

Neglected patellar tendon rupture in tibial tubercle avulsion fracture in an adolescent: A case report

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Abstract

A rare childhood injury is a combined tibial tubercle fracture and patellar tendon rupture, and this condition necessitates an open surgical procedure to perform a stable fixation of the tubercle fragment and a successful patellar tendon repair. When a tibial tubercle fracture in the tibia is present alone, a high index of sus-

picion is required. In this article, we described a case of a male teen who suffered a neglected patellar tendon rupture following close reduction and fixation of a tibial tubercle fracture.

Introduction

Tibial tubercle avulsion fractures occur rarely in the pediatric population, representing less than 1% of all physeal fractures.^{1,2} The peak of incidence ranges from 13 to 17 years of age, with a high prevalence in male gender, and these injuries are associated with high level of sport activities.³ Tibial tubercle avulsion can occur after a violent eccentric contraction of the quadriceps muscle during knee extension or by a rapid passive flexion of the knee against the contracting quadriceps, as during jumping and landing activity. Osgood-Schlatter disease and Sinding-Larsen-Johansson syndrome have been proposed as predisposing factors of tibial tubercle fracture, whereas other associated injuries include meniscal and ligament lesions, and avulsion of the patellar tendon.^{1,2,4} The latter condition is uncommon in the pediatric age, with a reported incidence of 7% of all extensor apparatus injuries.¹ It is well-known that the physis is the weakest link between the muscle-tendon-bone complex in this age, thus a tibial tubercle avulsion is more likely to occur compared to patellar tendon rupture. A double lesion of the extensor mechanism as a simultaneous tibial tubercle fracture and patellar tendon avulsion is even more rare, with less than 20 cases reported in the literature. Mayba *et al.* were the first to describe a case in 1982,⁵ while Frankl *et al.* classified this combination adding a subtype C to the Ogden classification.⁶ We presented a case of a neglected patellar tendon rupture in an adolescent male after close reduction and fixation of a tibial tubercle fracture.

Case Report

A 15-year-old male presented to our department complaining acute pain and swelling in his left knee after jumping during a basketball game. A history of bilateral Osgood-Schlatter disease has been reported, while his BMI (21.7 kg/m²) was normal. Clinical examination showed no joint instability, but a ligamentous laxity. Moreover, the patient was not able to perform a straight leg raise test. Plain Anteroposterior (AP) and lateral radiographs revealed a displaced tibial tubercle fracture with extension to the intra-articular surface that was classified as type IIIA according to Ogden⁴ (Figure 1). A three-dimensional-computed tomography (3D-CT) scan was carried out for preoperative planning (Figure 1).

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We performed a close reduction and internal fixation of the tibial tubercle on the same day. Anatomical reduction was achieved through knee hyperextension and maintained with two partially-treated 4 mm and 5 mm cannulated screws to allow compression and absolute stability of the fragment. The patient was immobilized in a full extension knee brace. However, an asymmetrically high-riding patella was noted at the post-operative clinical and radiographic examination. The Insall-Salvati (IS) ratio was 1.13 at

the preoperative X-ray and 1.25 at the postoperative X-ray (normal value: 0.8-1.2), while the Blackburne-Peel (BP) index was 1.04 and 1.29 (normal value: 0.8) at the preoperative and postoperative check, respectively. Therefore, we suspected a simultaneous total patellar tendon rupture, classifying the injury as type IIIC according to Frankl *et al.*⁶ (Figure 2).

Ultrasound examination was performed 2 days later and it confirmed the diagnosis. The patient was treated operatively 6-days

