Isolated Popliteus Muscle Rupture With Neurovascular Compression Requiring Surgical Decompression

Matthew Bollier, MD, Todd Ream, MD, and Gregory Hodgman, MD

The tibial nerve, popliteal artery, and popliteal vein are superficial to the popliteus muscle as they exit the popliteal fossa deep to the fibrous soleus arch (Figure 1). There are 9 case reports of tibial nerve compression in the popliteal fossa with etiologies including popliteus muscle rupture, mass lesion, or anomalous course of the gastrocnemius.[1-9] When masses, fibrous bands, or swelling compress the nerve and vein against the rigid soleus arch, clinical symptoms develop. There are 4 case reports of a popliteus muscle injury causing tibial nerve palsy, but surgical decompression of this problem has not been described previously.[1-4] We report the unique case of an isolated popliteus muscle rupture that led to compression of the tibial nerve in the popliteal fossa requiring surgical decompression.

The popliteus muscle forms the floor of the popliteal fossa coursing obliquely across the posterior tibia with a tendinous insertion on the lateral femoral condyle anterior and inferior to the lateral collateral ligament insertion.[10-13] The popliteus muscle functions as the primary internal rotator of the tibia, unlocking the knee during early flexion.[14-15] It also is a static and dynamic stabilizer of the lateral side of the knee.

Although most popliteus injuries are part of a complex posterolateral corner knee injury, isolated tendon avulsions and muscle belly ruptures have been described.[1-10,16-20] In this case, an isolated popliteus muscle rupture from a knee external rotation injury caused an inflammatory mass effect in the popliteal fossa, compressing the tibial nerve against the soleus arch leading to a progressive tibial nerve palsy and multiple deep vein thrombosis (DVT). This interesting case report demonstrates the anatomy of the posterior aspect of the knee, highlights the importance of a thorough physical exam and advanced imaging techniques, and reviews the current literature on neurovascular compression after a popliteus muscle rupture.

The authors have obtained the patient's written informed consent for print and electronic publication of the case report.

Case Report

A 34-year-old police officer presented to the emergency department with a 2-day history of excruciating posterior left knee pain. He described a twisting injury to his flexed left knee while helping a motorist change a tire 2 weeks prior. There was an immediate onset of posterior knee pain, but it resolved over several hours. During the 2 days prior to emergency department evaluation, he reported worsening posterior leg pain, weakness, and an inability to bear weight. Right knee and tibia/fibula radiographs showed no fracture or bony

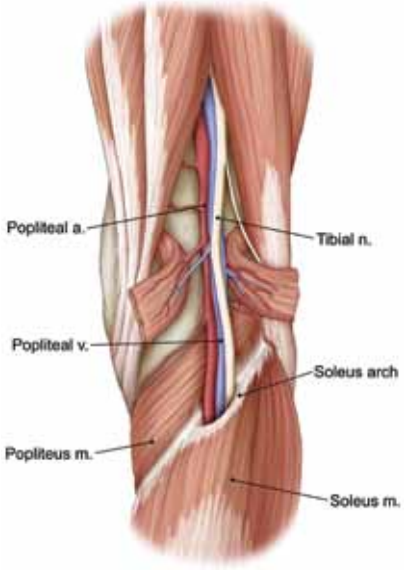

Figure 1. Popliteal fossa anatomy. The tibial nerve, popliteal artery, and popliteal vein are visualized directly superficial to the popliteus muscle as they course distally under the soleus arch. Abbreviations: a, artery; m, muscle; n, nerve; v, vein. Figure 1 provided by Matthew Morrey.

Dr. Bollier is Assistant Professor, Department of Orthopaedic Surgery, University of Iowa, Iowa City, Iowa. He was Orthopaedic Surgery Resident, Michigan State University, Kalamazoo Center for Medical Studies, Kalamazoo, Michigan, at the time the article was written.

Dr. Ream is Orthopaedic Surgeon, Kalamazoo Orthopaedic Clinic, and Clinical Assistant Professor, Michigan State University, Kalamazoo, Michigan.

Dr. Hodgman is Radiologist, Advanced Radiology Services P.C., Kalamazoo, Michigan.

