Case 14039
Avulsion fracture of the tibial tubercle in an adolescent

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Section: Musculoskeletal System
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Patient: 13 year(s), male

Clinical History

A 13-year-old boy presented to the emergency department of our hospital with a painful, swollen left knee after high jumping in gym class. During take-off, he felt a sudden snap in his knee, after landing he was unable to bear weight. Clinical examination revealed the impossibility to extend the knee.

Imaging Findings

Lateral radiograph revealed soft tissue swelling and an enlargement of the growth plate of the secondary ossification center of the tibial tubercle (Fig. 1).
Subsequent MRI was performed for further evaluation of the extent of the lesion. MRI confirmed the presence of an avulsion fracture of the secondary ossification center of the tibial tuberosity. The maximum gap of the growth plate was located anterolaterally and measured seven millimeters. In the ventral part of the proximal tibial epiphysis, bone marrow edema was visualized in keeping with lesion extension in the femoro-tibial joint space (Fig. 2). Haemorrhagic effusion of the deep tibial tubercle bursa and the infrapatellar subcutaneous bursa was seen as well.

Discussion

An avulsion fracture is caused by a high energy tensile force on a ligament or tendon which exceeds the strength of the bony tissue. In adolescents the growth plate is the weakest link, in comparison to adults whereas a tensile force will cause injuries of the musculotendinous junctions [1]. Typically avulsion fractures occur in boys between the age of 13-17 years because of the cartilage features of the growth plate. Avulsion fractures of the knee are uncommon compared to avulsion fractures of the hip or the pelvis [2]. Fractures of the apophysis of the proximal tibia comprise 0, 5% -3% of all fractures [3].

The mechanism of injury is thought to be a high energy extension of the knee against a fixed leg, such as in jumping sports [4].

Avulsion fractures of the tibial tubercle (TT) are classified according to the modified Watson-Jones classification (Fig. 3). The original classification of Watson and Jones described three categories of avulsion fractures of the tibial tubercle [5]. Ryu and Debenham introduced an additional fourth category in which the fracture extends into the proximal tibial epiphysis. The extent of the injury is related to the stage of fusion of the epiphysis [6].

Plain radiographs are the first step to define the displacement of the fracture, the degree of comminution and the extent of the injury[1].

Although MRI is not always mandatory, it may be of additional value to define the precise extent of the bone and soft tissue abnormalities, and allows more accurate classification of the lesion. In our case, plain radiograph showed an enlargement of the growth plate of the TT. In addition, MRI revealed bone marrow edema in the ventral part of the proximal tibial epiphysis indicating lesion extension in the articular surface of the tibia. After MRI the lesion was classified as a type II fracture.

The treatment, either conservative versus surgical, depends on correct staging of the lesion. If displacement is marked or if the physis is comminuted, surgical approach is recommended [7]. In our case the maximum gap of the growth plate measured seven millimeters, therefore surgical repair, consisting of open reduction and internal fixation with cortical screws, was performed, followed by six weeks of immobilization in a plaster cast.

Further follow-up was uneventful five months after trauma.

TAKE HOME MESSAGE

Although rare, avulsion fracture of the TT should be considered in sportive adolescents particularly in jumping. MRI may add in correct staging of the lesion.

Final Diagnosis

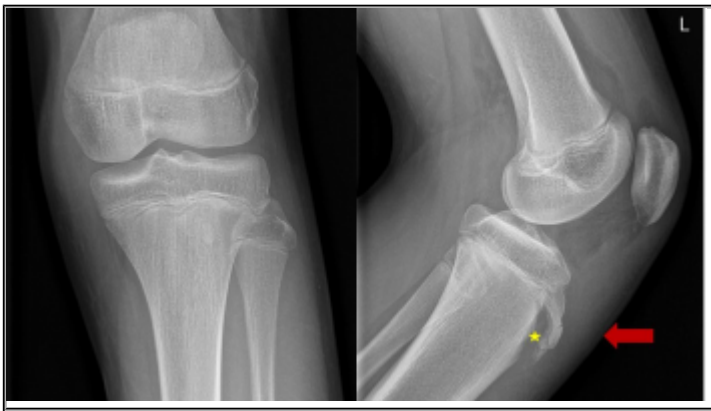
Acute avulsion fracture of the apophysis of the tibial tubercle.

