

Two Cases of Persistent Dropped Hallux after Intramedullary Nailing of Tibial Fractures in Pediatric Patients

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Abstract

Dropped hallux due to denervation of the extensor hallucis longus is a rare, usually transient complication seen after intramedullary nailing of the tibia and occurs in less than one percent of patients. This condition presents as either isolated extensor hallucis longus weakness or a complete loss of dorsiflexion of the hallux. The etiology is largely unknown, however it has been postulated that there could be a subclinical anterior compartment syndrome causing neuromuscular dysfunction. Though research is limited, one study suggests this phenomenon is more common in younger patients¹. Here we review 2 cases of post-intramedullary-nailing dropped hallux in 2 male patients ages 16 and 17 which have persisted after reduction despite the absence of known risk factors or perioperative complications. More reporting of this complication will hopefully lead to better understanding and prevention.

Background

Intramedullary nailing of tibial fractures is a widely used operation for patients of all ages and is currently the preferred treatment in fractures requiring open reduction. Considered a relatively safe operation with union rates as high as 90%, it remains the standard of care for displaced tibial fractures².

Current literature for this procedure suggests it has a relatively low complication rate, with the majority of instances resulting from transient nerve dysfunction in the lower leg³. Because of the close proximity of the peroneal nerve to the fibular head, care must be taken to avoid unnecessary damage related to the operation. It is thought that this nerve damage is responsible, at least in part, for postoperative dropped hallux. Surgical traction and anterior compartment syndrome have been identified as causes of peroneal nerve damage, although in many cases in the literature no cause can be identified. A prospective study identified 8 out of 208 subjects experiencing post-operative peroneal nerve dysfunction without evidence of compartment syndrome or intraoperative difficulties¹. All of these cases resolved by the 6-week follow-up visits. Regardless

of the cause, dropped hallux represents a serious, yet largely uninvestigated complication arising from a relatively common procedure in orthopaedics.

Case 1

A 16-year-old male sustained a moderate blow to the left lower leg when he was playing soccer and was inadvertently kicked by another player. He was immediately transported by ambulance to the emergency department (ED) and arrived with a temporary splint on the left leg. Upon arrival, he was complaining of moderate to severe pain in the left leg and was not able to ambulate or bear weight. He denied any numbness or tingling in the area. Physical examination revealed swelling and deformity of the left ankle with intact skin and full sensation throughout. Compartments in his leg were soft and there was no pain with active or passive movement of the toes. Grossly, he could flex and extend the toes, although individual muscle strength was unable to be assessed due to increased discomfort. An x-ray of the lower leg showed comminuted and displaced fractures of the distal shafts of the left tibia and fibula with overriding of the fracture fragments with posterior angulation. Orthopaedic surgery was consulted and, after examination, recommended intramedullary nailing of the left tibia due to the displacement of the fracture. The family was consented and the patient was taken to the operating room.

The procedure was tolerated well with no intraoperative complications. Reduction was achieved with a Smith and Nephew tibial nail, 10 mm in diameter and a length of 330 mm. The nail was fixed with 2 screws proximally and 2 screws distally using the perfect circle technique. Blood loss was estimated at 150 mL and the patient was admitted to the floor. The following day on exam he was noted to have soft compartments and good perfusion throughout the left leg. There was decreased strength of the extensor hallucis longus and tibialis anterior on the left as expected on post-op day 1. With no signs of compartment syndrome and well controlled pain, he was discharged home with pain medication and instructions to follow up as an outpatient.

On post-op day 5 he visited the orthopaedic surgeon for routine follow up. In the clinic there was decreased strength with decreased sensation in the dorsum of the left foot over the superficial peroneal nerve distribution. There was loss of dorsiflexion of the great toe and foot, suggesting weakness of the extensor digitorum longus and extensor hallucis longus muscles. All compartments appeared soft, and there was no pain with passive motion. Despite this, he was sent directly to the ED for evaluation of possible compartment syndrome. There he had an MRI without contrast which showed minimal muscle edema consistent with fracture status but no signs of muscular necrosis or a missed compartment syndrome. The MRI also confirmed a well-placed intramedullary rod and transfixation screws.

