

Case report

## Ligamentous rupture of the ACL associated with dislocated fracture of the proximal tibial physis in a 12-year-old boy

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### Abstract

**Background:** Dislocated fracture of the proximal physal plate of the tibia with or without metaphyseal fragment is rare in children. This unusual fracture classically excludes rupture of the anterior cruciate ligament due to the ligament's stability. A combination of both injuries has not been previously published in the literature.

**Case presentation:** The authors report the case of a 12-year-old boy who presented with a dislocated fracture (Salter-Harris II) of the proximal tibia combined with ligamentous rupture of the anterior cruciate ligament after a sporting accident.

### Background

In childhood, ligamentous injuries of the cruciate ligament or dislocated fractures of the proximal physal plate of the tibia are rare occurrences. The combination of both injuries is not described in the literature due to different mechanisms of injury and the stability of the ligament. We report the case of a boy with open physal plates who presented with a combination of both injuries after an accident at a sporting event. No similar case has been previously published.

### Case presentation

A 12-year old corpulent boy presented to the emergency room of our clinic after trauma to the right knee. When asked about the mechanism of injury, he stated that two fellow players had fallen on his right leg at a handball game. His chief complaints were severe pain and tenderness around the proximal tibia. On examination, an effusion of the knee joint with substantial extraarticular

swelling was noted. It was impossible to perform the appropriate function tests at the time of presentation secondary to swelling and pain at the joint. Therefore, no ligamentous injuries were detected on exam. Initial radiographs in three planes showed a slightly dislocated epiphysis of the proximal tibia with a metaphyseal fragment (Salter-Harris II), but no other osseous findings (Figures 1 and 2). The direction of the dislocation was anterior and lateral. Standard blood works was unremarkable. A hormonal disorder was not suspected because his history revealed a normal childhood development along the 97<sup>th</sup> percentile with overweight running in his family. Physical exam showed a genital development appropriate for his age. Subsequently, the boy was taken to the operating room to reduce the fracture under general anesthesia. Intraoperative films demonstrated restoration of accurate anatomic alignment of the bony fragments (Figures 3 and 4).



**Figure 1**  
The initial radiograph (lateral view) shows a slightly dislocated epiphysis of the proximal tibia with a metaphyseal fragment (Salter-Harris II).

Postoperatively, the right leg was immobilized with an open cast. To exclude further intraarticular damage and to determine potential damage to the growth plate that may preclude future leg-length discrepancy, magnetic resonance imaging (MRI) of the right knee joint was performed the next day. At this time, the evaluating physician did not note additional intraarticular injuries, specifically to the menisci and the cruciate ligaments. By postoperative day 7, the majority of the swelling of the knee joint had decreased sufficiently with conservative measures to allow application of a closed cast. The patient was then mobilized on crutches.

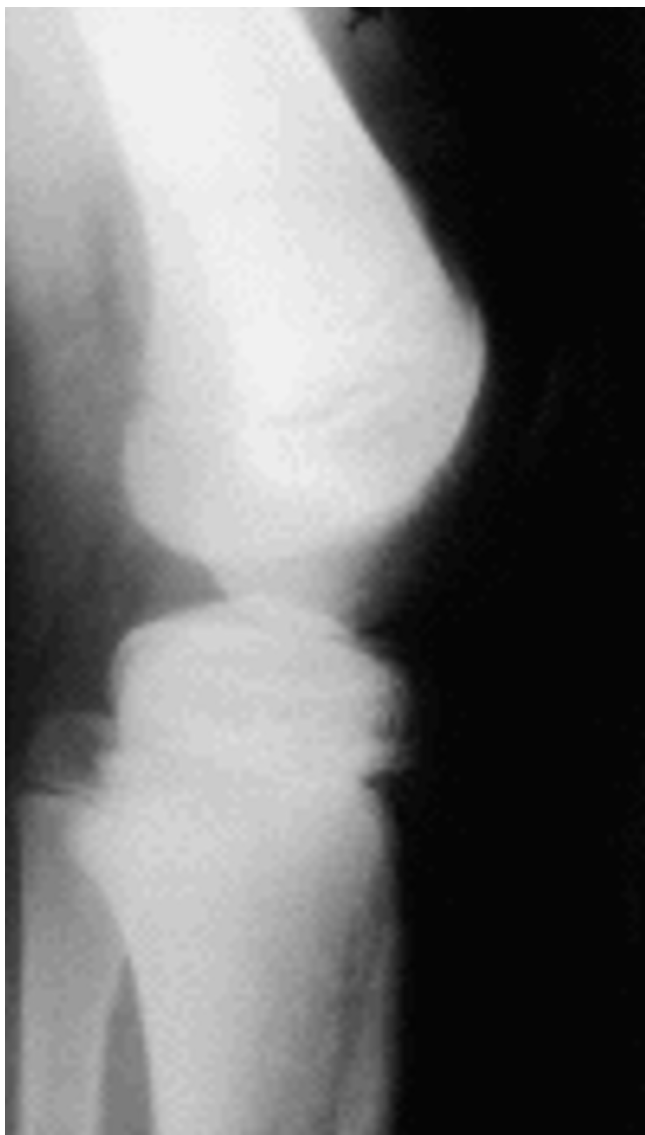
At the first scheduled follow-up visit 4 weeks post trauma, the cast was removed and the knee examined. Movement of the joint was painful with passive extension. A minor joint effusion was still present. Meticulous testing of liga-



