Acta Orthop. Belg., 2016, **82**, 918-922

CASE REPORT

Popliteal artery dissection presented 12 hours after admission for a Salter III fracture of proximal tibia

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A 16-year-old boy sustained a salter III fracture of the upper tibia following a motorcycle accident. Except for well localized knee pain, the patient did not have any other symptom. Repeated clinical examination did not reveal any absent peripheral pulse. Given the state of the fracture, anatomical reduction and screw fixation was planned in the operating room.

Twelve hours after admission the patient was taken to the operating room. During the period preceding surgery he continued to have normal vascular clinical examinations.

Further clinical assessment was performed in the operating room and remained to be normal. However after induction and upon extension of the lower limb, peripheral pulses in the affected side were abruptly lost. Urgent vascular exploration of the area showed a popliteal artery dissection necessitating a bypass graft to restore blood flow.

We present a review of the literature alongside a case report showing how popliteal artery pathology in a similar context can present late and be for a period of time clinically undetectable.

INTRODUCTION

We present a case of popliteal artery dissection occurring following trauma to a 16 year old patient. An initial diagnosis of Salter III proximal tibial fracture was made. The uniqueness of the case lies on the fact that the patient did not elicit any neurovascular deficit on clinical examination nor any posterior displacement on radiological images. The patient remained asymptomatic until extension was performed on the operating table which exacerbates the clinical hidden vascular involvement. This raises the question regarding the benefit of performing a CT with contrast aiming to evaluate the popliteal blood flow in such fractures.

CASE REPORT

A 16 year old boy presented to our emergency department at midnight following a motorcycle accident at a speed of 50 km/h. During initial assessment, the patient was alert with a Glasgow coma scale (GCS) of 15 and had no circulatory or respiratory compromise. The only presenting com-

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No benefits or funds were received in support of this study.
The authors report no conflict of interests.

plaint was an intense knee pain. Clinical examination revealed a number of skin abrasions over the right wrist and arm. In addition to this, he had an oedematous right knee which was very tender to touch. Apart from the pain, he was able to move all of his toes and all distal pulses were present. A radiograph was performed which revealed a Salter III fracture of the proximal tibial epiphysis. The patient was admitted and underwent an urgent computed tomography (CT) scan without contrast for further assessment of the tibial plateau. CT scan reported the fracture to be a Salter III, which further confirmed the diagnosis. No further pathology was mentioned in the CT report. Patient was kept fasting and an intervention was planned (pin or screw fixation) the next morning.

Twelve hours later, the patient was taken to the operating room. He was put in decubitus dorsal position with his knee flexed to 90 degrees. Re-assessment of distal pulses and neurological function was performed and found to be normal. After intubating the patient, we extended the patient's knee under radiographic control in order to reduce the fracture. Shortly after extending the patient's knee, his leg and feet turned white and felt very cold. Distal pulses were lost. Doppler echography was used and failed to detect any pulses distally nor over the popliteal region. The only detectable pulse was the one of the femoral artery. The vascular team was urgently summoned and the popliteal region was explored via a medial approach. Exploration revealed a huge retro-articular hematoma associated with a small laceration of the popliteal vein alongside a huge dissection of the popliteal artery facing the knee articulation. The vein was sutured with 6/0 Prolene and the dissecting area of the popliteal artery was bypassed with a vein graft taken from the contralateral limb (Great Saphenous vein).

The distal pulses recovered instantly after the bypass, and patency of flow was confirmed via arteriography. The knee was kept on flexion, and no further orthopaedic treatment was pursued as the fracture was deemed acceptable and given the fragility of the area, no further intervention was warranted.

Heparinzation was commenced for 24 hours and the patient was started on 75 mg of Aspirin. In the post-operative period, the patient was kept on a Zimmer splint with flexion of 90 degree. Repeated clinical examination did not reveal any neurovascular deficits. He was mobilized with non-weight bearing on the affected side.

Nine days after surgery he was discharged home without any complication.

