

Tibial Plateau Fractures in Children:
Literature Review and Case Report

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Abstract

Although fractures of the epiphyseal cartilage injuries are common in childhood, epiphyseal fractures involving the proximal tibia entities are very rare and are usually caused by high-energy trauma, with an incidence ranging between 0.5 and 3.1% of patients; peak incidence between the ages 12-14 years in male patients. The aim of this report is describe a case of fracture of the epiphyseal cartilage of a 13 year old boy, a victim of sports trauma showing lateral tibial plateau fracture and epiphyseal cartilage fracture at the same side, not compatible with the classifications of fractures in children.

Introduction

Although the fractures of the epiphyseal cartilage injuries are common in the childhood, epiphyseal fractures involving the proximal tibia entities are very rare [1-7], being usually caused by high-energy trauma, with just an incidence of 0,5% of all epiphyseal fractures according to Burkhart and Peterson [1] 3%, to Beaty and Roberts [2] 0,5 to 3,1%, to Verzin et al. [5] 0,6 to 2,1%, to Mubarack et al. [4], with the peak incidence between the ages of 12 to 14, in male patients.

The reason of the occurrence of that fact is based on the privileged anatomy of the knee, where the proximal epiphysis of the tibia does not usually receive any type of the tendineae insert in its medial and lateral edges apart from the ligamentary ones - colateral ligaments - medial and lateral [2-4,6], along with that, the lateral portion also has the mechanical support of the head of the fibula [2].

Therefore, the most frequent traumas - varus or valgus - are streamed directly to the proximal metaphysis of the tibia. The front face of the proximal epiphysis of tibia includes a portion in shield/tongue shape which includes the patellar ligament. That portion usually takes place as a shield, avoiding translational fractures of the proximal epiphysis of tibia, though it can promote the fracture to this level [2].

In spite of the fact that the cruciate ligaments are included in the physis portion of the proximal tibia, they do not seem to be associated to the fractures at this level, except in the interchondilar prominence fractures [2].

The major and most serious and catastrophic complication described in literature is the popliteal artery lesion [1,2], described yet as ligamentary lesion complications, compartmental syndrome of joint instability, growth disorders. The neurovascular involvement may reach to 10% [5].

Literature Revision Concerning the Fractures Classifications

The first physeal injuries were first described by Hippocrates, after in 1632 Marcus Aurelius Severnus described the separation of distal and proximal tibial epiphysis [8].

Malgaine in 1855 apud Peterson [8] noticed that the physeal injury was rarely confined to the epiphysis, generally being followed by a metaphyseal fragment, saving the epiphysis - being that the first probable fracture reference.

Foucher in 1863 apud Peterson [8]: three types: type 1 referred to epiphyseal divulsion which was a splitting between the epiphysis and the metaphysis; the type 2, referred as epiphyseal fracture, corresponding to a fracture of the proximal metaphysis, peri-physeal - referred as the peri-physeal fracture by other authors. Moreover, the third type, referred as pre- epiphyseal fracture, affecting the metaphysis, with due exception, this classification had been made without the radiographic examination.

In 1898, Poland apud Peterson [8] and Bright [9], describes that the physeal fractures were common entities and not rare ones, describing the first true injuries classification, based upon radiographic images. He proposed a classification of four types, including: type 1 - fracture affecting only the physis, type 2 - fracture by the growth and metaphyseal plate, saving epiphysis, type 3 - fracture by the growth and epiphyseal plate, saving metaphysis, type 4 - the fracture trace affects the physis and epiphysis.

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Bergensfeld in 1933 apud Peterson [8], publishes a study in which 295 patients were studied with growth plate fractures, showing a new classification, with six subtypes in which it was included the three subtypes of Poland besides describing three more. What is known nowadays as SH type 2 was divided in two segments, where one was followed by a very small fragment (Bergensfeld 3), the type 4 is equivalent to type 3 of Poland, the type 5 occurs a fracture trace that attacks the epiphysis, the physis and the overlying metaphysis, remaining these fragments connected in one block, and type 6 is a fracture that attacks the metaphysis 2 to 3 mm of the physis such as the fracture described in Foucher's type 2.