**Figure 2**  
The initial radiograph (anterio-posterior view) reveals an opened physal plate (medial) and a small metaphyseal fracture.

ment instabilities was impossible to perform due to the patient's ongoing pain. MRI- and radiographic pictures in two planes showed no increased postreduction displacement and regular anatomical alignment of the fracture (Figures 5 and 6). All intraarticular ligaments and the menisci were interpreted to be intact on the MRI-films. Consequently, the boy was allowed to weight bear as tolerated.

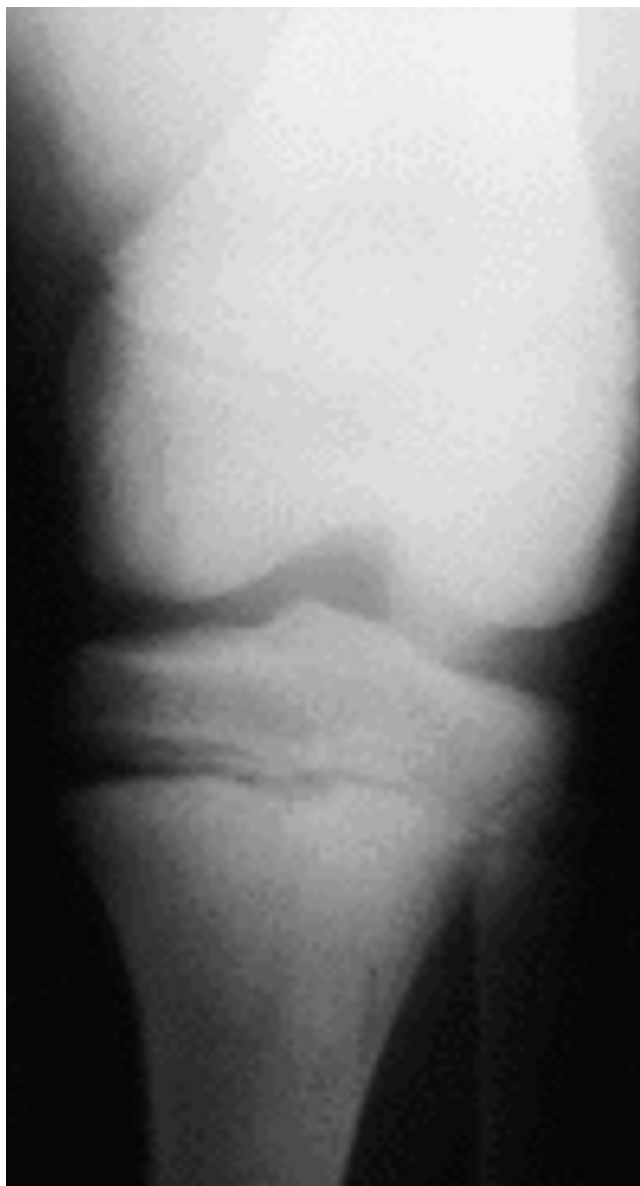
At the next outpatient visit four weeks later, a thorough physical examination of the right leg revealed an atrophic quadriceps muscle and a positive anterior drawer in comparison to the left side. Retrospective review of the previous MRI-films by an experienced colleague clearly depicted a previously missed rupture of the anterior cruciate ligament (ACL) with an enhanced signal of the tibial remainders of the ligament (Figure 7 and 8). Additionally, a pathologic signal along the tibial physal plate was suspicious for the beginnings of a bony bridge. Upon questioning, the patient admitted that he had never been able



**Figure 3**  
Intraoperative fluoroscopy after reduction (lateral view).

to walk without pain on the injured leg since the cast was removed. As a result he had avoided regular activities and sports. Physical rehabilitation to compensate the joint instability by muscular means was initiated.

