

# Popliteal Artery Pseudoaneurysm: An Unusual Complication of Tibial Traction

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## Abstract

Traction pins are an essential tool in the orthopedic surgeon's armamentarium. Historically a definitive treatment for some fractures, they are mainly used as a temporizing measure today. Despite their frequent use and relative simplicity, traction pins can have complications, many of which can be subtle and easily overlooked.

Here we report on an unusual complication that was difficult to diagnose but caused significant morbidity before being diagnosed and treated. Pseudoaneurysms can cause a range of symptoms and usually present as a painful, tender, pulsatile mass, but in this instance the popliteal artery pseudoaneurysm presented as chronic, painful lower extremity swelling. With diagnosis and treatment, the patient's symptoms resolved. We discuss the complications associated with traction-pin placement.

**T**raction-pin placement is a basic orthopedic skill learned in the early years of residency training. Skeletal traction historically was used as definitive treatment for long-bone fractures, and it is still in use in countries without access to modern medical care.<sup>1,2</sup> In current orthopedic practice, proximal tibial and distal femoral traction pins are most commonly used to temporize femoral shaft and acetabular fractures, respectively, before definitive surgical intervention. Although traction-pin placement is common, there are complications that can cause morbidity ranging from skin irritation to death.

In this article, we report on a popliteal artery pseudoaneurysm, a unique complication related to pin placement. The patient provided written informed consent for print and electronic publication of this case report.

## Case Report

A 22-year-old woman with no past medical history was driving a car at 35 miles per hour when she hit a telephone pole. She was wearing a seatbelt. She was taken by ambulance for a trauma evaluation. She sustained a right posterior hip dislocation with an associated Pipkin 2 femoral head fracture (Figures 1A, 1B), a right elbow skin avulsion, and a scalp abrasion.

The patient underwent closed hip reduction under sedation, and a proximal tibial traction pin was placed (Figures 2A, 2B). At our institution, proximal tibial traction pins are placed 2 cm distal and 2 cm posterior to the tibial tubercle without the use of fluoroscopy. The skin leg is prepared and draped in sterile fashion, and a local anesthetic is used to anesthetize the skin and periosteum on the medial and lateral aspects of the leg. A 1.5-cm incision is made laterally, and soft tissue is spread laterally down to the periosteum. Then the traction pin (always the

Figure 1. (A) Prereduction and (B) postreduction injury radiographs showing Pipkin 2 femoral head fracture.

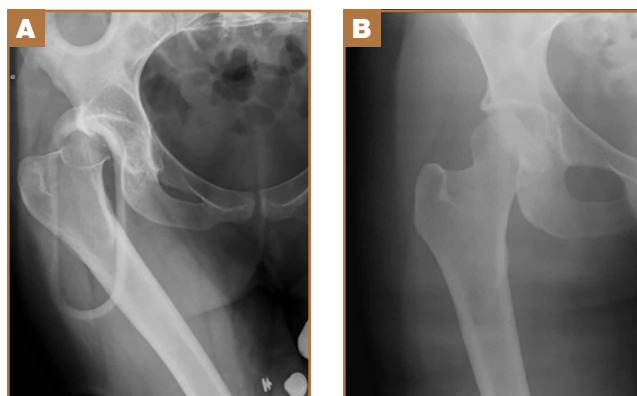
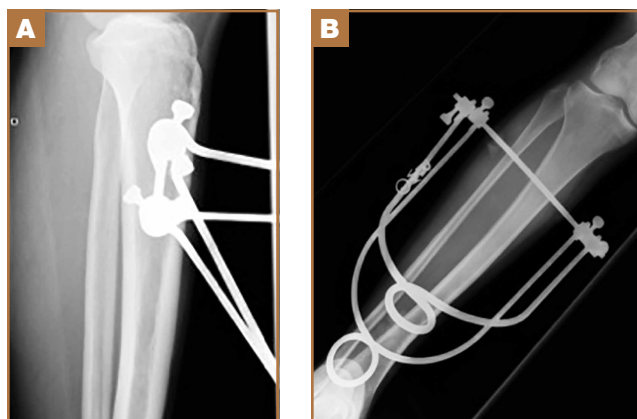
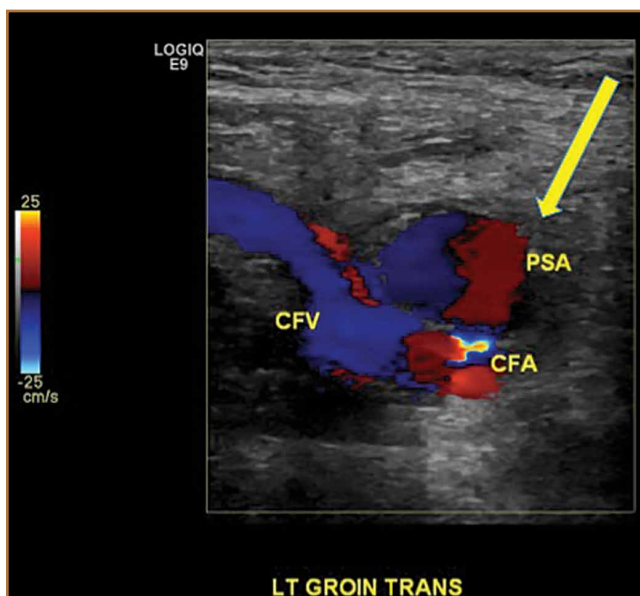


