

# Proximal Tibial Epiphysis Injury (Flexion Type, Salter–Harris Type 1)

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## What to Learn from this Article?

Proximal tibial epiphyseal injuries though rare in presentation, early fixation in the form of K-wires and protected with slab will have good results.

## Abstract

**Introduction:** Fractures of the proximal tibial epiphysis rare. It has been estimated that fractures of the upper tibial epiphysis account for 0.5-3.1% of all epiphyseal injuries. Who had no neurovascular deficit, with fixed extension deformity at the left knee was treated early with closed reduction techniques.

**Case Report:** We present a case of a 16-year-old boy who while playing cricket on the road was hit by a car. The patient presented in emergency room with extremely swollen knee and soft tissue swelling (hemarthrosis), he was unable to lift his leg actively due to severe pain because of hamstrings spasm, and he had no wound over his left knee and had no other associated injuries. Plain radiographs were taken which revealed, separated proximal tibial epiphysis (salter harris Type 1 injury) The epiphysis was anteriorly displaced fracture line extending beyond growth plate through metaphysis and tibial tuberosity also displaced anteriorly, the proximal fibular epiphysis fragment was displaced anteriorly with no injury to femoral epiphysis and no patellar fracture, radiograph also revealed no intra-articular fracture as joint appears congruent. Under spinal anesthesia, under all aseptic precautions traction was applied for few minutes, the fracture was reduced closed as the hamstring spasm gave way, reduction was confirmed under image intensifier in both AP and lateral planes, and joint congruity was examined. Proximal fibular epiphysis also snapped back in place. Post-operative patient was immobilized with nil weight bearing for 4 weeks, check X-rays taken, he was mobilized in wheelchair. After 4 weeks slab was removed, K-wires were removed, and partial weight bearing was started with rehabilitation for full range of motion of the left knee. At 6 weeks, both the knee joints appeared symmetrical with no abnormalities or limb length discrepancy or instability with knee from 0° to 140°, with full weight bearing.

**Conclusion:** Although less commonly seen, Salter-Harris Type 1 injuries to proximal tibial physis, if managed early with closed reduction and fixation, excellent long-term results can be achieved.

**Keywords:** Proximal tibial epiphysis, salter harris type 1, adolescent injury.

Access this article online

Website:  
www.jocr.co.in

DOI:  
2250-0685.572

## Author's Photo Gallery



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Journal of Orthopaedic Case Reports | pISSN 2250-0685 | eISSN 2321-3817 | Available on www.jocr.co.in | doi: 10.13107/jocr.2250-0685.572

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## Introduction

Injuries of the proximal tibial epiphysis are rare. It has been estimated that fractures of the upper tibial epiphysis account for 0.5-3.1% of all epiphyseal injuries [1, 2]. Popliteal artery, which runs posterior to epiphysis, may be disrupted during the injury but with closed reduction ischemia is reversible in the most cases (Fig. 1).

The Juvenile knee is frequently injured but this injury is relatively rare, rarity of this mode of injury is also known due to many anatomical peculiarities, insertion of semitendinosus directly over metaphysis, insertion of patellar tendon as separate center of ossification protecting epiphysis from avulsion strains, fibular and medial collateral ligaments inserting over the metaphysis, Most importantly varus-valgus forces around the knee directly transmits from femur to tibial metaphysis through collateral ligaments due to which distal femoral epiphysis injury being quite common as compared to proximal tibia.

## Case Report

We present a case of a 16-year-old boy who while playing cricket on a road was hit by a car from behind; He was standing in knee flexed position approximately 10°, at the time of injury, his leg was fixed to the ground and his knee was pushed anteriorly and leg was fixed at the ground resulting in hyperextension injury at the left knee. He tried to bear weight following trauma but he collapsed.

The patient presented in emergency room with extremely swollen knee and soft tissue swelling (hemarthrosis), he was unable to lift his leg actively due to severe pain because of hamstrings spasm, and he had no wound over his left knee and had no other associated injuries.

On clinical examination, left knee was in hyperextension attitude, patient had edematous swelling and intra-articular effusion over the left knee with generalized tenderness over the knee, palpation revealed no fracture of the patella or disruption of quadriceps or patellar tendon, any movement at the knee level provoked severe pain so were restricted, patient had palpable distal pulses, and had no sensory or motor loss distal to left knee. Assessment of collateral ligaments, menisci could not be done as the patient was in extreme pain, but it did not reveal any significant abnormalities. Compartment pressures were evaluated clinically which did not reveal any significant increase.

Plain radiographs were taken which revealed, separated proximal tibial epiphysis (salter harris Type 1 injury) The epiphysis was anteriorly displaced fracture line extending beyond growth plate through metaphysis and tibial tuberosity also displaced anteriorly. The proximal fibular epiphysis fragment was displaced anteriorly with no injury to femoral epiphysis and no patellar fracture, Radiograph also revealed no intra-articular fracture as joint appears congruent (Fig. 2 and 3).

Patient's left lower limb was immobilized and he was immediately shifted to the operation theatre (4 h interval following trauma).

Under spinal anesthesia, under all aseptic precautions traction was applied for few minutes, the fracture was reduced closed as the hamstring spasm gave way, reduction was confirmed under image intensifier in both anteroposterior and lateral planes, and joint congruity was examined. Proximal fibular epiphysis also snapped back in place.