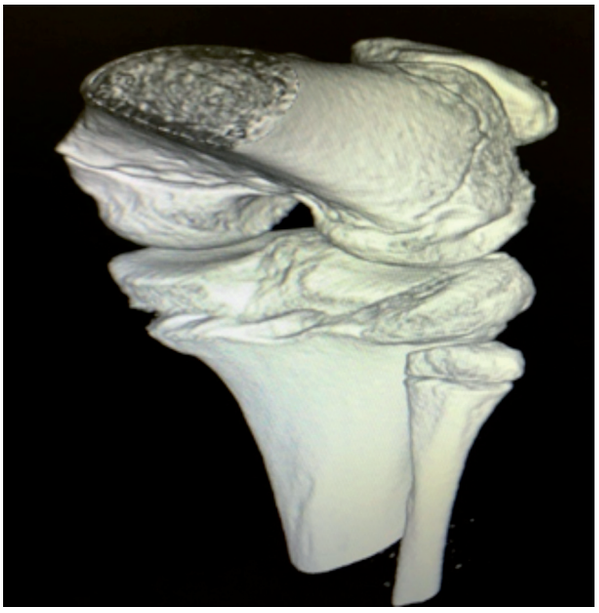

***Fig. 1.* —** 3D CT- SCAN Reconstruction of the knee.

LITERATURE REVIEW AND DISCUSSION

Proximal tibial epiphysis injuries are considered a rare entity *(13)*. One study reported that the incidence rate of such fractures to be between 0.6% to 2.1% of all physeal injuries *(7)*. This low incidence is the result of the anatomical stability of the proximal tibial epiphysis and the fact that it is not attached to the lateral and medial collateral ligaments *(7,13)*. Not having the medial and collateral ligaments attachments, diverts both the varus and valgus stress directly to the metaphysis, hence, further protecting the tibial epiphysis *(14)*. Furthermore, other factors that protect the tibial physis from being fractured are *(5)*:

– Irregular nature of epiphyseal attachment to the tibial shaft.

– Patellar tendon inserts into a different center of ossification.
– The extension of the semi-membranous tendon insertion into the neighboring metaphysis.

Generally, two types of epiphysis exist, traction and pressure epiphysis *(14)*. The proximal tibia involves both these types as it is located at the end of a long bone (pressure) and attaches anteriorly to the patellar tendon (traction) *(14)*. The majority of fractures involving the tibial epiphysis are avulsion fractures of the tibial tubercle secondary to the traction through the quadriceps muscle *(14)*. The other proposed mechanism, which corresponds with our case, involves pressure epiphysis. It involves direct impact to the proximal tibia with the knee being in either extension or hyperextension with or without the presence of valgus or varus strain *(3)*. Given the above information, it is worth noting that amongst the growing skeleton, the physeal region is the weakest biomechanical portion *(8)*.

Physeal injuries can occur anytime during childhood and adolescence, however, they are more frequent at times of rapid growth especially in the first years and during the prepubertal phase *(8)*. The peak incidence of such fractures is between 12-14 years of age, being more frequent in males *(13)*. Usual causes behind such injures are road traffic accidents and sport related injuries including bicycle traumas *(3,13)*. Usually patients will present lacking the ability to lift their legs because of pain secondary to hamstring spasm with potential hemarthrosis and soft tissue swelling and tenderness *(13)*. Initial radiographs can bring about a challenge in interpretation when epiphyseal injuries are suspected which may further necessitate stress views and x-rays of the unaffected limb *(13)*. During this period, careful attention should be taken to avoid extending the knee as popliteal artery injury can be present and potentially aggravated *(13)*.

Such fractures require anatomical reduction which can be achieved by closed reduction with cast immobilization or K wiring or open reduction with screw fixation *(13)*. A number of potential consequences can exist which include ligament injuries, as well as, vascular complications including compartment syndrome, knee instability and growth dis-