Aitken, 1936 apud Peterson [8] and Bright [9], discussing the physeal fractures describes three types, the first two ones corresponding to the classification proposed by Poland, and the third type would correspond to the type 5 of Bergensfeld.

Brashear [10] 1958, makes a classification proposal, dividing it in four types:

Type 1, which is equivalent to Poland's type 2, Bergensfeld's types 2 and 3 and Aitken's type 1; type 2, which is equivalent to the type 3 of Poland, 4 of Bergensfeld and 2 of Aitken; the type 3 equivalent to the type 5 of Bergensfeld and type 3 of Aitken, finishing with the type 4 where there had only occurred a physis crushing without damaging to the adjoining bone structure. Diagnosable at the radiographic examination (x-ray).

Salter and Harris [11] in 1963 proposed the classification that is currently the most acceptable and used worldwide. They divided the fractures into five types: the type 1 is equivalent to Foucher's, Poland's and Bergensfeld's types 1; the type 2 is equivalent to the type 2 of Poland, 2 and 3 of Bergensfeld, 1 of Aitken and 1 of Brashear; type 3, corresponds to Poland's type 3, Bergensfeld's type 4, Aitken and Brashear's 2; the type 4 corresponds to Aitken and Brashear's type 3 and to the type 5 of Bergensfeld; and type 5 to Brashear's type 4.

Rang [12] in 1969 annexed to Salter and Harris' classification the type 6 where there was the direct and exclusively occurrence by periosteal compression or from the perichondral ring, being described as a rare lesion.

Weber [13] in 1980 made a proposal of a classification in order to help the physician distinguish among the physeal injuries that have good prognosis and can be treated conservatively. Type A - the ones with good prognosis that can be treated conservatively and the type B - the ones with questionable prognosis, which must be taken with exposure. Subtype A1 fracture plane moves forward completely through the physis, with no ways to the bone, A2 when the fracture pass by the metaphysis. Fracture plane B1 going through the physis and fracture plane B2 going through the epiphysis, physis and metaphysis.

Ogden [14] in 1981 proposed a classification of nine types, 12 subtypes and 21 collectively to 21 types of fractures.

Shapiro [15] 1982 proposed a physiological classification of the fractures, concerning to the prediction of the prognosis of these ones, correlating the bone lesions with the physeal circulation.

Peterson [8] 1994, proposed a new classification identifying six different types of classification, type 1 is a metaphyseal fracture: the type 2 corresponds to Poland's type 2, Bergensfeld's 2 and 3, Aitken's

1, Brashear's 1 and 2 of SH, the type 3 is related to the Foucher, Poland, Bergensfeld and SH's type 1; the type 4 corresponds to the Poland's type 3, the Bergensfeld's 4, the Aitken and Brashear's 2 and SH's 3, the type 5 corresponds to the Bergensfeld's type 5, Aitken and Brashear's 3, and 4 of SH: moreover, type 6 is related to a fracture which occurs at the epiphysis/ physis/ metaphysis, with the association of the bone substance loss. It should be also considered that in this classification type 1 is subdivided into 6 subgroups that go from A to F.

Mubarack et al. [4] 2009, proposed a classification based upon the trauma mechanism, fractures caused by traumas in varus/valgus, fractures in extension and fractures in flexo- avulsion.

In Schazker [16] 1996, we can find a classification of the tibial plateau fractures, type I - fracture in wedge of the lateral plateau, type II - shearing fracture - lateral depression plateau, type III - fracture with pure depression of the lateral plateau, type IV - medial plateau fracture, type V - bicondylar fracture and type VI - fracture with metaphyseal - diaphyseal.

The aim of this present study is to report a patient case (EPA), male, 13 years old and victim of the right knee (R) valgus trauma during a football match, in which the fracture cannot be found in any of the classifications used for children's fractures.

No related case was found in the national literature.