Case 2

The next case is a 17-year-old male, brought to the ED after injuring his left leg falling off his bike. Upon initial evaluation he was complaining of severe pain in the left leg which worsened with movement and ambulation. On examination there was swelling of the left leg with tenderness to palpation. Skin was intact. Compartments were noted to be soft and equal compared to the uninjured leg. There was no neurological or vascular compromise on exam. He was able to dorsiflex and plantarflex the left foot and had grossly intact superficial peroneal, deep peroneal, and tibial nerves. At this point he was sent for an x-ray which showed a displaced fracture at the mid tibial shaft and at the junction of the proximal and middle third of the fibula with mild medial displacement. Intramedullary nailing of the tibia was recommended and the family and patient were consented.

During the procedure, a Synthes titanium tibial nail 8 mm in diameter, 260 mm in length was fixed proximally and distally with 2 locking screws, using the perfect circle technique. Multiple views showed proper placement of the hardware and anatomic reduction of the fracture site after fixation. There were no operative complications and compartments were soft during and immediately after the case. The patient was able to move his toes and had intact sensation on exam in the recovery room. He was admitted and had a 3 day recovery period. During this time, he was noted to be moving all toes with good perfusion throughout and normal sensation. He was subsequently discharged home with the left leg in a cast and instructed to follow up with the orthopedic surgeon in 1-2 weeks.

On post-op day 7, the patient presented to the clinic for follow up. He was complaining of the inability to dorsiflex the great toe and was subsequently found to have numbness over the superficial peroneal nerve distribution. There was also markedly decreased dorsiflexion of the hallux and left forefoot when compared with the right, with complete inability to flex against gravity. Minimal swelling was noted but with no pain

with passive motion. The compartments again appeared soft. The patient was sent directly to the ED where an MRI was performed. As in the first case, this study revealed no signs of compartment syndrome.

Discussion

Cases of dropped hallux due to postoperative peroneal nerve dysfunction in the absence of any perioperative complications are extremely rare and hardly reported in current literature. We believe many cases may go unreported, especially because the nerve dysfunction is usually transient, resolving within 48 hours after surgery. Interestingly, a study in an English journal showed the mean age of patients affected to be 25.6 years, which was significantly younger than the mean age of patients used in their study¹. Their sample included only adult patients and did not mention any cases in patients under 18 years of age. To date, we were unable to locate any studies in pediatric orthopaedic literature, and the incidence in this population remains largely unknown.

One of the proposed mechanisms for dropped hallux is a subclinical anterior compartment syndrome damaging the peroneal nerve. The proximity of the common peroneal nerve to the fibular head puts that area at risk for damage resulting from surgery. Anatomically, the extensor hallucis longus originates more distally in the leg, thus it would seem that isolated dropped hallux would result from injury to a distal segment of nerve. This anatomical setup could render the more distally originating extensor hallucis longus more vulnerable to subtle changes in compartment pressures and damage from a subclinical compartment syndrome. Although compartment pressures were not measured in these cases, the study by Robinson measured pressures in each case of dropped hallux, with no evidence of an increase to suggest compartment syndrome. Additionally, 3 patients in this study with neurological dysfunction underwent surgical exploration of the anterior compartment. These patients failed to show any signs of increased pressure in the explored compartments¹.

Because intramedullary nailing is a common procedure, even rare complications should represent a legitimate concern to physicians. The impact for affected patients is huge. Unforeseen dropped hallux can cause significant impairments in everyday life by interfering with gait and balance, which can lead to falls and immobility. For this condition, the work-up is nonexistent and the etiology is unknown. The high index of suspicion for compartment syndrome leads to unnecessary and expensive tests. Looking forward, more research is needed in order to better understand and prevent this rare post-operative complication. Future studies monitoring compartment pressures in the distal leg could help establish what level of compartment pressure can be tolerated before neuromuscular dysfunction sets in.

References

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