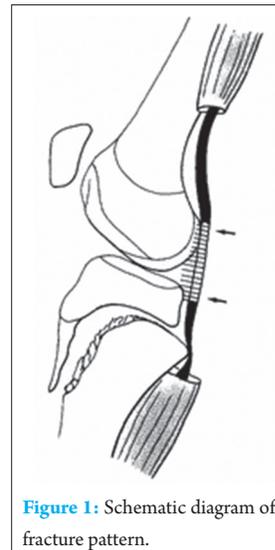


Figure 1: Schematic diagram of fracture pattern.



Figure 2: Clinical picture of patient at presentation.



Figure 3: Radiograph at presentation.

Two cross K-wires were inserted percutaneous from lateral and medial side and though mini-open approach from proximal epiphysis to

metaphysis. The reduction was found to be stable enough, and proximal fibular epiphysis was also stable, distal pulses were felt post reduction, Above knee posterior and anterior slab was given in 15° knee flexion to avoid popliteal vessel compression (Fig. 4).

Post-operative patient was immobilized with nil weight bearing for 4 weeks, check X-rays taken, he was mobilized in wheelchair. After 4 weeks slab was removed, K-wires were removed and partial weight bearing was started with rehabilitation for full range of motion of the left knee. At 6 weeks both the knee joints appeared symmetrical with no abnormalities or limb length discrepancy or instability with knee from 0° to 140°, with full weight bearing (Fig. 5a and b, 6a).

Follow-up at 1 year showed the full range of motion, no joint laxity, and no limb length discrepancy (Fig. 6b-d).

### Discussion

In the case presented, the mechanism of injury was twisting force with the foot fixed to the ground. The knee capsule and cruciate ligaments withstood the force but the physal plate failed. This resemble to the adult dislocated knee where the ligaments fail before the bone. Clinical features include the inability to lift the leg because of pain and because of hamstring spasm. Hyperextension of the knee should be avoided because of the possibility of popliteal artery injury [3].

Rotational force has resulted in a fracture through the growth plate, as opposed to ligamentous injury. This may be because with the patient's body weight acting through the extended knee, the proximal tibial epiphysis becomes the focus through which the rotational force acts.

Clinically, there was an internal rotation deformity and this is in contrast to the expected appearance of the knee when the mechanism of injury has been the more commonly described shearing, avulsing splitting, or crushing. The treatment consisted of accurate closed reduction and stabilisation with heavy K-wires and slab. Had the fracture extended into the joint surface (Salter-Harris Types III or IV), open reduction to gain articular congruity would have been carried out [3].

Analysis of five series of these types of injuries, published by Burkhart and Peterson [2], Poulsen *et al.* [4], Rhemrev *et al.* [5], Wozasek *et al.* [2], and Gautier *et al.* [6] gives a total of 84 patients of whom 63 were males and 21 were females.

There were 15 Salter-Harris Type I injuries, 19 Type II injuries, 24 Type III injuries, 22 V injuries (one case was bilateral Type IV fractures [2], four Type V injuries and one fracture described as "recurvatum and valgus" [7].

Mode of epiphysis separation include, direct violence (Burkhart and Peterson, 1979) intra-articular shearing stresses (Aitken and Ingersoll, 1956; Burkhart and Peterson, 1979; Salter and Harris, 1963) [8] avulsion strains transmitted by the patellar tendon (Burkhart and Peterson, 1979; Hutchinson, 1894) or by an abnormally large insertion of the medial collateral ligament into the epiphysis (Aitken and Ingersoll, 1956) [8]. The cruciate ligaments seem to play no part in the causation of these injuries (Aitken and Ingersoll, 1956; Burkhart and Peterson, 1979) [8].

Complications include ligamentous injuries [4], vascular complications [7] including compartment syndrome, knee instability, and growth disturbance [4, 6]. Growth disturbance, as defined by deformities



Figure 4: Post-operative radiograph.



Figure 5: (a and b) Follow-up radiograph at 1 year.



Figure 6: (a-d) Clinical photograph at 1 year.

of more than 25 mm in length, or more than 50 of angulation, has been reported to occur in more than 25% of cases of proximal tibial injuries in children, when a meta-analysis of published series was performed [6]. Gautier *et al.*, in a study of six children with proximal tibial injuries

reports that the most consistent clinical deformity was recurvatum, with a resultant effect on the range of motion of the knee [6].

### Conclusion

Although less commonly seen, Salter-Harris Type I injuries to proximal tibial physis, if managed early with closed reduction and fixation, excellent long-term results can be achieved.

### Clinical Message

Proximal tibial epiphyseal injuries are rare to be seen but early diagnosis, and neurovascular status evaluation is of utmost importance. Immediate management in the form of reduction and re-evaluation of the neurovascular status is crucial and is beneficial for the patient.

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Conflict of Interest: Nil  
Source of Support: None

### How to Cite this Article

Israni P, Panat M. Proximal Tibial Epiphysis Injury (Flexion Type, Salter–Harris Type 1). *Journal of Orthopaedic Case Reports* 2016 Sep-Oct;6(4):62-65.