2. When he presented to an outside orthopedic surgeon, radiographs and magnetic resonance imaging (Fig. 1) revealed a 4.5 × 5-cm heterogeneous, lytic bone lesion in his proximal tibia and advanced degenerative arthritis. He was referred to our orthopedic oncologist (C.O.M.) for further evaluation and management. Physical examination of the

IRB Approval: This case report was approved by the Institutional Review Board of the University of Arkansas for Medical Sciences.

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https://doi.org/10.1016/j.artd.2021.03.012

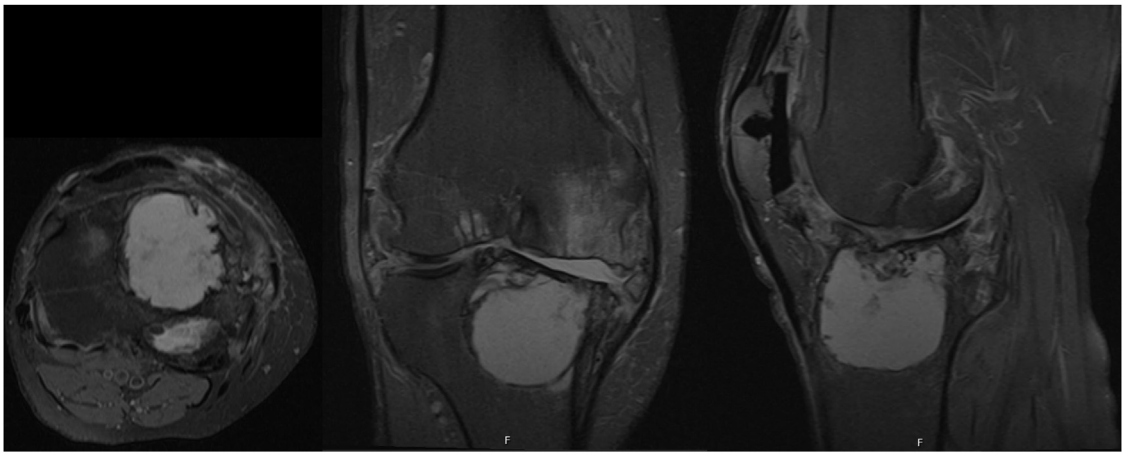

Figure 1. Axial, coronal, and sagittal images from proton-density weighted magnetic resonance imaging sequence demonstrating a large fluid-filled lesion in the proximal tibia of the right knee.

knee revealed a well-healed previous incision without signs of infection, a flexion contracture of 5°, and knee flexion to 95°. There was crepitus noted with range of motion and tenderness to palpation about the proximal tibia. Based on the patient's symptoms and appearance of the lesion on imaging studies, the working diagnosis was an intraosseous ganglion cyst with internal debris. A biopsy was recommended to further classify the lesion.

The patient underwent right proximal tibia curettage and bone grafting with allograft cancellous bone chips (Fig. 2). The pathological specimen was identified as a benign process notable for polyethylene particle deposits and giant cell reaction consistent with osteolysis-related polyethylene wear (Fig. 3). The patient continued to have pain with activities and advanced degenerative arthritis of the knee. He was then referred for reconstructive surgery. On presentation, his incision was well healed, and he had marked antalgia with gait. Range of motion was 5-95°, and he had a varus thrust. Before proceeding with further intervention, the right knee was aspirated to rule out infection, which revealed 320 white blood cells, was negative for synovial fluid alpha-defensin, and yielded negative cultures. Three months after curettage and bone grafting, he underwent right total knee arthroplasty with revision of the patellar component. Extensive wear of the polyethylene patellar component was encountered with wear of the trochlea as well as advanced degenerative changes of the tibiofemoral joint (Fig. 4). The patellar component had worn through the polyethylene and into the cement. The bone graft had not incorporated in the tibial cyst, and this was removed. As the proximal tibial bone quality was of concern, a metaphyseal cone (Optetrack Logic Metaphyseal Cone; Exactech Inc., Gainesville, FL) and tibial stem were used for additional fixation of the tibial component. The tibial metaphyseal was prepared for cone placement using a high-speed burr (Fig. 5). The medial and lateral collateral ligaments were assessed, and the use of primary, low-constraint implants was deemed appropriate. A medial pivot design bearing knee with tibial stem was used (Evolution; Microport Orthopedics, Arlington, TN). The stem was fully cemented. All nonsupportive patellar bone was debrided, and the patella was recut. There was sufficient patellar thickness to accept a new polyethylene patellar component. The