Two months later, the atrophy of the right quadriceps decrease and the size of the right quadriceps was equalised to the left. The patient was able to participate in light sport activities without pain or instability. At examination, the right knee joint still demonstrated a positive anterior drawer but no effusion or additional ligamentous instability. Repeated MRI films showed a small bony bridge at the lateral physis, but no alignment changes. The missing



**Figure 4**  
Intraoperative fluoroscopy after reduction (anterior-posterior view).

anterior cruciate ligament was confirmed by the MRI-study.

Eleven months after the trauma, complete healing of the fracture with correct alignment was confirmed (Figures 9 and 10). A leg-length discrepancy of 15 mm in favor of the injured right leg was found on the radiographs but did not increase over the following year. At the last office visit about 30 months post injury, a minimal anterior drawer without further ligament instability or muscle atrophy



**Figure 5**  
Four weeks after the accident: the radiograph shows good alignment (lateral view).

was noted. The boy was not restricted in his regular activities and was able to play team handball again.

### Conclusions

Fractures in skeletally immature patients behave differently than those in adults. One major reason for this phenomenon is the physal plate which functions as the weak link in the integrity of a growing skeleton when subjected to trauma. When a joint with open physis is traumatized, the energy is dissipated by fracturing through the physis. The ligaments, capsule and bone are spared. It has been accepted that fractures involving the tibial growth plate of the knee preclude associated ligament damage.

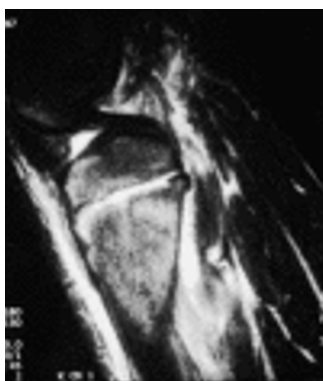
Overall, fractures of the proximal tibial physal plate are rare with a reported incidence of 0.2% of all pediatric fractures [1]. A literature review reveals no reports of fracture of the proximal tibial physis combined with rupture of the



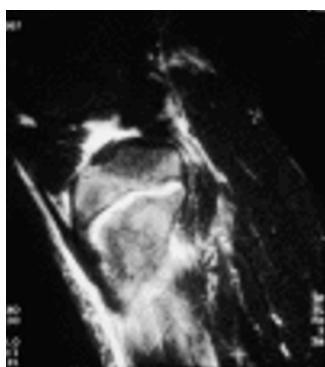
**Figure 6**  
Four weeks after the accident: the radiograph shows good alignment and callus (antero-posterior view).

anterior cruciate ligament. Most publications dealing with this fracture fail to mention ligamentous integrity of the knee. Only Bertin and Goble [2] found laxity of the anterior cruciate ligament in four of thirteen adolescents in their review of ligament injuries associated with physal plate fractures of the tibia. However, the authors did not report one single ruptured cruciate ligament. In this series, MRI or arthroscopy was not applied. All injuries were caused by high-energy trauma (motorcycle).

In the presented case, the dislocated Salter-Harris II fracture was accompanied by rupture of the anterior cruciate ligament. The diagnosis was documented by physical examination and repeated MRI. Clinical examination directly after trauma was impossible due to pain, effusion and swelling of the knee. The accuracy of immediate examination of stability under anesthesia is very reliable [3]. But, this important examination was not done because the attention was directed to the initial reduction without con-



**Figure 7**  
Four weeks after the accident: the MRI shows an intact posterior cruciate ligament (hypodense).



**Figure 8**  
Four weeks after the accident: no anterior cruciate ligament can be detected. The MRI shows an enhanced signal of the tibial remainders of the ligament.

sideration of the intraarticular effusion and possible ligament damage. Also, mobility due to the fracture itself can simulate a positive anterior drawer. These may be reasons that this combination of injuries has never been reported previously. Associated anterior cruciate ligament tears might have been initially overlooked.