Figure 2. (A) Lateral and (B) anteroposterior views of tibial traction pin.



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**Figure 3.** Ultrasound of pseudoaneurysm. Abbreviations: CFA, common femoral artery; CFV, common femoral vein; PSA, pseudoaneurysm (arrow).



**Figure 4.** Computed tomography angiogram of pseudoaneurysm arising from tibioperoneal trunk (arrow).

largest nonthreaded pin available) is used to sound the anterior and posterior aspects of the tibia—the goal being to end at the anterior two-thirds/posterior one-third mark. After the pin is advanced through both cortices, the place where the pin will exit the skin is noted, and another incision is made. For this patient, no complications were noted at time of pin placement.

On postinjury day 1, she was taken to the operating room for open reduction and internal fixation of the femoral head fracture through a Smith-Petersen approach. At the same time, a traction pin was removed. Routine postoperative protocols were followed. The patient was started on enoxaparin, was seen by physical therapy on postoperative day 1, and was kept non-weight-bearing on the right lower extremity. Pain was well controlled, and the patient was discharged on postoperative day 3 (postinjury day 4).

Three weeks after surgery, she returned for a scheduled follow-up with complaints of paresthesia and decreased sensation in the right lateral cutaneous femoral nerve distribution and burning pain in the toes. A stiff right ankle was noted. A night splint, amitriptyline, and additional pain medications were ordered.

The patient returned for her scheduled 6-week follow-up reporting she had not taken the enoxaparin because her pharmacy “did not have any.” Her primary care physician had given her “another blood thinner,” which she had taken orally for 1 to 2 weeks. She had complaints of right calf pain, but her hip was pain-free. There was a large amount of calf swelling and tenderness along with mild equinus contracture of the ankle. She was sent to the emergency department (ED) for Doppler ultrasound evaluation for deep venous thrombosis (DVT).

Duplex Doppler imaging of the deep venous system of the lower extremities was performed with visualization from the

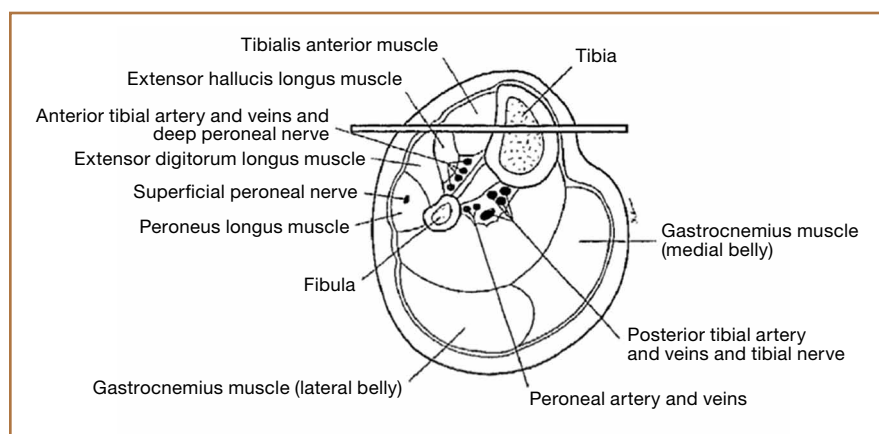
common femoral veins to the popliteal veins bilaterally. There was normal compressibility, respiratory phasicity, and flow with no intraluminal thrombus. A radiograph of tibia and fibula showed soft-tissue swelling and lucencies from the traction pin but no other abnormalities.

