

# Knee Mass From Severe Metallosis After Failure of a Metal-Backed Patellar Component Total Knee Arthroplasty

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**F**ailure of metal-backed patellar components in total knee arthroplasty has previously been reported.<sup>1-11</sup> Developments in prosthetic design such as adding a third peg to the metal baseplate and the use of a mobile-bearing patella have led to lower patellar revision rates.<sup>10,11</sup>

Bayley and colleagues<sup>2,3</sup> reported on the failure of metal-backed patellar components in 25 patients after total knee arthroplasty. Mechanisms of failure included polyethylene wear, fracture, and dissociation.<sup>2,3</sup> Wear or dissociation of the polyethylene from the metal backing, enhanced by abnormal patellofemoral biomechanics or patellar malalignment, is followed by articulation of the patellar metal backing against the femoral component.<sup>1,2,3,5,8</sup> Patellar metallic wear against titanium surfaces causes much more severe abrasion and metallic debris generation in comparison with cobalt-chromium alloys.<sup>6,7,12</sup>

Over time, the abrasive metallic wear debris leads to synovitis.<sup>2, 3, 12, 13</sup> The patients generally experience any of a multitude of symptoms relating to the accompanying synovitis, including pain, limitation of motion, or crepitus with knee motion. Weissman and colleagues<sup>9</sup> introduced the “metal-line sign” as a preoperative aid in radiographic detection of metal-induced synovitis from failure of the metal-backed patellar components after total knee arthroplasty. Breen<sup>14</sup> reported on “titanium lines” as a manifestation of metallosis at the knee in the 3 patients following implantation of titanium tumor prostheses. The radiographic appearance of the titanium lines may mimic soft-tissue tumor recurrence.<sup>14</sup>

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Our case report details a patient referred for a knee mass 9 years after primary total knee arthroplasty with a metal-backed patellar component.

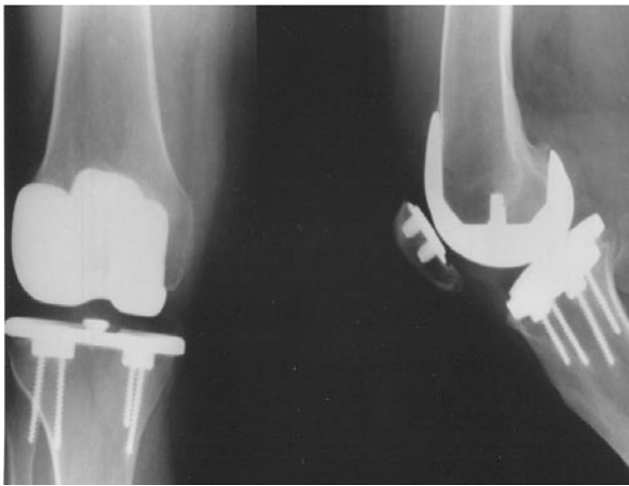
## CASE REPORT

A woman in her mid-70s with rheumatoid arthritis and knee pain was managed with a posterior cruciate ligament–preserving right Miller-Galante I total knee arthroplasty with a metal-backed patellar component (Zimmer, Warsaw, IN) in the late 1980s at an outside institution. The patient had an

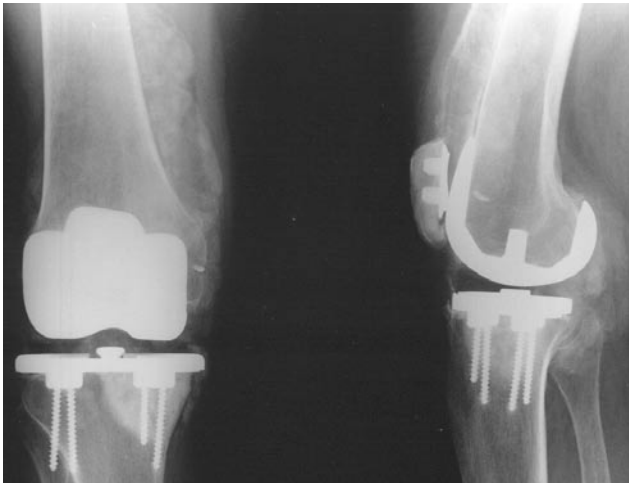
**“...detecting progression to failure of total knee arthroplasty prostheses prior to metal-on-metal articulation... can make revision surgery less technically difficult.”**

unremarkable postoperative course with relief of her pain. About 5 years later, she began to experience mild, progressive pain in the region of her right knee; the radiographs are shown in Figure 1. This was the last routine yearly radiograph obtained of her knee. About 4 years later, in the mid-1990s, she began having nocturnal knee pain with swelling and an anterior mass near the knee. Radiographs revealed a large radiopaque mass and failure of the metal-backed patellar component with metal-on-metal articulation of the patellofemoral components (Figure 2).