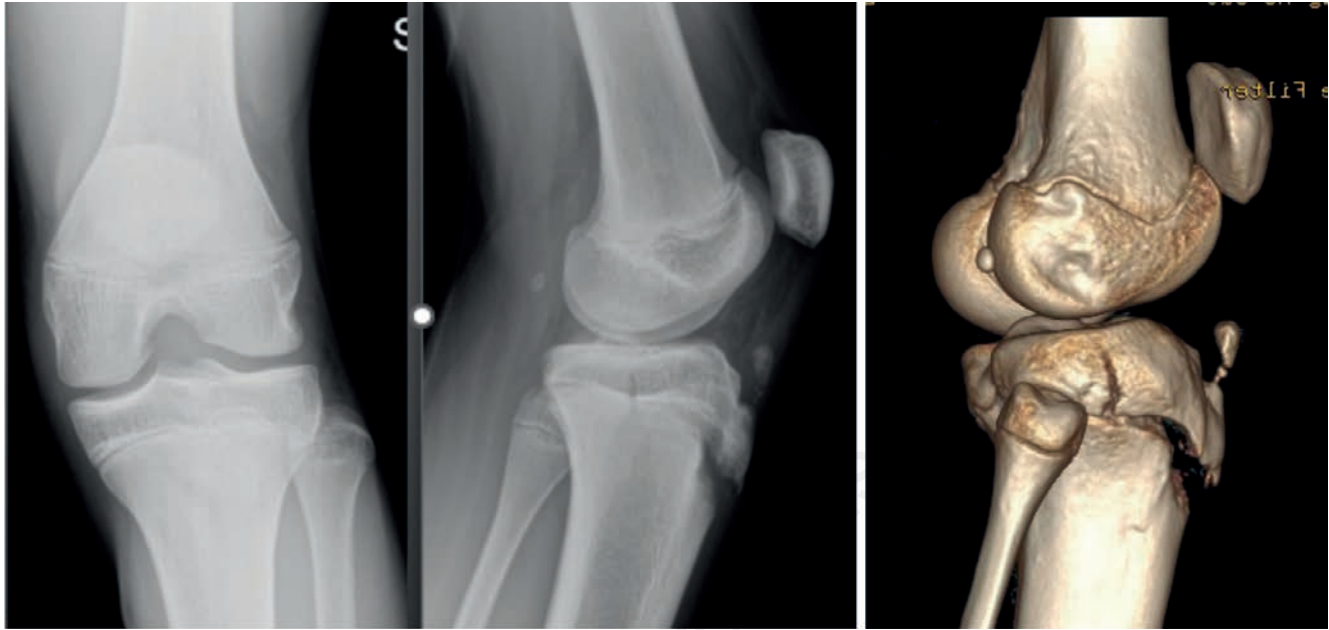


Figure 1. AP (left) and lateral (middle) radiographs showing displaced tibial tubercle fracture with extension to the intra-articular surface (Ogden IIIA). A 3D-CT scan (right).

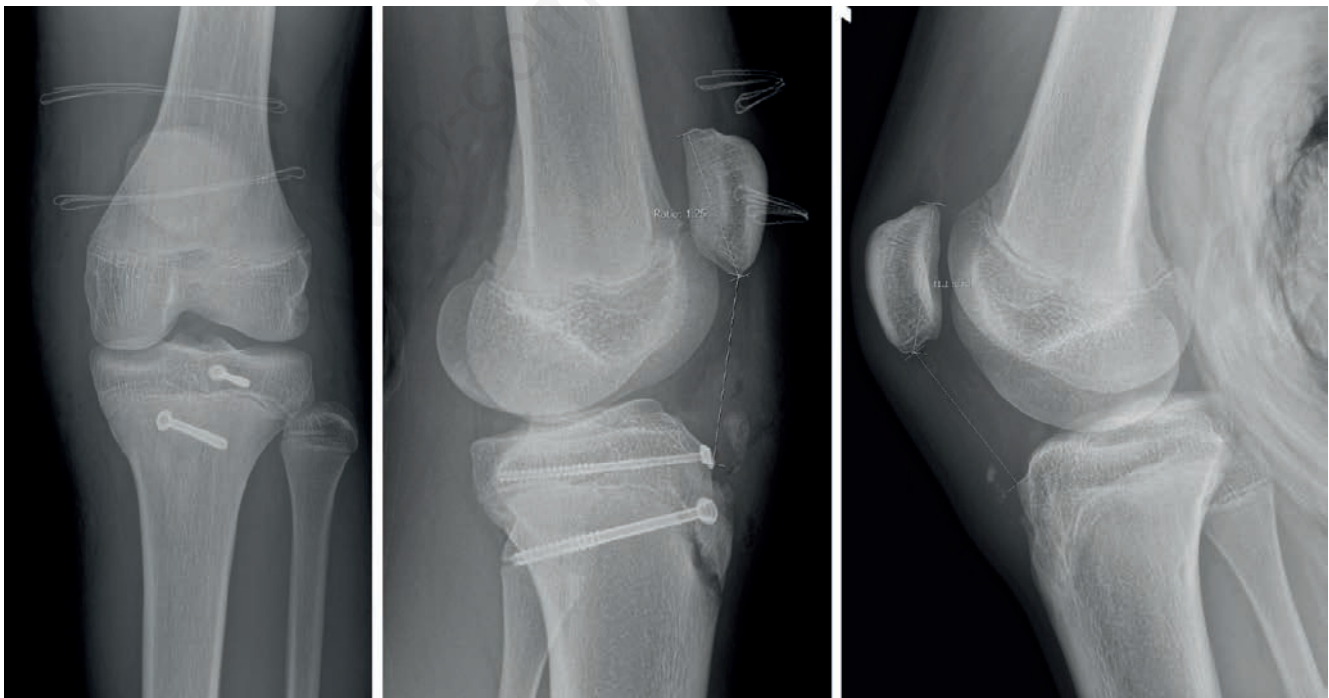


Figure 2. AP (left) and lateral (middle) postoperative radiographs showing an asymmetrically high-riding patella compared to the contralateral side (right). The IS ratio was 1.13 at the preoperative X-ray and 1.25 at the postoperative X-ray (middle).