Address correspondence to: Matthew Bollier, MD, Department of Orthopaedic Surgery, University of Iowa Hospitals and Clinics, 2701 Prairie Meadow Dr, Iowa City, IA 52242 (tel, 319-467-8254; e-mail, matthew-bollier@uiowa.edu).

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Figure 2. Patient presented to the emergency room with a large effusion of the left knee.

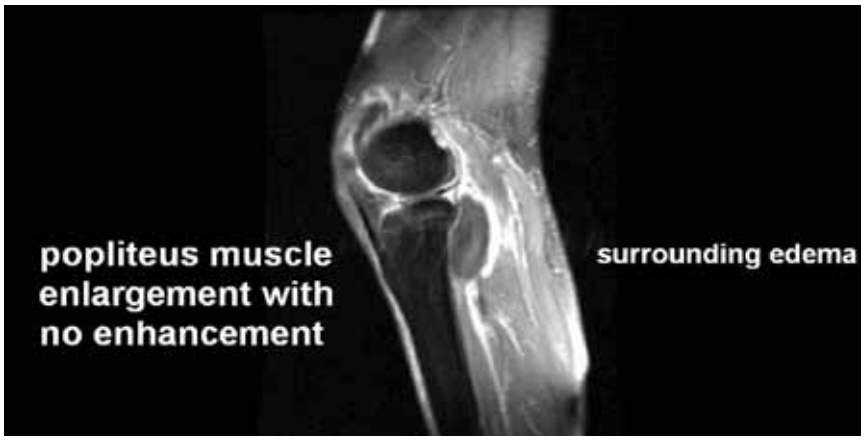

Figure 3. T_1-weighted sagittal magnetic resonance imaging of left knee after intravenous gadolinium reveals popliteus muscle enlargement with no enhancement, and edema posterior to the muscle.

Figure 4. T_1-weighted coronal magnetic resonance imaging of left knee after intravenous gadolinium shows popliteus muscle hypertrophy with no enhancement.

abnormalities. Laboratory analysis revealed an erythrocyte sedimentation rate of 55 mm/h, C-reactive protein of 13.5 nmol/L, and a white blood cell count of 10.9×10^9/L.

After the emergency department evaluation, the orthopedic surgery service was consulted. Initial questioning revealed a burning posterior knee pain that radiated distally along the posterior left leg, plantar foot dysesthesias, and a knee effusion. The patient had an elevated temperature (38.5°C). He appeared anxious and couldn't find a comfortable position. He had a large knee effusion and painless passive knee range of motion from 0° to 45° (Figure 2). Posterolateral calf swelling and tenderness were present, and the patient reported posterior leg discomfort with passive ankle dorsiflexion and resisted ankle plantarflexion. There was decreased sensation to light touch and pinprick on the lateral plantar foot. The gastrocnemius and soleus muscles showed grade 5/5 strength by manual muscle testing, but flexor hallucis longus muscle strength was grade 3/5. The remainder of the neurovascular examination was normal. Knee stability testing showed symmetric findings compared to the contralateral knee with the Lachman test, posterior drawer test, varus/valgus stress test, and Dial test. There was no erythema, fluctuance, or wounds. Calf compartments were soft.

A knee aspiration was performed and 30 mL of clear yellow fluid was obtained. Laboratory analysis revealed a white blood cell count of 10.0×10^9/L, normal glucose and lactate dehydrogenase levels, and no organism present with bacterial cultures. A lower-extremity ultrasound showed deep vein thrombosis in the anterior tibial, deep peroneal, and posterior tibial veins. Magnetic resonance imaging (MRI) with intravenous gadolinium of the left knee and left calf demonstrated popliteus muscle swelling with no enhancement and surrounding edema (Figures 3–5). The MRI findings were consistent with a popliteus muscle rupture and subsequent necrosis. An associated inflammatory mass effect and popliteus muscle swelling compressed the nerve and vein against the fibrous soleus arch leading to an acute tibial neuropathy and multiple DVT. The patient was started on therapeutic enoxaparin (1 mg/kg) to treat DVT and was admitted to the hospital for observation and pain control.