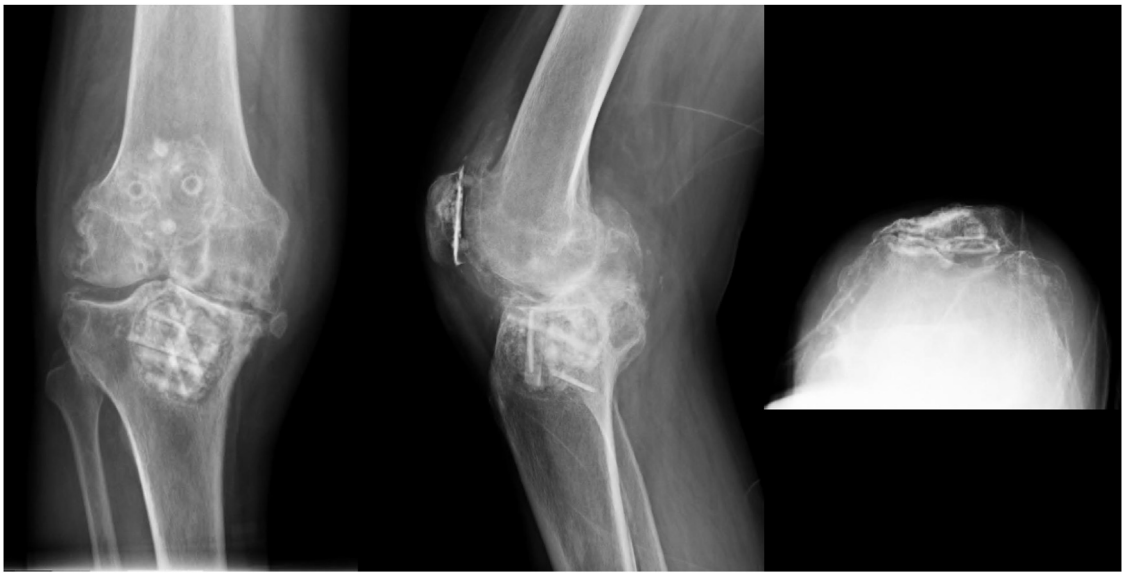

Figure 2. Anteroposterior, lateral, and sunrise radiographs of the right knee demonstrating a large osteolytic lesion in the proximal tibia after curettage and bone grafting, previous patellar resurfacing, and advanced tricompartmental degenerative changes.

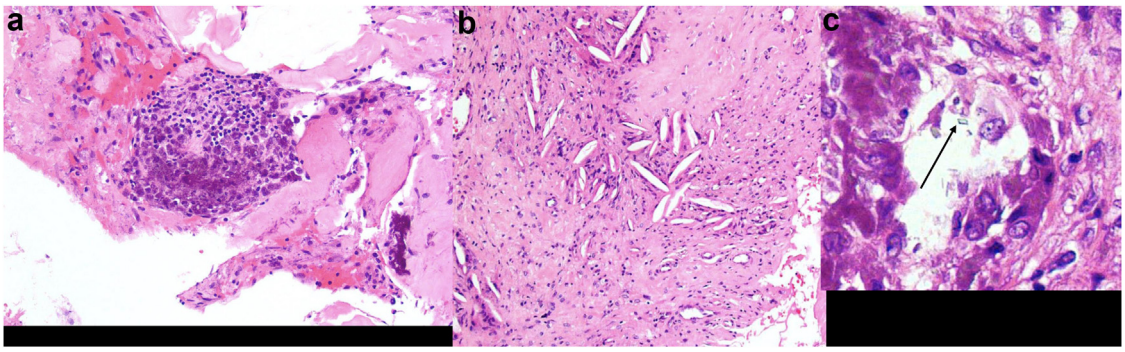

Figure 3. Pathological specimens from right knee proximal tibial lesion. (a) Multinucleated giant cell associated with the reactive process. (b) Clefts formed around polyethylene particles that have been cleared by the slide preparation process. (c) Polyethylene debris particle (arrow).