On physical examination, the patient ambulated with an antalgic gait. Alignment of the right lower extremity was normal. Right knee motion was from full extension to 120° of flexion without any extensor lag. Pain was elicited only at the extreme of flexion. There was anterior fullness about the right knee, without tenderness to palpation. There was no demonstrable instability, and palpable crepitus was appreciated over the patellofemoral joint. Laboratory evaluation revealed normal calcium, phosphorus, and alkaline phosphatase levels with an elevated serum parathyroid hormone level of 108 pg/mL (normal, 10 to 60 pg/mL). The erythrocyte sedimentation and serum immunoelectrophoresis were normal.



**Figure 1.** Anteroposterior and lateral radiographs illustrating metal-backed patellar component of a total knee arthroplasty.



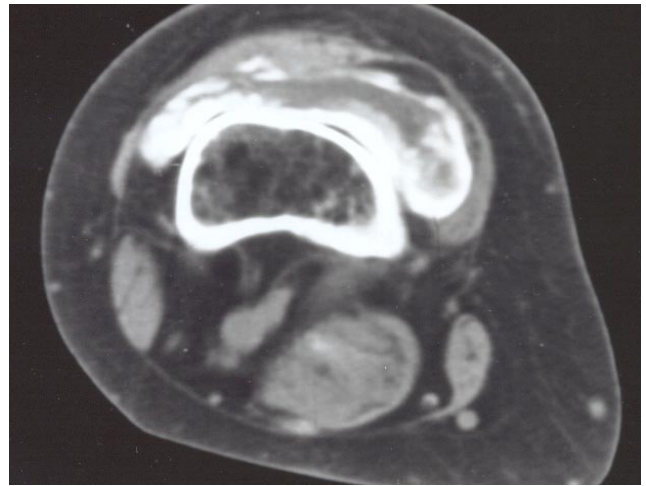
**Figure 2.** Anteroposterior and lateral radiographs illustrating failure of a metal-backed patellar component with metal-on-metal contact and extensive streaking of soft tissues as the “metal-line sign.”

A computed tomography (CT) scan showed a well-circumscribed distal femoral knee mass with displacement of the anterior thigh compartment. There was no evidence of cortical destruction or extension into the muscular compartments of the thigh (Figure 3).

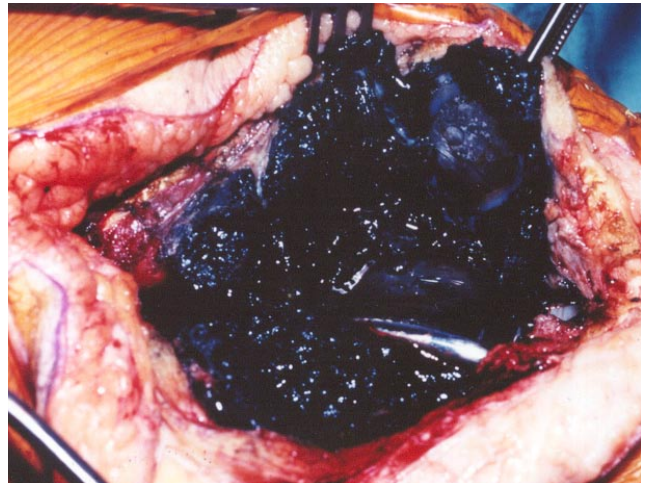
Open biopsy of the mass revealed black-stained synovial fluid and synovium from metallic debris generated by the metal-on-metal articulation at the patellofemoral joint of the arthroplasty components (Figures 4 and 5). Pieces of the polyethylene fragments from the failed metal-backed patellar components were present in the joint. The patient was treated with an extensive synovectomy. Given her activity level and existing bone stock, she was treated with patellectomy rather than a revision total knee arthroplasty.