Eighteen hours after admission, the patient required an increased amount of intravenous pain medications and reported worsening posterior leg pain. Examination revealed decreased sensation to light touch and pinprick involving the entire plantar foot. Manual muscle testing showed grade 0/5 flexor hallucis longus strength and grade 2/5 gastrocnemious and soleus strength. The patient's posterior calf compartment was soft but diffusely tender to palpation. He had increased discomfort with passive ankle dorsiflexion.

The patient was felt to have a progressive tibial neuropathy and urgent surgical decompression was

planned. He was placed in a prone position for a posterior approach to the knee. A lazy S-shaped incision was made, curving from distal medial to proximal lateral. After dissecting down to the fascia, the sural nerve and small saphenous vein were identified and traced proximally. The fascia was split in line with the incision, and the dissection proceeded between the medial and lateral heads of the gastrocnemius muscle. The tibial nerve was identified and found to be pale, atrophic, and flattened at the soleus arch (Figure 6). The soleus arch was divided longitudinally to decompress the nerve and vein. Necrotic-appearing popliteus muscle was débrided (Figure 7). The skin was closed, and the patient's leg was placed in a soft dressing. The patient was made non–weight bearing for 2 weeks and knee range of motion was limited to 45° of flexion. The neuropathic pain resolved immediately after surgery.

Postoperative vascular surgery consultation was obtained, and the patient was started on a 3-month course of coumadin to treat DVT. At 2 weeks, weight bearing and knee range of motion were progressed. At 2 months, the patient had full knee range of motion and ambulated independently. He still reported decreased plantar foot sensation. He had grade 4/5 gastrocnemius muscle strength and grade 1/5 flexor hallucis longus muscle strength. He was able to return to active duty as a police officer.

At 9 months, medial plantar sensation had returned, but the patient still reported numbness on the lateral plantar foot. He had grade 5/5 ankle plantar flexion strength and grade 1/5 flexor hallucis longus muscle strength. He was able to ambulate with a normal gait and to continue working as a police officer.

Discussion

Isolated injuries to the popliteus muscle are extremely uncommon, limited to various case reports.[1-10,16-20] Most popliteus muscle injuries are part of a multiligament knee injury involving the posterolateral corner.[21] Less than 10% of popliteus muscle injuries are isolated.[16,22] Several patterns of isolated popliteus injury have been described: a tendon avulsion or rupture, muscle belly rupture, or popliteus tendinitis. The diagnosis of an isolated popliteus injury requires a thorough history, physical examination, and appropriate diagnostic imaging to check for associated injuries.[2,22]

Popliteus tendinitis has been described in athletes who present with chronic posterolateral knee pain.[14] Posterolateral joint line tenderness and pain with resisted internal rotation of the leg often are present. Patients typically display full active knee range of motion with no knee effusion, ligamentous laxity, or mechanical symptoms. Conservative treatment involves injections, quadriceps strengthening, stretching, and rest.

Popliteus tendon avulsion is more common than muscle belly injuries and typically involves a sudden external rotation force to a partially flexed knee.[16] These avulsions usually are associated with a posterolateral corner ligament injury, so it is essential to perform a detailed knee exam. Patients with isolated tendon avulsions will have a stable knee and similar physical examination findings to those with popliteus tendinitis . Diagnosis can be confirmed with MRI or lack of visualization of the popliteus tendon during arthroscopy.[16,23] An isolated popliteus muscle belly rupture occurs with a similar mechanism of

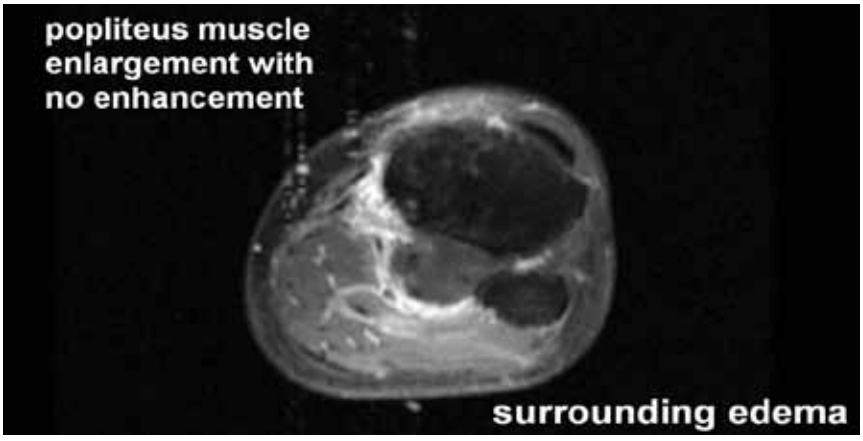

Figure 5. T_1-weighted axial magnetic resonance imaging of left knee after intravenous gadolinium reveals popliteus muscle enlargement with no enhancement, and edema posterior to the muscle.