patella measured approximately 15 mm before and 12 mm after resurfacing when measured on radiographs.

Postoperative radiographs are shown in Figure 6. He had an uneventful postoperative recovery with discharge home the following day after surgery and outpatient physical therapy. At 7-month follow-up, the patient has an increasing Knee injury and Osteoarthritis Outcome Score for Joint Replacement score (39.63 preoperatively to 79.91 at 7 months), decreased pain, improved range of motion (0-120° of flexion), is no longer using an assistive device for ambulation, and has returned to work as an electrician.

Discussion

We report a case of a large osteolytic lesion in a native tibia 20 years after isolated patellar resurfacing with a polyethylene component. While this lesion was at first thought to represent a benign osseous process related to his arthritis, further pathologic investigation revealed polyethylene debris particles within the lesion. In this case, the patient had reasonable function of the knee for many years after undergoing patellar resurfacing but over time developed pain with bearing weight and progression to severe tricompartmental arthritis. Initial presentation was concerning for a cancerous process in the proximal tibia as the only prosthetic component was the polyethylene patellar button. The lesion was found to be benign after undergoing curettage and bone grafting, and further studies indicated osteolysis as the culprit.

In total knee arthroplasty, component positioning and alignment may play a role in increased polyethylene wear and osteolysis [6,9]. Once a suspected osteolytic lesion is identified on plain radiographs, infection must be ruled out by laboratory studies and joint aspiration. Imaging studies should be scrutinized for evidence of polyethylene component thinning or failure. Frequently, osteolytic lesions are asymptomatic and discovered on routine follow-up imaging, and advanced imaging may be necessary to understand the size and involvement of the lesion. Surgical indications relate to component stability and the patient's symptoms [9]. Smaller lesions may be treated with isolated bone grafting, while larger lesions may require additional structural support in the form of allografts, augments, cones, or sleeves [9,10].

The evolution of isolated patellar resurfacing began with a vitallium prosthesis articulating with a native trochlea described by McKeever [1] in 1955 in a series of 40 patients, followed up for up to

