

Massive Baker Cyst Resulting in Tibial Nerve Compression Neuropathy Secondary to Polyethylene Wear Disease

Thomas F. Moyad, MD, MPH

Abstract

Symptomatic synovial cyst formation is an infrequent, late complication after total knee arthroplasty. Most often, these cysts are found incidentally. However, rarely they may become larger leading to significant pain and disability. The formation of gigantic cysts necessitating revision knee surgery has been detailed in a few case reports. To the author's knowledge, this is the first report in the medical literature that describes peripheral neuropathy of the tibial nerve secondary to a massive Baker cyst after total knee replacement.

Symptomatic synovial cyst formation is a rare, late occurrence after total knee arthroplasty (TKA); these cysts are generally discovered by chance. If they enlarge, they can result in significant pain and disability. A few case reports have described the development of very large cysts that required revision knee surgery. In this patient, polyethylene wear disease after TKA resulted in a massive synovial cyst that extended into the posterior compartment of the leg, as well as a progressive peripheral neuropathy. Revision of a loose patella component and worn polyethylene liner with complete synovectomy, plus decompression of the cyst via needle aspiration, resulted in an excellent short-term outcome.

To the author's knowledge, this is the first case report of peripheral neuropathy of the tibial nerve secondary to a massive Baker cyst after total knee replacement. The patient provided written informed consent for print and electronic publication of this case report.

Case Report

The patient was a 65-year-old woman with a complex medical history and multiple left knee surgeries, including a high tibial osteotomy and subsequent cemented TKA performed in the mid-1990s. She presented to the orthopedic department at a university hospital with complaints of knee pain 13 years after TKA. Observation was recommended; however, she was lost to follow-up.

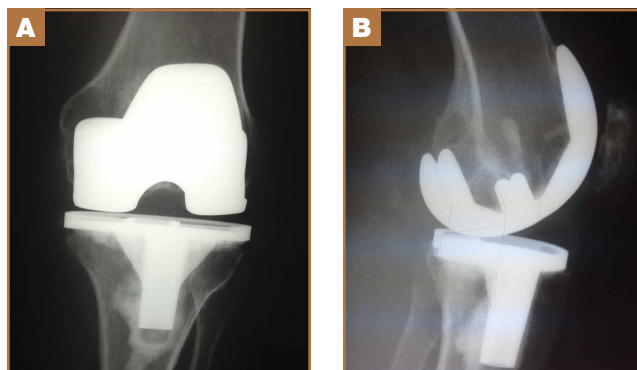
The patient presented to her primary care physician (PCP) 16 years after TKA with a very large, painful mass in the back of her left leg. An ultrasound showed a large Baker cyst, and the patient was sent to interventional radiology. A few months later, she had an ultrasound-guided aspiration into the left calf, which produced 300 mL of thick synovial fluid. A cell count was not performed, but bacterial cultures were negative. Immediately after the aspiration, the pain was relieved.

Approximately 3 months after the aspiration, she presented again to her PCP with re-accumulation of fluid in the back of her left leg and severe leg pain. She was referred to a different orthopedic surgeon who determined that the risk of surgery was too great given her complex medical history.

The woman's PCP referred the woman to our office 6 months after the aspiration. On presentation, her pain was localized to the posterior left leg. She reported the pain level as a constant 9 out of 10 on the visual analog scale, despite ingesting high doses of narcotics, including oxycontin and morphine. Her physical examination was remarkable for an ill-defined large calf mass. The posterior compartment of her left leg was firm and severely tender, similar to the characteristic findings seen in acute compartment syndrome.

Radiographs showed evidence of asymmetric polyethylene wear on the medial side of the knee (Figures 1A, 1B). Serum

Figure 1. (A) Anteroposterior and (B) lateral radiographs showing a well-fixed total knee arthroplasty with asymmetric polyethylene wear on the medial side.



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Figure 2. Magnetic resonance imaging of the left leg showing a massive Baker cyst. Note the presence of a large, homogenous fluid-filled mass immediately posterior to the tibia on T1-weighted imaging.

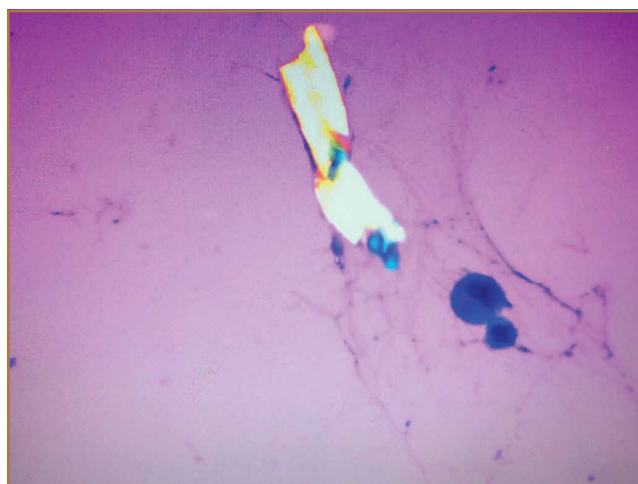


Figure 3. Histologic examination using polarizing light filters. Note the positively birefringent amorphous material consistent with high-molecular-weight polyethylene debris.