Figure 6. The patient is in the prone position for posterior approach to the left knee. The tibial nerve is pale, atrophic, and compressed at the soleus arch.

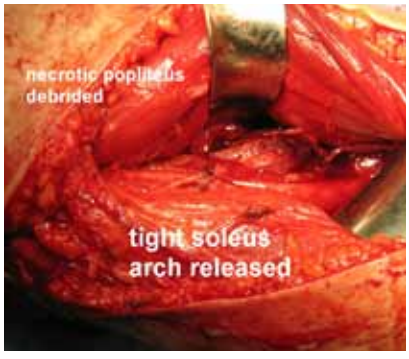

Figure 7. Popliteal fossa. The soleus arch is divided longitudinally and the necrotic popliteus muscle is débrided.

injury, but patients are more likely to demonstrate an acutely painful swollen calf.[3,4]

Isolated tibial nerve lesions are rare and typically are located in the tarsal tunnel posterior to the medial malleolus. A review of the literature revealed only 9 cases of tibial nerve palsy in the popliteal fossa: 5 cases of atraumatic compression and 4 cases of traumatic popliteus injury.[1-9] The tibial nerve lies superficial and lateral to the popliteal artery and vein as it enters the popliteal fossa. It provides innervation for the gastrocnemius, soleus, and popliteus muscles before passing deep to the fibrous soleus arch.[2] As the nerve dives deep to the soleus arch, it lies directly posterior to the popliteus muscle and is at risk for compression (Figure 1).

There have been several reports of atraumatic tibial nerve compression in the popliteal fossa secondary to mass lesion, gastrocnemius hypertrophy, fibrous bands, or anomalous gastrocnemius fibers.[5-9] In one case, surgical decompression of the soleus arch was performed for an atraumatic tibial nerve palsy secondary to a popliteus muscle lesion.[5] As in our case, neuropathic pain resolved immediately and near full neurologic recovery was obtained.

There have been 4 case reports of traumatic tibial nerve palsy secondary to a popliteus muscle rupture.[1-4] Each of these cases shared a similar mechanism of injury and physical examination with our case. All cases involved some plantar sensory deficit, and 3 cases reported toe flexion and ankle plantar flexion weakness. Unlike the present case, each patient was treated nonoperatively. Two of these patients had complete neurologic recovery and 2 patients had minor neurologic deficits at long-term follow-up.

The present case is the first account of surgical decompression for tibial nerve palsy after an isolated popliteus muscle rupture. Surgical decompression was chosen because of the progressive neurologic deficit and increasing neuropathic pain over a 24-hour period. As in acute carpal tunnel syndrome, the tibial nerve is compressed in a confined area. With acute carpal tunnel syndrome, urgent decompression is thought to minimize permanent nerve damage and motor and sensory deficits.[24-25]

An isolated popliteus muscle rupture is a rare injury, but it may be associated with an inflammatory mass effect that compresses the tibial nerve against the fibrous soleus arch. Although previous reports have recommended nonoperative treatment, our patient had documented progressive neurologic decline. Urgent surgical decompression allowed full functional recovery and immediately relieved his neuropathic pain. However, he was left with a permanent partial neurologic deficit with lateral plantar foot numbness and flexor hallucis longus muscle weakness.

Conclusion

Based upon this single case report, we are unable to conclude whether surgical intervention leads to superior results than nonoperative treatment in cases that present with stable tibial nerve injuries. However, when progressive neurologic deterioration is noted, surgical intervention can produce immediate neuropathic pain relief and improvement of tibial nerve function.

Authors' Disclosure Statement

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

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