after the initial trauma. Through an anterior longitudinal approach, the more distal tibial screw (5 mm) was removed and relocated more angulated, while the patellar tendon was identified as completely avulsed from its distal bone footprint. Visually, it appeared delaminated with multiple degeneration areas. The tendon was reconstructed with the knee at 30° of flexion to avoid over tightening, and two high resistance sutures were placed into the patellar tendon (one medially and the other laterally) in a Krakow fashion through a transverse hole 2.5 cm distal to the tibial tuberosity. An additional high resistance suture was passed into a transverse patellar and proximal tibial bone tunnel (almost 4 cm below the tubercle) in order to augment and neutralized the repair

(Novacheck technique). Postoperative radiographs showed correction of patella height (Figure 3).

The knee was immobilized in full extension for the following three weeks in a hinged knee brace, with no weight-bearing. After three weeks, flexion was increased by 15° every 5 days, and partial weight-bearing with crutches was allowed. The brace was removed after 8 weeks. Subsequently, strengthening exercise of the quadriceps were initiated, and five months later the patient returned to sport activities. At the latest follow-up (7 months postoperatively), the patient had a complete range of motion (0° to 140°), and no axial and sagittal deformity were observed (Figure 4).

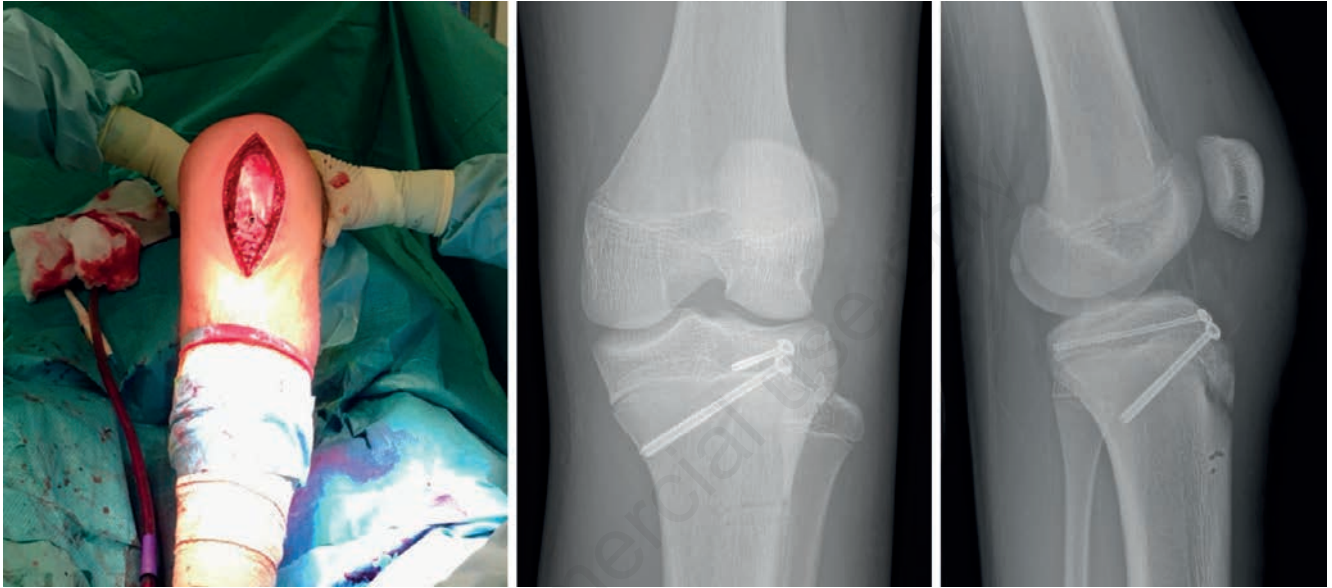


Figure 3. Intraoperative image (left) of the patellar tendon repair through the Krakow technique with 2 high resistance sutures. AP (middle) and lateral (right) postoperative radiographs showing correction of the patella height.



