

Repair of a Vascular Injury Associated With a Pediatric Femur Fracture

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Pediatric vascular injuries are relatively uncommon. The risk for such injuries in the setting of blunt, orthopedic trauma is quite variable depending on the extremity involved. In regards to the thigh, there have been few reports of pediatric vascular disturbances resulting from femur fractures, blunt trauma, and benign neoplasms; however, none of these injuries required repair.

To our knowledge, this is the first report of a child under age 15 who sustained an isolated femur fracture from blunt trauma that led to a vascular injury that required repair.

CASE REPORT

A 12-year-old boy struck by an automobile was brought to a community hospital with an obvious right thigh deformity, significant pain, and inability to bear weight. After transfer to a level I pediatric trauma center, he had a Glasgow coma score of 15 and no obvious head, chest, or abdominal injuries. The patient had a grossly deformed right thigh and ecchymosis over the lateral aspect of the knee. Distally, the patient had 0/5 extensor hallucis longus and tibialis anterior function. In addition, there were no detectable dorsalis pedis or posterior tibial pulses by palpation or Doppler. The right foot was cooler than the left, and capillary refill was slightly longer than 2 seconds. The other extremities were free of injury and distally neurovascularly intact. Radiographs showed a distal-third, short-oblique femoral shaft fracture (Figures 1A, 1B). The patient was taken emergently to the operating room for stabilization of the femur fracture and for lower extremity arteriography for presumed vascular injury.

The patient underwent standard external fixation of the

right femur. Acceptable anatomical alignment was achieved with the aid of C-arm fluoroscopy (Figure 2). There was still no return of distal pulses by palpation or Doppler. The vascular surgery service then performed arteriography, which showed no flow in the superficial femoral artery at the adductor canal adjacent to the fracture site (Figure 3). An acute thrombosis was suspected, and cut-down and exploration of the artery were performed. An intimal tear with a small, elevated intimal flap was identified as the etiology of the thrombosis. The artery was then repaired with a saphenous vein interposition graft with immediate return of distal pulses. Four-compartment fasciotomy of the right lower extremity was performed. The fasciotomy sites were dressed with vacuum-assisted closure sponges.

The patient tolerated the procedure well and was admitted to the floor. He now had decreased sensation and ankle dorsiflexion, for which he was fitted with an ankle-foot orthosis by occupational therapy. The patient was discharged in stable condition on postoperative day 18 and had vascular and orthopedic follow-up scheduled. Follow-up physical and duplex examinations at 2 weeks and 1 month demonstrated patent arterial reconstruction without any significant stenosis in the right lower extremity. The patient's footdrop was still present, so a series of stretch

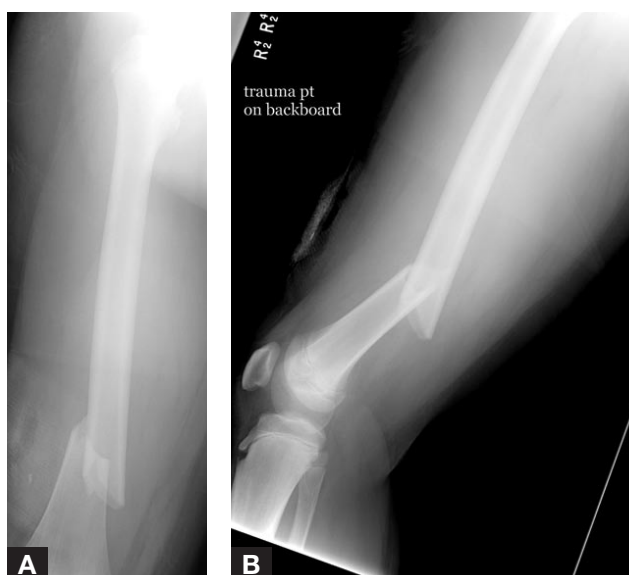


Figure 1. Anteroposterior (A) and lateral (B) radiographs of right distal femur show distal-third, short-oblique femur fracture.