As the potential mechanism of injury the authors suggest that the dislocation of the tibial growth plate, which is one of the two largest and sturdiest of the human body, was too minimal to consume the energy of the trauma completely. Subsequently, the remaining energy was directed to the anterior cruciate ligament and finally depleted by its rupture.

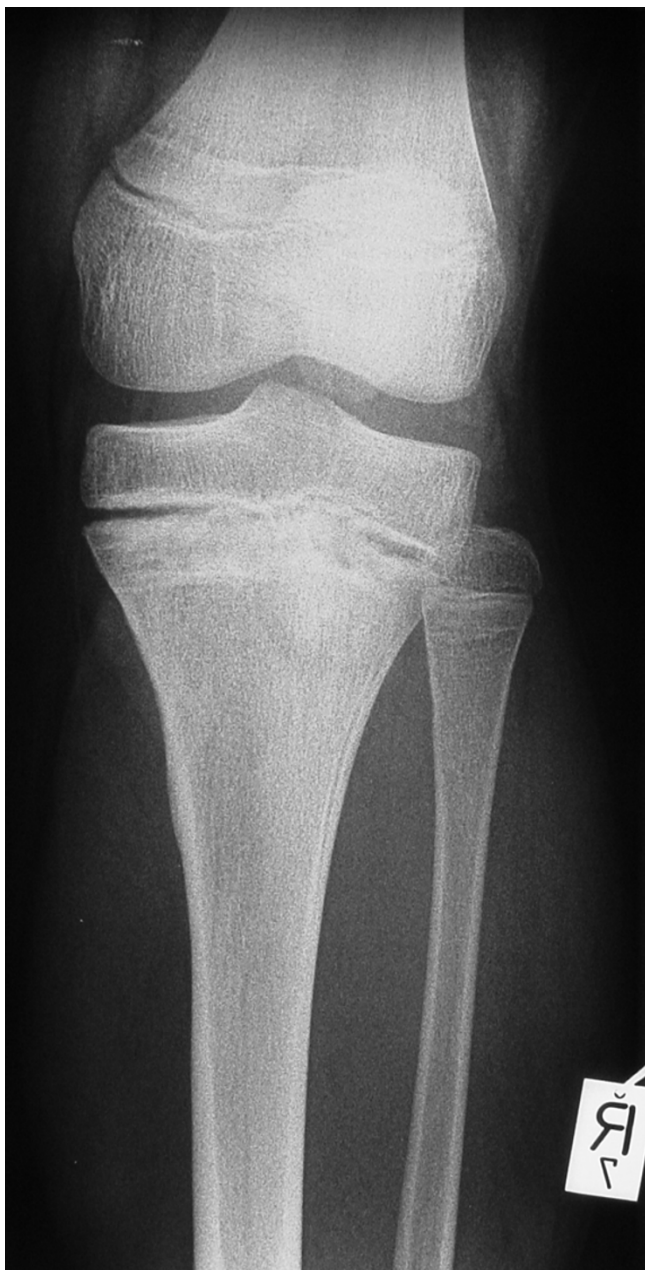
Recent publications [4,5] have shown that the ability of MRI to predict pediatric intraarticular knee pathology is comparable to that in adults with an overall sensitivity



**Figure 9**  
Lateral radiograph after 1 year.

and specificity of 95% and 88%, respectively. Those numbers correspond to our experience with arthroscopically controlled intraarticular damage of the knee joint which was detected by MRI with adequate planes before [6]. The repeated MRI-pictures combined with the clinical findings confirm the ruptured anterior cruciate ligament in the presented case. However, the initial MRI early after trauma may miss a ligamentous injury, as demonstrated in this case.

The leg-length discrepancy of 15 mm, which was seen in the follow-up radiographs after one year, must be called idiopathic. Differences in the length of the legs are commonly detected accidentally at the time of an injury. Idiopathic leg-length differences exist in 25 to 75% and vary between 5 and 30 mm [7]. As recommended by most authors [8], the patient was treated with physical rehabilitation and close follow-up to monitor functional instability and growth discrepancies.



**Figure 10**  
Anterior-posterior radiograph after 1 year.

**Competing interests**

None declared.

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