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Anterior Tibial Artery Impingement by a Distal Interlocking Screw: A Case Report

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Abstract: A case is presented of a twenty-eight-year-old male with bilateral closed tibial fractures presenting with no right posterior tibial pulse, who was treated with bilateral reamed intramedullary nails. A post-operative arteriogram, to assess injury to the posterior tibial artery due to the initial insult, revealed impingement of the right anterior tibial artery by the most distal screw of the distal locking screws. The screw was exchanged and the patient recovered without further complication. The factors that place the anterior tibial artery at increased risk of injury from distal locking screws are reviewed here.

Introduction

Stabilization of diaphyseal fractures of the tibia by locked intramedullary nails is a common treatment. Vascular and neurologic complications of this procedure are rare [1]. Cases have been reported where the proximal locking screw of the tibial intramedullary nail obstructed the popliteal artery [2], the distal locking screw occluded blood flow in the anterior tibial artery [3], and where an ischemic limb developed following intramedullary nailing of a tibia fracture [4]. We report a case of a twenty-eight-year-old man with closed fractures involving both tibias, treated with bilateral reamed intramedullary nail fixation, complicated by impingement of the anterior tibial artery by the distal locking screw in one leg.

Case Report

A twenty-eight-year-old man, otherwise healthy, was evaluated in the emergency department as a result of trauma he sustained when his motorcycle crashed into a tree. The patient was found to have closed diaphyseal fractures involving both of his tibias. The right tibia fracture was transverse and associated with a high non-displaced fibula fracture (Fig. 1). The left mid-tibia fracture had a small butterfly fragment. Physical examination revealed the lower leg compartments to be moderately swollen with only mild pain on passive stretch of his tendons. Pulses were present in the left leg. In the right leg, only the dorsalis pedis artery was palpable. The right posterior tibial pulse, however, was not present even on Doppler examination. The patient's neurologic examination was normal, and no other injuries were present. The tibia fractures were splinted and the patient was admitted to the trauma service.

The following morning the patient was brought to the operating room for stabilization of his tibia fractures. On morning rounds, it was discovered that the patient had developed increased swelling in both of his lower legs and he had increased pain with passive stretch of his tendons, suggesting compartment syndromes. Compartment pressures were obtained intraoperatively from each of the compartments in both legs. The highest pressure in the left leg was thirty-five mmHg in the anterior compartment. The highest pressure in the right leg measured forty-five mmHg in the deep posterior compartment. These pressures were twenty mmHg and ten mmHg below the diastolic blood pressure respectively. At that time, we elected to perform bilateral fasciotomies using the two-incision technique to release all of the compartments [5]. The muscles were noted to be viable in both legs. Both tibia fractures were treated without the use of a tourniquet. The tibias were stabilized using reamed, intramedullary nail fixation, locked both proximally and distally with two screws (Fig. 2). The patient's vascular examination was unchanged following the procedure. A vascular surgery consult recommended only close observation.

On morning rounds, the patient complained of decreased sensation of the right foot. While the patient did have capillary refill, it was slowed and his dorsalis pedis pulse was subjectively diminished. Since the patient's clinical vascular status appeared to be changing, it was decided by the orthopaedic and vascular surgeons to obtain an angiogram of the right leg. The angiogram revealed a lacerated posterior tibial artery near the midshaft fracture of the tibia. In addition, the study demonstrated impingement of the anterior tibial artery by the more distal of the two distal interlocking screws (Fig. 3). This resulted in kinking of the artery; however, the artery remained partially patent. The patient was subsequently taken back to the operating room on postoperative day number four for closure of his fasciotomy sites. At

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Fig. 1. AP radiograph of the right tibia and fibula in a 28-year-old male status post motorcycle collision revealing a transverse tibial fracture and a high, nondisplaced fibular fracture.

Fig. 2. AP radiograph of the right tibia and fibula after insertion of a reamed intramedullary rod with distal and proximal locking screws.

Fig. 3. AP arteriogram of the right lower extremity, subtraction view, demonstrating the disrupted posterior tibial artery near the fracture site. The distal screw is indenting the intact anterior tibial artery (black arrow). The tibial cortex is not well visualized on this study.

Fig. 4. AP radiograph of the right tibia and fibula after exchange of the most distal screw of the distal locking screws from a 30-mm to a 25-mm screw (white arrow).

this time the right distal interlocking screw was changed from a thirty-millimeter screw to a twenty-five millimeter screw (Fig. 4). It did not appear as though the intramedullary rod used in the right lower extremity was externally rotated or too short. Fluoroscopic images demonstrated that the screw no longer protruded through the cortex of the distal tibia. The patient was discharged home on hospital day eight in stable condition. Follow-up demonstrated union of the fractures with gradual functional recovery.

Discussion

Complications as a result of intramedullary nailing of tibia fractures include, but are not limited to: fracture propagation, malreduction, poor screw purchase, neurologic defects, wound hematomas, malunion, nonunion, patellar tendonitis, screw irritation, deep infections, compartment syndrome, deep vein thrombosis, pulmonary embolism, amputation, proximal vascular injury, and distal vascular injury [1]. To our knowledge, there is only one case report of a vascular injury to the anterior tibial artery occurring as a result of a distal interlocking screw from a tibial nail [3]. That case involved the more proximal of the two interlocking screws.

The anterior tibial artery originates from the popliteal artery and subsequently courses distally, passing between the two heads of the tibialis posterior. The artery then travels through the oval interosseous foramen and enters the anterior compartment of the leg. The artery subsequently descends on the anterior surface of the interosseous membrane and travels in the proximal two-thirds of the lower leg between the tibialis anterior and extensor digitorum longus muscles. Approximately five centimeters proximal to the intermalleolar midpoint the artery courses from the lateral to the anterior surface of the tibia. Based on anatomic studies by Ebraheim et al, and Raimbeau et al, relative “safe zones” for placement of percutaneous transfixation implants in the leg have been described [6,7]. These “safe zones” include the anterior and middle thirds of the proximal tibia, the anterior third of the mid-tibia, and the posterior third of the distal tibia.

It has been suggested that the risk of neurovascular injury after intramedullary nailing of a tibia may be higher than with other commonly performed intramedullary nailing procedures of long bone fractures. In addition, it has been hypothesized that vascular injuries during surgery on tibial fractures frequently may go undiagnosed due to the presence of significant collateral blood flow [3]. Although injury to the anterior tibial artery is not significant in a three-vessel leg, its patency is essential for a severely traumatized leg when the other vessels are occluded or obliterated. While the results of a prospective study by Lutz et al. [9] revealed that routine preoperative angiography of the lower limb was not justified, even in the absence of one pedal pulse, these patients should be followed closely for changes in their vascular status.

The case we have presented demonstrates that the anterior tibial artery may be at risk for injury from a distal locking screw of an intramedullary nail in some patients. It is important to understand the factors that place the anterior tibial artery at increased risk of injury from distal locking screws. First, if the nail is too short the distal locking screws will cross the tibia in a location where the anterior tibial artery is in a more posterior location. This results in the distal locking screws exiting the opposite cortex of the bone in closer proximity to the artery. Second, placing the nail in an externally rotated position will move the screw tip anteriorly into the usual anatomic location of the anterior tibial artery. Finally, screws that protrude too far from the bone increase the risk of injury to the artery. The distal locking screws in the system utilized in this case come in 5mm increments; therefore, the surgeon may have to choose between a screw that is either too long or too short. In conclusion, if the surgeon suspects an injury to the posterior tibial artery, great care should be taken in placing the distal locking screw to prevent injury to the anterior tibial artery.

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