labs were ordered to evaluate for infection. C-reactive protein was mildly elevated at 5.5 mg/L (normal range, 0-5 mg/L); however, the erythrocyte sedimentation rate was normal at 12 mm/h (normal range, 0-20 mm/h). Magnetic resonance imaging of the left lower extremity with intravenous contrast showed the presence of a very large Baker cyst contained within the posterior compartment of the knee and a smaller surrounding cyst adjacent to the popliteal neurovascular bundle (**Figure 2**).

The Baker cyst was re-aspirated in the office. The automated synovial fluid cell count could not be performed because of high fluid viscosity. However, a manual review of the fluid specimen under light microscopy revealed proteinaceous, viscous tan-colored fluid containing no neutrophils and a few macrophages. Fluid cytology was also sent for review under polarizing light microscopy as described by Peterson and colleagues.¹ Scattered fragments of polarizable foreign material were consistent with polyethylene debris (**Figure 3**).

The patient was counseled about the risks and benefits of surgery and was offered revision TKA with polyethylene liner exchange and synovectomy, only after complete cessation of smoking. She underwent serum nicotine monitoring to ensure tobacco cessation; however, she also reported the onset of a progressive sensory deficit over her left foot during this period. Although her medical history was remarkable for spinal stenosis, she noted a progressive decline in sensory function and new-onset paresthesia of her left foot.

An urgent consult to neurology was requested for nerve conduction studies. According to the electrodiagnostic study, the patient had a moderately severe left tibial neuropathy, likely at the popliteal fossa or distal to it. The nerve conduction study showed a chronic tibial nerve peripheral compressive mononeuropathy, and she was immediately scheduled for revision knee surgery with decompression of her Baker cyst to prevent further neurologic deficit.

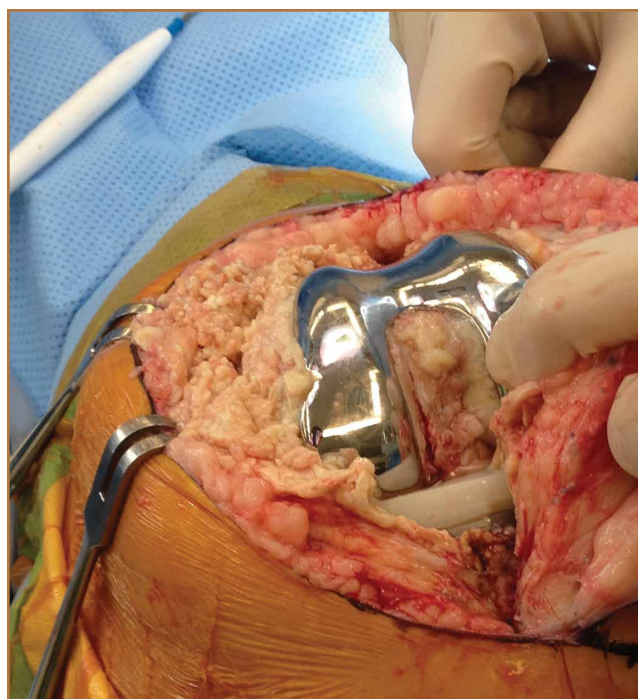


Figure 4. Hypertrophic synovitis secondary to polyethylene wear disease.

During surgery, the knee joint exhibited hypertrophic synovitis with a characteristic pale-yellowish discoloration secondary to significant polyethylene wear disease (**Figure 4**). The polyethylene liner was severely worn with pitting, cracking, and delamination (**Figure 5**). While the patellar component was grossly loose, the tibial and femoral components were stable. After a complete synovectomy, the loose patellar component and tibial polyethylene liner were replaced. Osteolytic areas within the tibia underwent curettage and allograft impaction



Figure 5. The modular tibial liner shows severe wear including pitting, cracking, and delamination.