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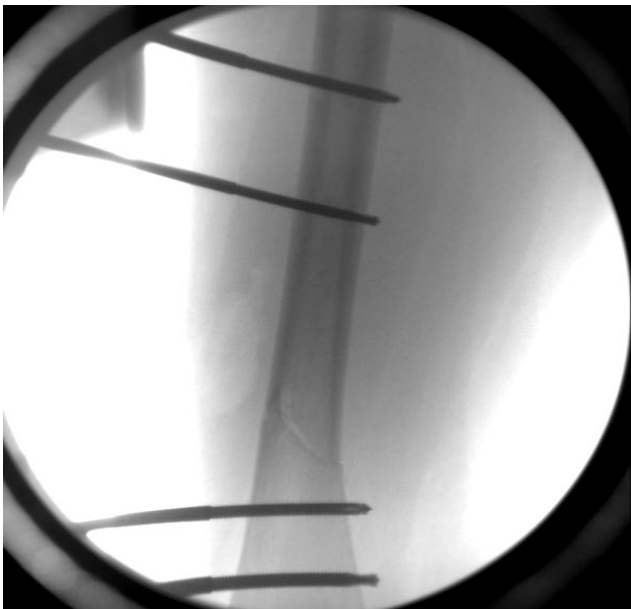


Figure 2. Under fluoroscopic guidance, appropriate alignment was achieved with external fixation.

casting was begun to treat the dorsiflexion weakness. At 6 weeks, the femur fracture demonstrated good interval healing and callus formation, and the patient was asymptomatic with ambulation. Because of limited range of motion (ROM) of the knee (0° - 80°), the patient was started on an intensive physical therapy program. By 4 months, the fracture had healed and alignment was acceptable, so the external fixator was removed (Figures 4A, 4B). Knee ROM had improved to 100° of flexion, and ankle ROM had improved to 5° past neutral. The footdrop resolved, and the patient had 4/5 dorsiflexion and extensor hallucis longus function at last follow-up. The sensory examination had returned to normal, and he continued to have pain-free ambulation and no further sequelae from his previous vascular injury.

DISCUSSION

Probably the most common major traumatic injuries treated by pediatric orthopedic surgeons are femoral shaft fractures. These are typically associated with blunt trauma and have the potential to involve several other major organ systems. When a femoral shaft fracture is suspected, a thorough history and physical examination should be performed and appropriate radiographic studies obtained. Common complications of femoral shaft fractures include malunion, nonunion, angular and rotational deformities, skin-tract infections, and compartment syndrome. Vascular injuries can have devastating consequences if they go unrecognized, and they should be treated if there are abnormal physical examination findings. In our patient's case, the traumatic mechanism and the absence of distal pulses were highly suggestive of a vascular injury.

Pediatric peripheral vascular injuries are uncommon and account for only 2% of all pediatric injuries.¹ In children, vascular injuries resulting from blunt trauma most often occur from the sharp edge of a fractured bone.² Injury to a major vessel after blunt trauma without fracture or



Figure 3. Intraoperative arteriogram shows no flow in superficial femoral artery at adductor canal adjacent to fracture site.



Figure 4. Anteroposterior (A) and lateral (B) radiographs of right distal femur 4 months after injury show appropriate healing with acceptable alignment status after external fixator removal.

crush injury has been reported, but it is exceedingly rare.³ Although the overall risk for arterial injury with orthopedic fracture or dislocation is 0.3% to 6.4%, several orthopedic injuries are at increased risk up to 20% of the time. The classic lower extremity fractures or dislocations associated with vascular injuries involve the distal femur (superficial femoral artery), the posterior knee (popliteal artery), and the proximal tibia (popliteal trifurcation).^{4,5}

In adults, femur fractures from blunt trauma can result in direct arterial injury that requires repair.⁶⁻⁸ In the pediatric population, however, vascular injuries

associated with femoral shaft fractures typically are limited to vasospasm or pseudoaneurysm formation. To our knowledge, there have been no reports of vascular injuries associated with closed, femoral shaft fractures necessitating repair in a child under age 15. However, Isaacson and colleagues⁹ described the case of a 7-year-old boy who sustained femoral artery thrombosis after a closed femur fracture and was treated with thrombectomy without formal, open repair.

Other forms of vascular disturbances can occur with femoral shaft fractures. Shah and Ellis¹⁰ described the case of a young child with false aneurysm formation in the superficial femoral artery after a transverse femoral shaft fracture treated in skeletal traction. Esposito and Crawford¹¹ described a 10-year-old boy who developed a pseudoaneurysm of the popliteal artery after a closed femur fracture in an automobile accident. In either case, the aneurysms did not rupture, and there was no need for vascular repair. There have also been several reports of false aneurysm formation associated with femoral shaft exostoses.¹²⁻¹⁴ In these cases, vascular injury resulted from compression of bony growths during innocuous activities, such as running and stretching.

Vascular injuries are relatively uncommon in children. The risk for such injuries in the setting of blunt, orthopedic trauma ranges from <1% to 6%. Of the few reports that have described vascular injuries after femur fractures specifically, none described injuries that required repair. Although rare, vascular injuries requiring repair can occur in children under the age of 15 who have sustained closed, isolated femur fractures.

AUTHORS' DISCLOSURE STATEMENT

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

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

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This paper will be judged for the Resident Writer's Award.