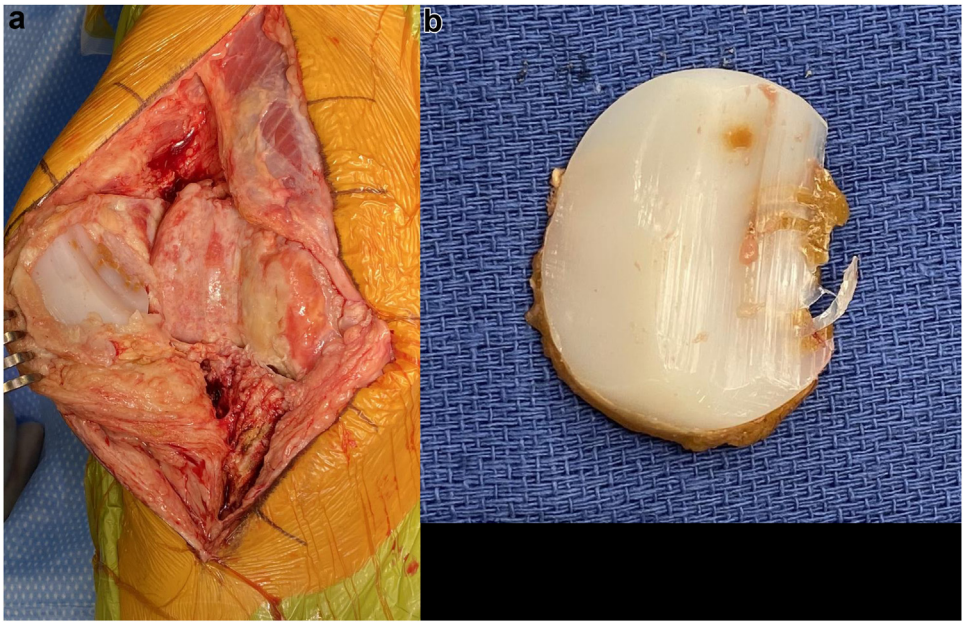

Figure 4. (a) Intraoperative photograph demonstrating significant wear of the polyethylene patellar component and erosion of the femoral trochlear groove. (b) Close-up view of the explanted polyethylene patellar component with complete wear of the lateral aspect of the implant, which had exposed the cement mantle.

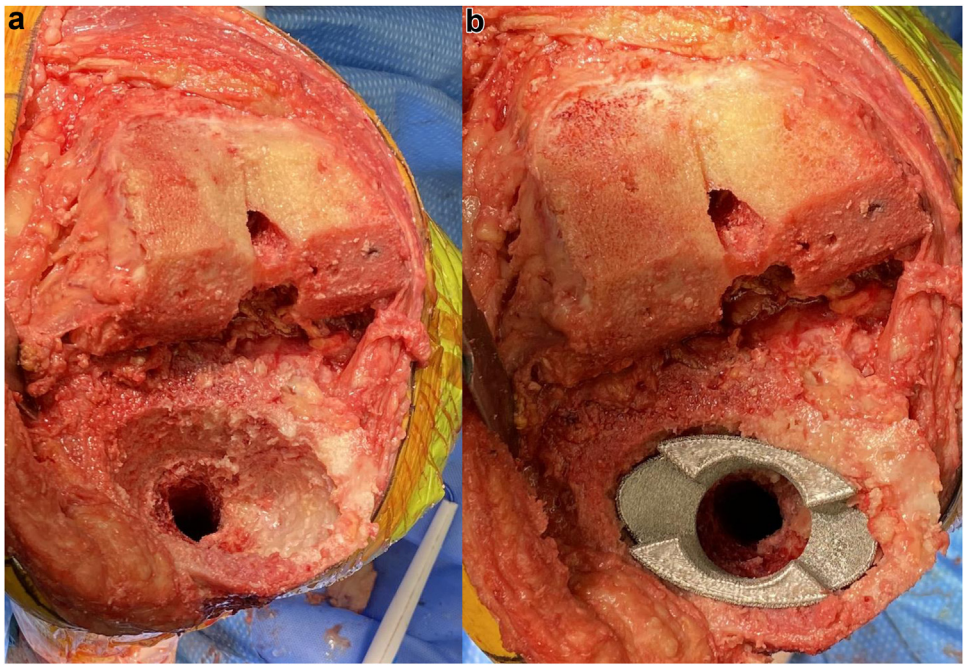

Figure 5. (a) A high-speed burr was used to remove the bone graft and prepare the proximal tibia to accept a large metaphyseal cone. (b) Metaphyseal cone impacted into place.

5 years. Most of the outcomes were described as successful (36/40), and complications were related to infection [1]. Additional reports of the McKeever prosthesis were promising, but issues related to the differential hardness of the prosthesis vs the native femoral groove were identified [11]. Subsequently, polyethylene prostheses were developed for isolated resurfacing, but long-term results were also unsatisfactory because of erosion of the femoral trochlear groove [2,4,5]. First generation inlay patellofemoral arthroplasty, developed in 1979, involved resurfacing of both the patella and the trochlear groove. These prostheses relied on the patient's anatomy for component positioning, with complications related to patellar maltracking [2,5,12–14]. Second generation onlay designs offer more constraint, improved patellar tracking, and better long-term results [2,5,12,13]. Newer gender-specific patellofemoral arthroplasty designs (third generation) have been shown to have promising results at 5 years [15].