Differential Diagnosis List

Patellar tendon rupture , Osgood-Schlatter disease

Figures

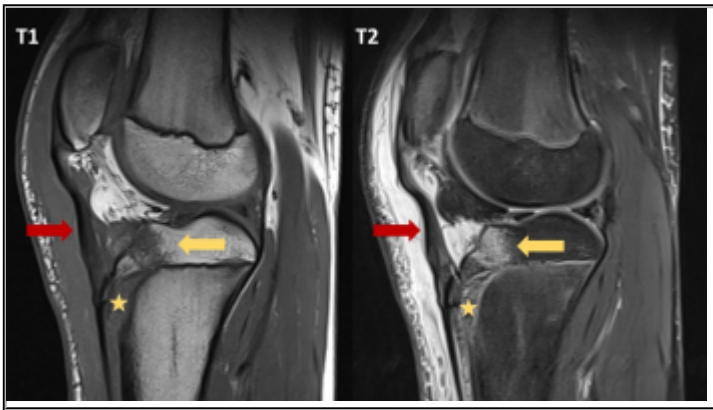
Figure 1 Plain radiograph of the left knee: Anteroposterior and Lateral view



Lateral view: Soft tissue swelling (red arrow) and broadening of the growth plate of the apophysis of the tibial tubercle (yellow star).

Area of Interest: Musculoskeletal joint;
Imaging Technique: Plain radiographic studies;
Procedure: Diagnostic procedure;
Special Focus: Trauma;

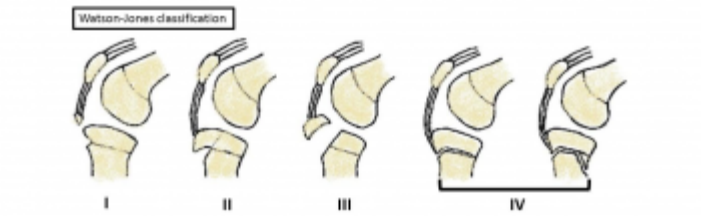
Figure 2 MRI scan: sagittal T1 and T2 weighted images



1. Undulating course of patellar tendon (red arrow), adjacent soft tissue swelling. Bone marrow edema in ventral proximal tibial epiphysis (yellow arrow) indicating lesion extension in the knee joint. 2. Broadening of the growth plate (star).

Area of Interest: Musculoskeletal joint;
Imaging Technique: MR;
Procedure: Diagnostic procedure;
Special Focus: Trauma;

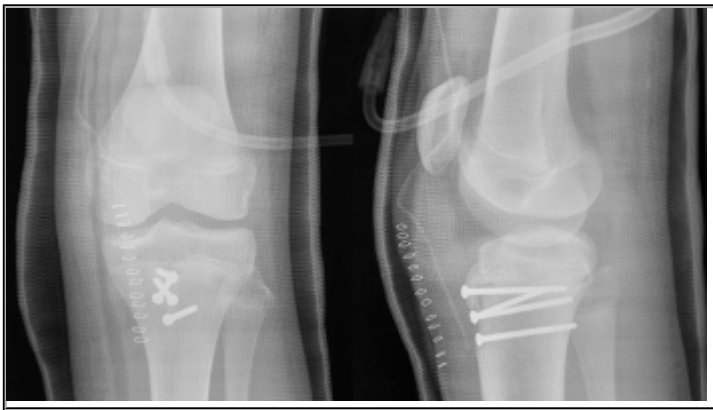
Figure 3 Modified Watson-Jones classification [5]



I: Upward displacement of tibial tubercle (TT). II: Fracture extension through the articular surface. III: Upward displacement of TT together with ossified part of tibial epiphysis. IV: Fracture through growth plate of proximal tibial epiphysis.

Area of Interest: Musculoskeletal bone;
Imaging Technique: Conventional radiography;
Procedure: Normal variants;
Special Focus: Trauma;

Figure 4 Postoperative radiographs: Anteroposterior and Lateral view



The avulsion fracture was treated surgically with open reduction and internal fixation with four cortical screws. Postoperative x-ray shows correct alignment of fracture and correct position of screws.

Area of Interest: Musculoskeletal joint;
Imaging Technique: Plain radiographic studies;
Procedure: Diagnostic procedure;
Special Focus: Trauma;

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Citation

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