Eight weeks after surgery, the patient returned to the ED because of continuing calf pain. Given that the ultrasound findings had been negative, magnetic resonance imaging (MRI) was ordered, and orthopedic follow-up scheduled. About 10 weeks after surgery, she returned to the ED, still with calf pain, and reported having been unable to go for her MRI because of financial reasons. Physical examination revealed increased calf swelling and a new ecchymosis tracking along the tibia. Repeat ultrasound, performed from the common femoral veins through the popliteal veins, showed a right posterior calf pseudoaneurysm (8.5×4.3×5.3 cm) arising from the popliteal artery about 5 cm below the popliteal fossa. In addition, a large hematoma was seen originating in the upper posterior calf and extending inferiorly (Figure 3).

Computed tomography angiogram confirmed the ultrasound diagnosis of a large (5.6×4.8-cm) right calf pseudoaneurysm arising possibly from a small muscular branch of the proximal tibioperoneal trunk, with a large surrounding hematoma in the posterior compartment of the proximal right calf (Figure 4). Vascular surgery was consulted, and coil embolization of the pseudoaneurysm was performed later that night in the interventional radiology suite.

After the coiling of the pseudoaneurysm, the calf swelling and pain slowly improved. At 12-week orthopedic follow-up, the patient was no longer using any pain medications, and she noted improvement in the right foot’s neuropathic symptoms. Serial casting was prescribed for the equinus contracture of the ankle. She was allowed to start weight-bearing on the right lower extremity. Radiographs at 12 weeks showed collapse of the superomedial aspect of the femoral head with surrounding sclerosis consistent with posttraumatic avascular necrosis.

At final orthopedic follow-up, about 16 weeks after surgery, the patient reported 0/10 pain. Sensation was noted as being intact throughout the right lower extremity but decreased in the tibial nerve distribution. Ankle range of motion was still limited, with 5° of dorsiflexion and 25° of plantar flexion. The hip was pain-free with flexion of 0° to 100°, 10° of internal



**Figure 5.** Cross-section of tibia at level of traction-pin placement. Reprinted from: Althausen PL, Hak DJ. Lower extremity traction pins: indications, technique, and complications. *Am J Orthop.* 2002;31(1):43-47. Used with permission of Dr. Hak.

rotation, and 20° of external rotation. Additional appointments were scheduled, but the patient did not follow up. Two years after initial injury, she returned to the ED for evaluation of rhinorrhea, and no orthopedic complaints were noted.

## Discussion

Skeletal traction begins with the insertion of a wire or pin through a bone. It is extremely important to use proper technique in order to minimize the risks associated with pin insertion.<sup>3</sup> Potential pitfalls involve the energy transferred into the bone during insertion, the incisions used to place the pin, and injury to surrounding neurovascular structures. For proximal tibial pins, standard technique dictates placing the pin in a lateral-to-medial direction 2 cm posterior to the tibial tubercle and avoiding the dense anterior cortical bone. At our institution, traction pins are placed with a power drill after the patient is given a local anesthetic or is placed under conscious sedation. Which type of anesthesia to use is based on the patient's overall condition and on the ED attending physician's willingness to administer conscious sedation.

The 2 most common types of tibial traction involve use of either a large Steinmann pin attached to a metal bow or a Kirschner wire (K-wire) placed under tension before traction. Which to use is the surgeon's choice. Surgeons at our institution historically have used Steinmann pins. No studies have directly compared fine-wire and Steinmann-pin traction, but with this complication our institution is evaluating a change to tensioned wires. Compared with large Steinmann pins, fine-wire pins create less of a defect in the bone but also bend or break more easily if tension is not applied or if it fails. A fine wire with its smaller surface area may also cut more easily into osteopenic bone than a large-diameter pin would.

Proximal tibial traction typically is indicated for femoral shaft and acetabular fractures. Although the subcutaneous nature of the tibia makes for easier pin placement, the anatomy of the tibia can predispose this bone to complications. Its triangular shape can lead to intracortical rather than the preferred

bicortical pin placement. Increased heat caused by intracortical placement can lead to osteonecrosis and even to damage of surrounding soft tissues. Green and Ripley<sup>4</sup> found that chronic osteomyelitis typically resulted from intracortical placement of traction pins.