Figure 4. Postoperative lateral X-ray at 7 months of follow-up (left) showing retention of the correct patella height and the full recovery of range of motion (middle and right).

Discussion

Simultaneous tibial tubercle fracture and patellar tendon avulsion is rare, with a reported incidence ranging from 4% to 23%.⁷ This injury mainly affects adolescents between 13 and 17 years old, during the age of secondary ossification of the tibial tubercle apophysis with the epiphysis, and often it is correlated with excessive sport activity, like basketball and football. The eccentric quadriceps contraction can lead to tibial tubercle avulsion since the secondary growth plate is more vulnerable compared to bone and tendon.³ However, the mechanism of injury in combined tibial tubercle fracture and patellar tendon rupture is unclear. It has been proposed that tubercle avulsion is followed by rotation, which tensions soft tissues around the tubercle, arresting fragment translation, and a violent continued quadriceps contraction then can lead tendon avulsion even after the fracture occurred.⁵ Frankl *et al.* postulated that violent flexion of the knee in opposition to a hardly contracted muscle of quadriceps when the foot is fixed to the ground was the main cause of these injuries.⁶ In contrast, Yousef suggested that the tibial tubercle fails firstly due to violent quadriceps contraction, then due to continued muscle contraction with either incompletely detached or incarcerated tubercle fragment, subsequent avulsion of the patellar tendon occurs.⁷ The association with pre-existing condition such as Osgood-Schlatter disease is controversial, as few cases are reported. Clinical diagnosis is challenging due to pain and swelling. High level of suspicion should arise in the presence of an asymmetrically high-riding patella compared to the contralateral side, and inability to extend the knee against gravity. On radiographs, the presence of patella alta at the lateral projections should raise suspicion for patellar tendon lesion. Moreover, increased patella-to-tibia tubercle distance in a flexed position in lateral X-ray, Insall-Salvati and Caton-Deschamps indexes have also been prove to be helpful.⁶

The detection of a simultaneous tibial tubercle avulsion and patellar tendon rupture is crucial as directly impacts the management plan, considering that patellar tendon rupture can also occurs in non-displaced Ogden type I fracture that can be treated conservatively or by percutaneous reduction and fixation. A bifocal failure of the extensor mechanism requests anatomic reduction and stable fixation of the tubercle fragment, as well as a strong and effective repair of the patellar tendon. To our knowledge, this is the third cases reported in the literature of neglected patellar tendon avulsion after tibial tubercle fracture fixation.¹

The treatment of these injuries consisted of open reduction and internal fixation of the tibial tubercle and surgical repair of the avulsed patellar tendon. Multiple fixation technique have been described. The tibial tuberosity fragment can be secured with screws, Kirschner wires, staples, or trans-osseous sutures, while staples, trans-osseous suture, standard Krakow sutures, figure-of-eight tension band wiring, cerclage wire and suture bone anchor, potentially augmented with protective wire loop or semitendinosus graft have been described for patellar tendon reinsertion.^{1,3,7-11} Reinforcement of ligament repair can be done either with cerclage wire or fiber wire through a patella bone tunnel, as in our case.³ Moreover, contralateral patellar tendon, quadriceps graft, hamstring graft, Achilles tendon allograft, or synthetic ligament augmentation has been described. Mousafeiris *et al.* reported a fixation with two half-threaded 6.5 mm cannulated screws for the tibial tubercle in a 15-years-old male and a bone anchor with two high resistance sutures placed according to Krakow technique.¹⁰ Additional suture was placed through the quadriceps tendon in a figure-of-eight manner to enforce the repair.¹⁰ Pereira *et al.* performed a patellar tendon repair in a 15-years-old boy with two anchors augmented with a semitendinosus tendon autograft, and a fixation of the tubercle

through two 4.5 mm cannulated screws.¹¹ The reported period of postoperative immobilization in a long-leg cylindrical cast ranged from 3 to 6 weeks, whereas other authors allowed early range of motion and full weight-bearing immediately.

Long-term complications are rarely reported and include genu-recurvatum caused by premature closure of the anterior physis, and leg-length discrepancies, due to growth plate injury. Other sequels include malunion, nonunion, patella infera, saphenous nerve neuroma, prominent tubercle or pain on squatting, and posterior cruciate laxity.⁸

Conclusions

Simultaneous tibial tubercle avulsion fracture with patellar tendon rupture is rare, but a high index of suspicion has to be considered in order to avoid missed diagnosis. Open reduction and internal fixation is mandatory in such cases to repair the extensor mechanism and restore the correct patellar height. It is preferable to perform an open approach to explore the patellar tendon in doubtful cases.

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