CASE REPORT

Simultaneous bilateral patellar tendon avulsion in an adolescent

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A 13-year-old boy sustained an injury to both knees upon landing after a forceful jump in a soccer game. Plain radiography and magnetic resonance imaging demonstrated bilateral distal patellar tendon avulsions without fracture of the tibial tuberosities and the physes. To our knowledge, this particular injury has not been previously described in the literature. Open surgeries and internal fixation were performed with excellent functional outcome. This type of injury was similar to the well-recognised acute tibial tuberosity avulsion fracture in terms of the pathogenesis and treatment. We propose a further subtype of this injury pattern.

Introduction

Avulsion fracture of the tibial tubercle in an adolescent is rare. The reported frequency ranges from 0.4 to 2.7% of all epiphyseal injuries.[1] However, there is a comprehensive classification for this uncommon type of fracture, which has been evolving and modified from time to time ever since 1976, when Watson-Jones[2] first introduced it (Fig 1). The classification involves three types, as follows: (1) a small fragment becomes avulsed from the distal portion of the ossification centre of the tubercle; (2) the tubercle's secondary ossification centre having already coalesced with the proximal tibial epiphysis, and the entire tubercle becomes hinged upward at the proximal tibial tubercle physeal junction; and (3) avulsion ensues, with extension of the fracture proximally into the joint. In 1980, Ogden et al[3] modified this classification to include subtypes A and B according to the absence or presence of a displaced fragment and comminution, respectively. In 1985, Ryu and Debenham[4] proposed a type IV avulsion fracture of the tibial tuberosity, with propagation of the fracture line into the posterior cortex through the epiphyseal plate as either a Salter-Harris I or II fracture. In 1990, Frankl et al[5] proposed an expansion of Ogden's classification with the addition of a subtype C for a fracture of the distal portion of the tibial tubercle with avulsion of the patella ligament. In 2003, McKoy and Stanitski[6] suggested a type V avulsion fracture, in which there were two fracture patterns forming a Y configuration of the proximal tibia. Up to now, pure patellar tendon avulsion from the tibial tuberosity with no physeal injury has not been considered in this classification.

Simultaneous bilateral avulsion fractures of the tibial tuberosity are even rarer. Borch-Madsen[7] first described such an injury in 1954. Twelve similar cases of simultaneous bilateral avulsion fractures have been reported subsequently in the English literature.[7-17] The majority of these dealt with displaced avulsed bony fragments treated by open reduction and internal fixation. None entailed pure patellar tendon avulsions in a skeletally immature patient. Our patient had bilateral distal patellar tendon avulsion from their respective tibial tuberosities but with no bony fragment (ie no evidence of physeal injury). Unlike patellar tendon ruptures in adult or those with chronic systemic diseases, this condition occurred in a normal adolescent with skeletal immaturity, and to our knowledge this has never been described in the literature.

The purposes of this report were to draw attention to bilateral simultaneous patellar tendon avulsion in an adolescent, review the literature, and propose a further subtype for the classification about this type of injury.

Key words
Athletic injuries; Fractures, comminuted; Tibial fractures

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Case report

The patient was a 13-year-old boy, who enjoyed good past health and was of average body height and weight. There was no history of steroid use. The patient complained of immediate bilateral knee pain after a jump during a soccer game in April 2007. He denied any history of pain or swelling in the knees. Physical examination showed bilateral knee effusions with high riding patellae. The extensor mechanisms were disrupted bilaterally, but there was no neurovascular deficit. Roentgenographic examination reviewed bilateral patella alta and no obvious avulsion fracture at both inferior pole of the patellae or tibial tuberosities. The magnetic resonance imaging (MRI) of both knees showed avulsion rupture of both distal patellar tendons with gaps measuring about 0.8 cm on the right

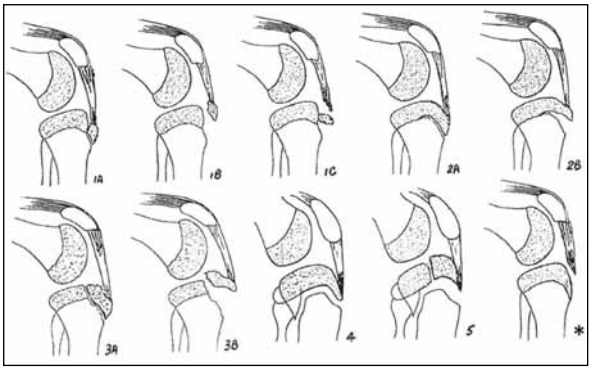

FIG 1. Diagrammatic representation of the different classification of the tibial avulsion fracture in adolescents

* Tendon injury pattern described in this case report, proposed as subtype 6

side and 1.3 cm on the left side (Fig 2a). There was no displaced fracture at the inferior pole of the patella or proximal tibia epiphyseal injury. The collateral ligaments, cruciate ligaments, and menisci of both knees were normal.