## DISCUSSION

Sarcomatous degeneration at the site of total joint arthroplasty and metallic orthopedic implants has been reported in the literature.<sup>14-18</sup> The potential of malignancy in the setting



**Figure 3.** CT scan illustrating a nearly circumferential distal femoral knee mass displacing the quadriceps.



**Figure 4.** Intraoperative photograph documenting extensive black, metallic staining of the synovium.

of metallic prostheses is quite rare given the rate of occurrence of sarcomas in the proximity of implants relative to the number of total joint arthroplasties performed annually. Metal-on-metal wear with generation of metallic debris from failure of total joint arthroplasty is more common. Although implants utilized for total joint arthroplasty are thought to be biocompatible, Rae demonstrated the toxicity of different components of metal alloys utilized for total joint prostheses by incubating human synovial fibroblasts with different preparations of metals.<sup>19</sup> Local metal toxicity can cause local tissue reaction, inflammation, and necrosis. Although metal toxicity may contribute to the malignant degeneration near a metallic prosthesis, the metal wear debris and tissue response causing symptoms of pain or a palpable mass near a joint prosthesis can present a diagnostic dilemma.

Bayley and colleagues<sup>2,3</sup> reported on the clinical presentation, radiographic findings, and mechanisms of failure in 25 patients after failure of the metal-backed patellar component in total knee arthroplasty. Clinical history and physical examination were not helpful in making the diagnosis.



**Figure 5.** Photograph of the tissue from synovectomy.

There was no radiographic evidence of metallic debris in the majority of patients preoperatively. Radiographs, however, revealed failure of the metal-backed patellar components when metal-on-metal articulation was evident. The average time to failure was 18 months. In the majority of patients, the clinical presentation was sudden.<sup>2,3</sup> The “metal-line sign” on radiographs aids in the diagnosis of metal-induced synovitis secondary to failure of joint prosthesis.<sup>9</sup> In a study regarding this radiographic sign, 11 of 18 patients with metallic synovitis had a “metal-line sign” on preoperative radiographs at a range from 19 months to more than 6 years after the index arthroplasty procedure.<sup>9</sup> For titanium total joint arthroplasties, significantly elevated serum titanium levels have been reported as a means of diagnosis of failure and metal-on-metal articulation prior to the appearance of radiographic signs.<sup>20</sup>

**“The ‘metal-line sign’ on radiographs aids in the diagnosis of metal-induced synovitis secondary to failure of joint prosthesis.<sup>9</sup>”**

Our case report demonstrates a late failure of a metal-backed patellar component in a patient 9 years following total knee arthroplasty presenting as a knee mass. The rare formation of a thigh mass and a fistula from a popliteal cyst have each been reported in the setting of failure of a total knee arthroplasty.<sup>21,22</sup> Our patient’s presentation, with nocturnal pain and a knee mass, raised concern of a possible malignancy. Radiographic evidence of a circumscribed mass with the “metal-line sign” with a failed metal-backed patellar component and the CT scan of the mass supported the diagnosis of a metal debris-induced synovitis. The differential diagnosis included a sarcoma, heterotopic

### **A CAUTION: DON’T DISREGARD THE POSSIBILITY OF A TUMOR**

Despite the presence of a radiographic sign—the “metal-line sign”—pointing to a debris-induced synovitis, the potential toxicities associated with orthopedic metallic implants and debris make the surgeon consider a sarcoma in the differential diagnosis of this knee mass.<sup>17</sup> Although a cause-and-effect relationship between metal debris and carcinogenesis has not been clearly established, the diagnosis must be considered, because inappropriate treatment of a tumor by an unsuspecting surgeon may limit definitive treatment. Synovectomy or revision of the prosthesis in the setting of a sarcoma at the site of an arthroplasty can limit limb-salvage options or delay the diagnosis.

Conversely, this case report illustrates how the orthopedic oncologist should be familiar with the various pseudotumors, including metallosis and its accompanying synovitis.

ossification, myositis ossificans, vascular malformation, and metallic synovitis. A metabolically induced mass was possible given the elevation of the parathyroid hormone. A case report by Chang and colleagues<sup>23</sup> describes a similar presentation in a patient with the same Miller-Gallante I knee prosthesis with a metal-backed patella. At 7 years after the index surgery, the patient developed an acutely painful calf mass with failure of the patellar implant and metal-on-metal articulation.<sup>23</sup> An arthrogram showed extension into a large popliteal cyst. The design of the Miller-Gallante I total knee prosthesis with a metal-backed patellar component (Zimmer, Warsaw, IN) with a thin patellar polyethylene contributed to risk of polyethylene component failure.<sup>23</sup> The operative finding of black-stained synovium in our case report demonstrates the utility of the “metal-line sign.” Routine yearly radiographs are essential in detecting progression to failure of total knee arthroplasty prostheses prior to metal-on-metal articulation and can make revision surgery less technically difficult.

### **AUTHORS’ DISCLOSURE STATEMENT**

The authors report no actual or potential conflict of interest in relation to this article.

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