Description of the Case

This report is on a thin 13-year-old male patient, brown, (BMI 21), victim of the right knee trauma, in valgus, during a football match.

In the initial exam we observed limitation of the range of motion besides pain upon bone palpation along the right knee lateral plateau as well as articular instability associated in valgus.

In the initial x-ray it was verified the lateral plateau fracture (Figure 1), better studied by computed tomography (Figure 2), verified fracture of lateral, center-side plateau, with its enlargement, with no shearing, inconsistent with any of the classifications reported; therefore, we opted to classify it in the classification described by Schatzker 1996, which could be compatible with a fracture type Schazker III.

It was not observed in the initial exam any kind of neurovascular change, the patient attends to the doctor appointment after 24 hr trauma, not mentioning at first having received treatment at an

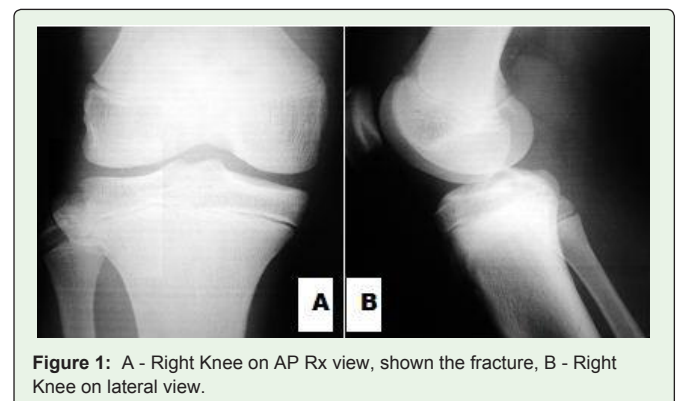


Figure 1: A - Right Knee on AP Rx view, shown the fracture, B - Right Knee on lateral view.

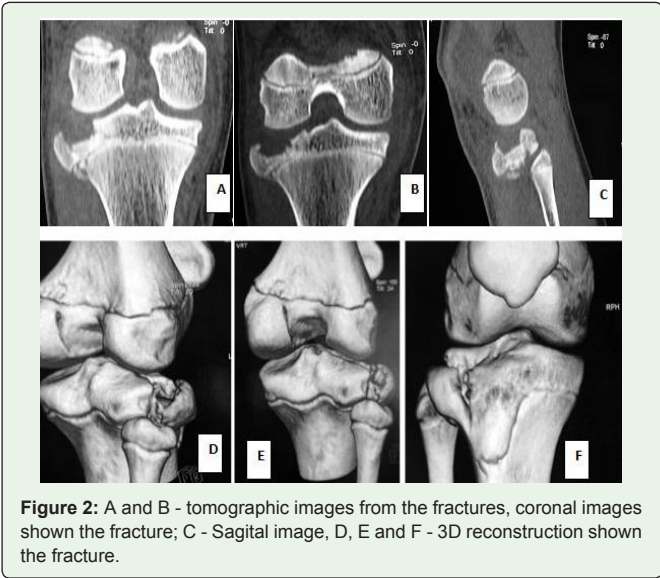


Figure 2: A and B - tomographic images from the fractures, coronal images shown the fracture; C - Sagittal image, D, E and F - 3D reconstruction shown the fracture.

optional service, by a general practitioner when it was not noticed any fracture.

Surgical treatment was done 48 hours after the initial trauma.

It had been opted for a lateral access route, allowing a direct approach to the lateral tibial plateau.

It was not possible to access the articular surface of the lateral plateau, in order to allow us to reduce it, without performing transverse osteotomy to the fracture.

By performing osteotomy, a block central declination of the lateral plateau (approximately 15 mm) was noticed, with a severe impaction of the subchondral bone.

The lifting of the fragment was conducted, just in the epiphysis with a temporary stabilization type “grate” and posterior definitive fixation with 4.0 canulated screw and washer, being implanted two screws in the epiphysis and one at the top of osteotomy (Figure 3).

It was not used bone grafting, in the hope that we could avoid local epiphysiodesis, once the bone graft, in our view, would facilitate the occurrence of that.