Injury to surrounding soft tissues, either from heat necrosis or from infection introduced through pin sites, can also have consequences. Pin-site infections increase with duration of treatment, though care seldom requires more than pin removal and antibiotics.<sup>5,6</sup> More-invasive infections range from cellulitis surrounding the pin site to subcutaneous abscesses. There is 1 report of a *Clostridium perfringens* infection leading to death only 5 days after

pin placement.<sup>7</sup>

Neurovascular structures are at risk with any orthopedic procedure. With proximal tibial pins in pediatric patients, the peroneal nerve, the anterior tibial artery, and the proximal physis are most at risk. The deep peroneal nerve and the anterior tibial artery run together deep to the anterior compartment, which places them at highest risk with pin insertion. The peroneal and tibial arteries run deep to the deep posterior compartment along with the tibial nerve behind the posterior cortex of the tibia, which makes injury less likely.<sup>8</sup>

Historically, long-bone fractures were often treated with traction. Kirby and Fitts<sup>9</sup> reported on 342 transfexion pins and wires used in the treatment of 233 long-bone fractures between 1943 and 1945. Of the 305 pins/wires observed over the entire treatment period (average, 6 weeks), only 12 (3.93%) developed a complication. There were 4 loose K-wires, 1 broken wire, and 1 bow failure; Steinmann pins were involved in 1 infection and 2 transient peroneal nerve palsies; and 3 Roger Anderson pins loosened. Pin-tract drainage was not included as a complication if it did not also involve localized or general signs of inflammation. The 2 peroneal nerve palsies were associated with medial-to-lateral pin insertion creating a more posterior pin path.

Pins inserted for external fixators of the tibia have injured the anterior tibial vessels and branches of the peroneal and saphenous nerves. A proximal tibial traction pin, in essence a transfexion pin, can cause similar injuries, particularly with imperfect placement (Figure 5).<sup>3,10</sup>

A pseudoaneurysm is a pulsating, encapsulated hematoma that remains in communication with the lumen of a ruptured or injured vessel. The arterial wall itself is torn or ruptured, and the external wall of the aneurysmal sac consists of outer arterial layers, perivascular tissue, blood clot, or a layer of reactive fibrosis. This contrasts with a true aneurysm, in which all 3 arterial layers (intima, media, adventitia) remain confluent but are dilated beyond their normal diameter. Of all pseudoaneurysms, those caused iatrogenically are the most common

and are typically produced by femoral artery catheterization, accounting for 70% to 80% of the incidence.<sup>11</sup>

Our patient's injury was most likely caused by an initial error in pin placement before the pin was driven across the tibia. The typical teaching for traction-pin placement involves finding the correct starting point and then using the pin to feel the anterior and posterior surfaces of the bone (described earlier). If the pin slid posteriorly, it may have contacted the artery and caused a small tear that eventually led to the formation of the pseudoaneurysm.

The pseudoaneurysm was not the only complication in the present case. There was also the delay in diagnosis. A standard technique is used to evaluate the lower extremity venous system for DVT. The ultrasonographer starts with the probe as proximal as possible (above the inguinal ligament), ideally proximal to the saphenofemoral junction, and moves distally in 1-cm increments, checking the veins for compressibility, color, and Doppler signal. Unless advised otherwise, the ultrasonographer typically does not examine distal to the knee.<sup>12,13</sup> As this patient's pseudoaneurysm was distal to the knee, it was not found on initial ultrasound, and her inability to obtain her MRI compounded the delay. The second ultrasound identified the pseudoaneurysm. The ultrasonographer examined more distally, given the contrast between the clinical diagnosis of vascular pathology and the negative Doppler study. Computed tomography angiogram confirmed the diagnosis and guided the vascular surgeons in identifying the lesion as a pseudoaneurysm, allowing it to be coiled rather than bypassed.

Duplex ultrasound is the preferred diagnostic modality for imaging pseudoaneurysms. Although our patient's scan was performed in timely fashion, it did not image the area of pathology. Instead, this patient with multiple orthopedic injuries was scanned for DVT, the most likely cause of her lower extremity swelling. Had a pseudoaneurysm been suspected, the ultrasonographer would have been instructed to image the entire extremity and not just the area where DVT might be found.

Fortunately, despite the treatment delay, the patient recovered well from both the traumatic injuries sustained in the car crash and the likely iatrogenic pseudoaneurysm. Although traction pins are easily and frequently used, they can have complications, which are often preventable. Starting with pin placement itself, there were several opportunities for improving this patient's care or, at a minimum, reducing the time

spent in diagnosis. If the pin had been noticed sliding posteriorly during insertion, extra attention during follow-up visits could have helped identify the injury sooner. Another difficulty in diagnosis was that of obtaining the appropriate outpatient radiology studies which necessitated repeat ED visits. An additional juncture was between the patient's multiple ED visits for similar complaints. Obtaining advanced imaging sooner could have helped in diagnosing the pseudoaneurysm earlier.

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