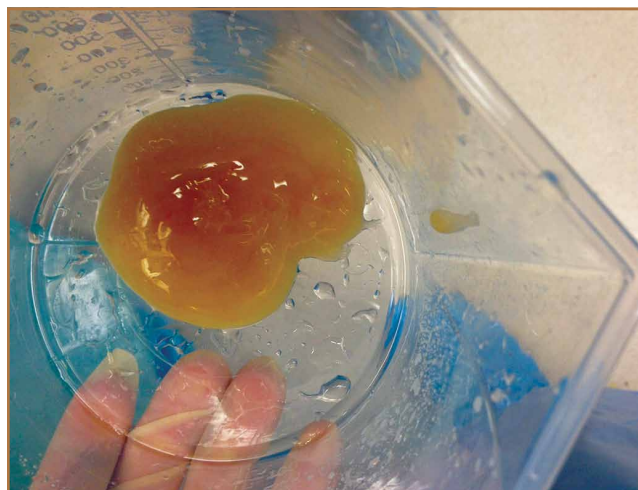


Figure 6. Thick “tapioca pudding–like” synovial fluid aspirated from the Baker cyst at the time of revision surgery.

grafting. Lastly, decompression of the ruptured Baker cyst was performed via a 16-gauge needle placed in the posterior compartment of the left leg. The calf was gently squeezed with a “milking” maneuver, which yielded approximately 200 mL of thick, mucoid yellowish-brown synovial fluid resembling tapioca pudding (Figure 6).

Postoperatively, all intraoperative cultures were negative, and the patient was followed closely at 1 week, 2 weeks, 6 weeks, and 3 months after the surgery. At her latest follow-up, the posterior leg compartment remained decompressed and her progressive sensory deficit had nearly resolved. Moreover, the left leg and posterior knee pain completely resolved.

Discussion

A leading cause of TKA failure is attributed to aseptic loosening from polyethylene wear disease.² Implanted high-molecular-weight polyethylene (HMWPE) liners are known to undergo a variety of mechanical wear patterns within the knee. Observed patterns include pitting, scratching, burnishing, scratching, and delamination, which can all liberate numerous fine polyethylene particles.³ This wear debris induces macrophage phagocytosis that triggers an inflammatory reaction within the knee joint and can lead to synovitis, repeat effusions and, ultimately, to aseptic loosening.

Prior to 1996, polyethylene used in total knee replacement underwent a sterilization process in air. This oxygen-rich environment led to the development of free radical formation within the HMWPE. Ultimately, this had a detrimental effect on the polyethylene, leading to the formation of increased wear debris.⁴

Subsequently, orthopedic companies have changed their sterilization and manufacturing methods. Polyethylene components now undergo a variety of processes to eliminate or reduce oxidation, free-radical formation, and mechanical wear debris. Now, sterilization typically takes place in an inert atmospheric environment. Modern HMWPE implants

often undergo higher irradiation to induce mechanical cross-linking, followed by either a re-annealing or remelting step. In other cases, manufacturers “dope” their polyethylene with vitamin E to quench free radicals within the material. While these steps have reduced the number of in vitro wear particles, the problem of wear debris, subsequent osteolysis, and aseptic loosening has not been eliminated.¹⁻⁵

Polyethylene wear debris within the synovial fluid or tissue of failed TKAs can be identified with scanning electron microscopy or by light microscopy utilizing polarized light.¹ In this particular case, wear debris was confirmed within the synovial tissue and in the fluid of the Baker cyst by microscopic analysis.

Formation of a popliteal or Baker cyst as a result of polyethylene wear disease is an infrequent but known complication of TKA. Reports have demonstrated variable success in cyst eradication when revision surgery is performed on knees with synovial cysts. Most of these reports indicate that cyst formation tends to occur as a late complication (7 or more years) after TKA.⁶⁻¹²

Treatment options may include skillful observation with close follow-up or revision surgery. Polyethylene exchange with synovectomy when feasible, as well as component revision with or without excision of the synovial cyst, are surgical options.

Niki and colleagues¹³ described a gigantic popliteal synovial cyst caused by wear particles after TKA. In this report, the surgeon performed a synovectomy and polyethylene liner exchange with retention of prosthetic components. At 12-month follow-up, the patient was reported to be doing well.

Mavrogenis and coauthors¹⁴ reported a wear debris–induced pseudotumor in the popliteal fossa and calf after TKA. In this case, in addition to the synovectomy, the surgeon removed all prosthetic components and used a semi-constrained implant to revise the knee. At 30-month follow-up, the patient reported having a painless knee.

While case reports have indicated that revision TKA for

large, painful synovial cysts is a reasonable treatment option in carefully selected patients, there is a paucity of literature on this subject. Moreover, the present case appears to be the first literature report of a tibial nerve compressive neuropathy secondary to a synovial cyst after TKA.

Conclusion

In this report, polyethylene wear disease after TKA resulted in a massive synovial cyst extending into the posterior compartment of the leg. A progressive peripheral neuropathy confirmed by electromyography was also discovered. The patient underwent revision of a loose patellar component and worn polyethylene liner with complete synovectomy plus decompression of the cyst via needle aspiration. This resulted in an excellent short-term outcome with resolution of pain and significant improvement of the peripheral neuropathy 3 months after surgery.

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