For the shear forces neutralization that would act in the synthesis, it was used a hybrid external fixator, assembled with a semicircle of external fixator type Ilizarov of 15cm in the anterior and proximal face of the knee, with 4.5mm Schanz pins and anterior single bar of 20cm, fixed to the tibial crest (Figure 4).

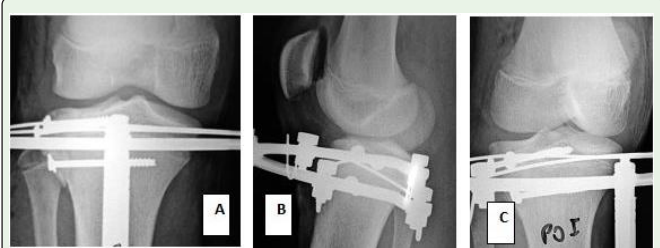


Figure 3: Images taken on operating room immediately after the surgical procedure.

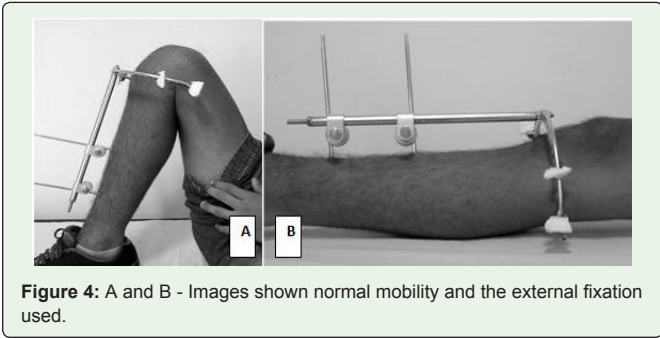


Figure 4: A and B - Images shown normal mobility and the external fixation used.

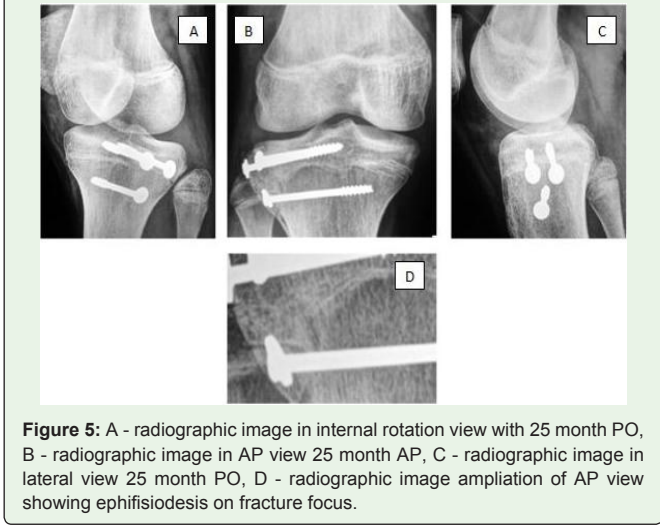


Figure 5: A - radiographic image in internal rotation view with 25 month PO, B - radiographic image in AP view 25 month AP, C - radiographic image in lateral view 25 month PO, D - radiographic image ampliation of AP view showing epiphysiodesis on fracture focus.

Keeping the patient without any type of immobilization to be able to go under early physiotherapy and preserve the movement amplitude of the operated knee.

The synthesis of neutralization (hybrid external fixator) was removed in six weeks, being the bone loss in the lateral plateau level, caused by the declination of the subchondral bone, completely filled up by newly-formed bone verified in 12 weeks.

In the post-operative 25 months the patient lost outpatient follow-up, however, he had already presented epiphysiodesis signs (Figure 5); yet, without presenting associated deformities or any other variation to walking as well as the movement amplitude (Figure 4).

Tibial plateau fractures in children are rare clinical entities, with few cases described by literature.

The present case report has shown the therapeutic option adopted by the author and ineffectiveness of attempting to avoid epiphysiodesis.

In post operative twenty five months could be observed by x-ray signs of the epiphysiodesis.

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