Osteolysis has been reported in the lateral tibial plateau adjacent to a medial unicondylar knee arthroplasty [16], but not as a complication of isolated patellar resurfacing with a polyethylene component. Patellar osteolysis in the setting of total knee

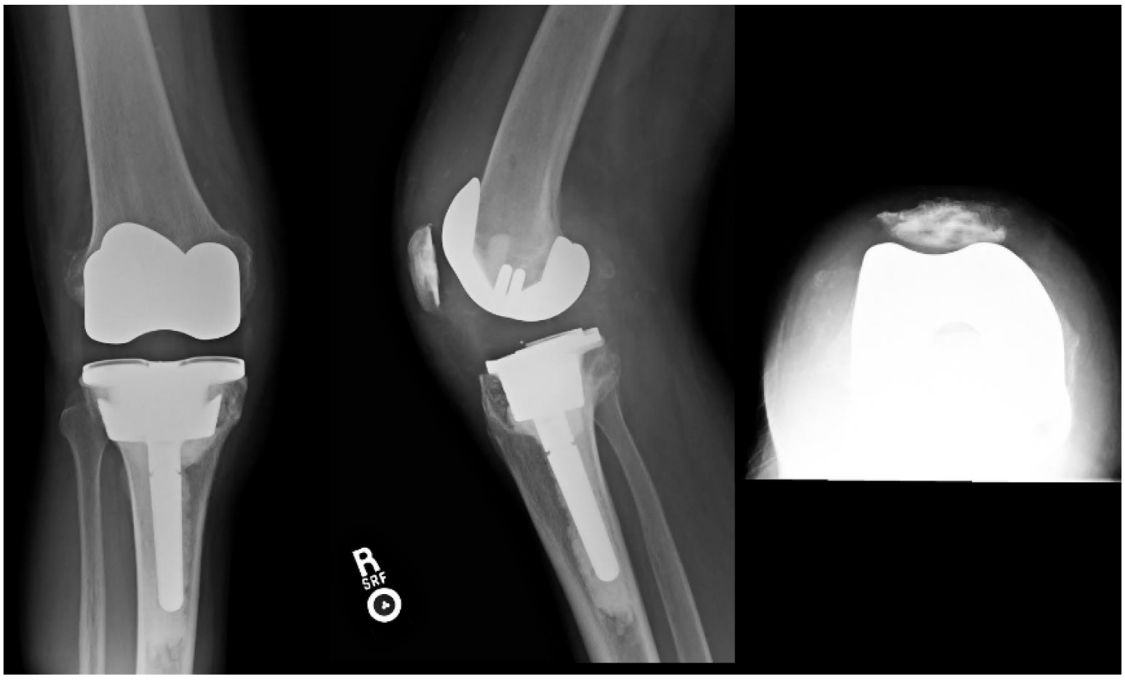

Figure 6. Postoperative anteroposterior, lateral, and sunrise radiographs of the right knee after total knee arthroplasty demonstrating tibial cone and stem placement and revision of patellar component.

arthroplasty is potentially under-recognized and may be related to increased pressure in the patellofemoral joint [8,17]. Reported early complications of patellofemoral arthroplasty include persistent knee pain, stiffness, patellar maltracking, and extensor mechanism disruption [2,5,12,14]. The primary late complication of patellofemoral arthroplasty is progression of tibiofemoral arthritis, which occurs in up to 22% of patients at 5 to 15 years postoperatively [2,5,12,14,15]. Rarely, loosening of the components has been reported in 0.5% of patients at 7 years and more commonly in uncemented prostheses [2].

Summary

Isolated patellar resurfacing was an early treatment option for patellofemoral arthritis and has been supplanted by newer designs that replace the entire patellofemoral articulation. It is important to recognize the potential for osteolysis resulting from wear of the patellar component even when articulating against native cartilage and bone. Once identified, proper work up and treatment can be initiated, with careful attention to bone quality at the time of primary or revision arthroplasty.

Conflicts of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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