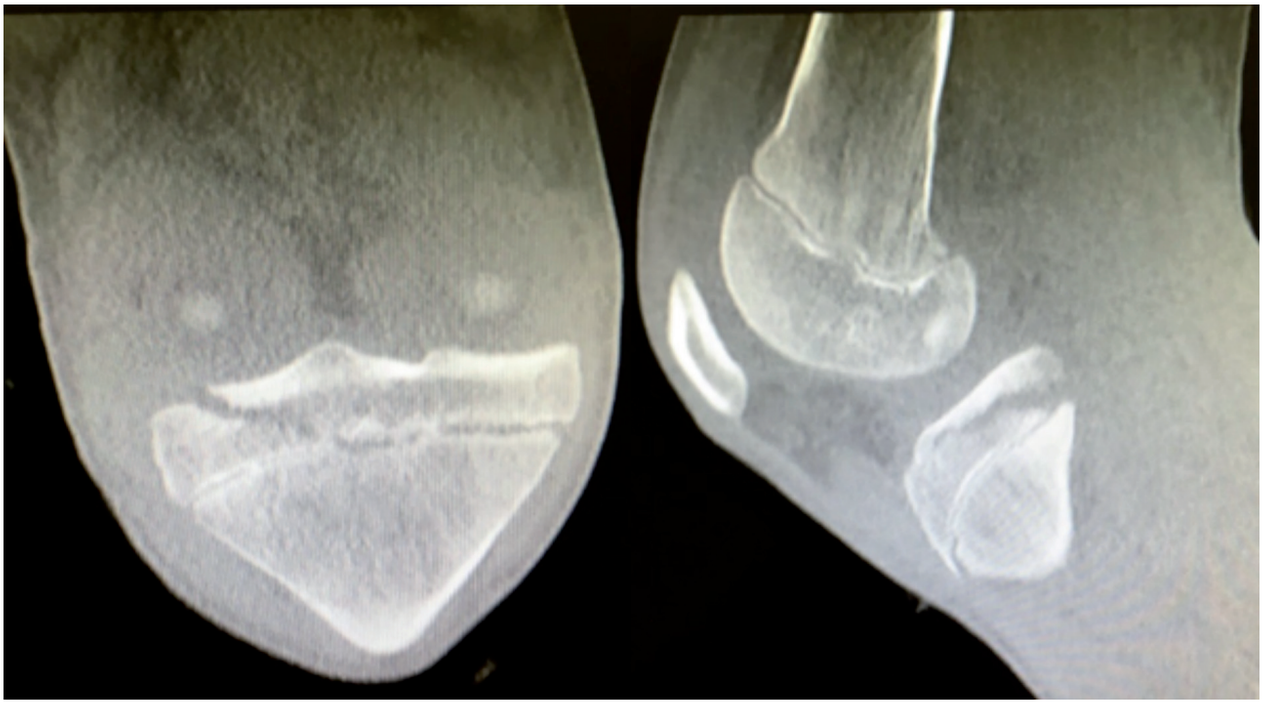

***Fig. 2.* —** Left frontal view & right sagittal view of the knee show salter III fracture of proximal tibia.

turbances *(13)*. A study reported that more than 25% will present with growth disturbances defined as more than 25 mm or more than 5 degree angulation *(4)*. The same study reports that the Harris classification does not reflect the prognostics well enough, as there were more post traumatic deformations amongst Salter I and II than III and IV *(4)*.

Amongst the risks associated with proximal tibial fractures, neurovascular complications are of highest significance. The popliteal artery lies very close in its distal portion to the posterior aspect of the upper tibial, where a firm connective tissue septa also holds the vessel tightly to the knee capsule, hence further augmenting the vulnerability in case of injury. Given the anatomy, great attention is warranted concerning the popliteal artery in the context of proximal tibial fractures *(13)*. In a series involving 39 patients with fractures of proximal tibial epiphysis, two patients had disruption of the popliteal artery both of them having posterior displacement of the tibial shaft *(12)*. It is important to note that popliteal artery injury can still occur without radiographic evidence of posterior displacement *(11)*. In such fractures, an epiphyseal fragment can act as a loose body while displacing posteriorly, potentially causing major vascular trauma, but after the forces of the trauma dissipate, it can return to a relatively normal position *(11)*. Within pediatrics trauma, vascular trauma is noted to occur only in 0.6% *(2)*. Amongst all peripheral vascular injuries, popliteal artery injury holds the highest amputation rates secondary to an insufficient collateral circulation *(1,6)*. Given the gravity of such complication, another challenge faces doctors as the signs of vascular injury are not always evident at initial presentation *(1)*. A study reported that 10% of patients with popliteal artery injury did have palpable pulses distal to the knee, therefore physical examination alone is not sufficient for accurately determining arterial trauma *(9,10)*. Because of the possible ambiguous presentation of such fracture with regards to vascular compromise, evidence suggests that vessels should be evaluated rapidly – if needed – via Doppler, MRI, angiography or CT angiography, although CT angiography has excellent sensitivity and specificity with fewer complications when compared to conventional arteriography when used for screening, and it was found to be much easier to obtain than MRI *(10)*.

Finally, paediatric patients have a higher overall survival rate after vascular trauma when compared to adults, which could be due to non-atherosclerotic calcified arteries in pediatric age groups *(2)*. The same previous fact is the reason of making vascular repair in adults less optimal *(2)*.

CONCLUSION

A high index of suspicion should be present for patients with such fractures .We hypothesize that performing a CT angiography for all patients presenting with such a fractures is needed in order to better plan their management. Prompt diagnosis and vascular repair should be achieved to avoid limb amputation.

REFERENCES

1. **Bakia J-M, Tordoir JHM, van Heurn LWE.** Traumatic dissection and thrombosis of the popliteal artery in a child. *J. Pediatr. Surg*. 2012 ; 47(6) :1299–1301.
2. **Barmparas G, Inaba K, Talving P, David J-S, Lam L, *et al.*** Pediatric vs adult vascular trauma: a national trauma databank review. *J. Pediatr. Surg*. 2010 ; 45(7) :1404–1412.
3. **Clement ND, Goswami A.** Salter-harris ii injury of the proximal tibial epiphysis with both vascular compromise and compartment syndrome: a case report. *J. Orthop. Surg. Res*. 2009 ; 4:23.
4. **Gautier E, Ziran BH, Egger B, Slongo T, Jakob RP.** Growth disturbances after injuries of the proximal tibial epiphysis. *Arch. Orthop. Trauma Surg*. 1998 ; 118(1–2) : 37–41.
5. **Gill JG, Chakrabarti HP BS.** Fractures of the proximal tibial epiphysis. *Injury*. 1983 ; 14(4) : 324–331.
6. **Kim J-W, Sung C-M, Cho S-H, Hwang S-C.** Vascular injury associated with blunt trauma without dislocation of the knee. *Yonsei Med. J*. 2010 ; 51(5) : 790.
7. **Mubarak SJ, Kim JR, Edmonds EW, Pring ME, Bastrom TP.** Classification of proximal tibial fractures in children. *J. Child. Orthop*. 2009 ; 3(3) : 191–197.
8. **Nanni M, Butt S, Mansour R, Muthukumar T, Cassar-Pullicino V, Roberts A.** Stress-induced salter-harris i growth plate injury of the proximal tibia : first report. *Skeletal Radiol*. 2005 ; 34(7) :405–410.
9. **Peck JJ, Eastman A, Bergan JJ, Sedwitz MM, Hoyt DB MD.** Popliteal vascular trauma: a community experience. *Arch Surg*. 1990 ; 10(125) : 1339–1344.

10. **Redmond, J. Levy, B. Dajani, K. Cass, J. Cole P.** Detecting vascular injury in lower-extremity orthopedic trauma: the role of ct angiography. *Orthopedics*. 2008 ; 31(8).
11. **Rivero H, Bolden R YL.** Proximal tibial physis fracture and popliteal artery injury. *Radiology*. 1984 ; 150(2) : 390.
12. **Shelton WR, Canale ST.** Fractures of the tibia through the proximal tibial epiphyseal cartilage. *J. Bone Joint Surg. Am*. 1979 ; 61(2) : 167–173.
13. **Verzin EJ, Kealey D, Adair A, Sloan S, Dilworth GR.** Salter harris type i fracture of the proximal tibial epiphysis. *Ulster Med. J*. 2001 ; 70(2) : 136–138.
14. **Yoshino N, Watanabe N, Fukuda Y, Fujita N, Kitamura T, *et al.*** Case report simultaneous bilateral salter-harris type ii injuries followed by unilateral salter-harris type iii injury of the proximal tibia in an adolescent with osteogenesis imperfecta. *J. Orthop. Sci*. 2010 ; 15(1) : 153–158.