Open repair of each patellar tendon was performed. Intra-operatively it was found that there were complete avulsions of the patellar tendon from the tibial tuberosity with attachment of a thin piece of periosteum from the proximal tibia (Fig 2b). There were complete tears of both medial and lateral retinacula, the findings being similar on both sides. We used the midline longitudinal incision. The patellar tendons were reattached to the tibial tuberosity with a 4 mm x 50 mm cancellous screw and a soft tissue washer through the periosteum (Fig 2c). The repair was further secured by an Ethibond suture in a Krackow suture between the patellar tendon and the predrilled transverse tibial bone tunnel. These were protected by figure-of-eight tension band wiring. The patient was allowed full–weight-bearing walking with a hinge brace (range, 0-30 degrees) after the operation. During the patient's hospitalisation, a complete medical and endocrinological examination was performed. No predisposing factor was identified. The patient was able to return to his school 2 weeks after the surgery.

Five months after the operation, range of motion of both knees was 0 to 135 degrees. There was some difficulty in squatting due to weakness of both quadriceps. The cancellous screws and soft tissue washers were subsequently removed (at 11 months after the index surgery). The range of movement of both knees was 0 to 140 degrees, and the patient was able to squat without difficulty. Radiographs of both knees showed normal position of the patellae (Fig 2d) and there was no premature closure of the physes or genu recurvatum deformity. The patient has resumed his usual physical activities without any limitations, and has been followed up for 1.5 years following the operation.

一名青年的雙側髕骨肌腱同時撕脫

一名13歲青年在踢足球時用力跳躍，雙腿着地時膝蓋受傷。X光片及磁共振成像顯示他的雙側髕骨肌腱撕脫，而脛骨粗隆及骨骺則未見骨折。為病人進行手術及內固定有極佳的治療成效。據我們所知，文獻中未有類似的受傷報告。這種肌腱撕脫在發病機理及治療中與為人熟悉的急性脛骨結節撕脫骨折很相似。根據這個病例報告，我們提出髕骨肌腱撕脫為這種肌腱損傷模式的一種亞型。

Discussion

The most important difference from previous case reports was the nature of patellar tendon avulsions. In our patient, they were pure patellar tendon avulsions with simultaneous involvement of both knees, which is extraordinary uncommon in children with open physis and not described in the literature to date. Of the reported patients with simultaneous bilateral fracture,[7-17] the majority underwent open reduction and internal fixation; their mean age being 15 years. The injury has been described as a result of violent active extension of the knee or violent

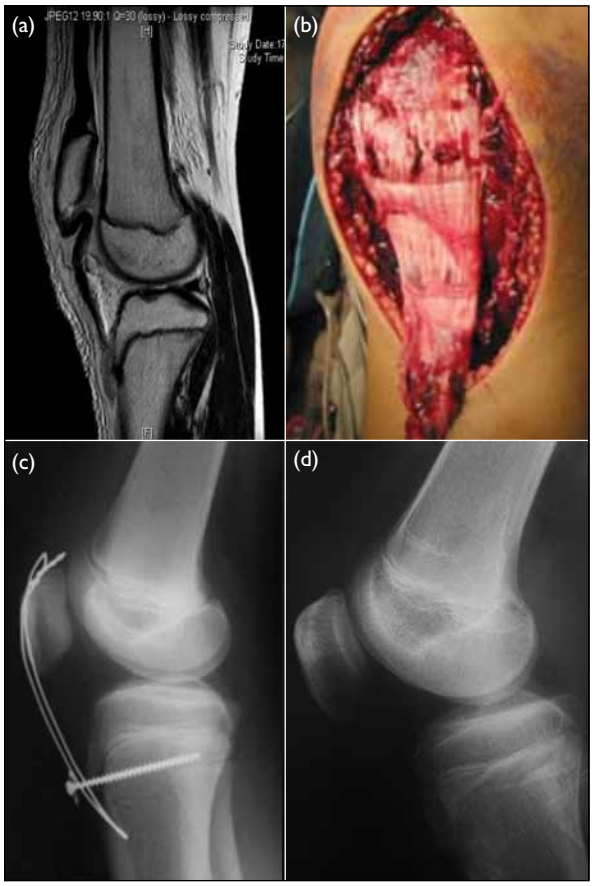

FIG 2. (a) Magnetic resonance imaging showing avulsion of right patellar tendon with patella alta and intact physeal plate. (b) Intra-operative photo showing the avulsed end of the right patellar tendon. (c) Lateral radiograph of right knee early after operation. (d) Lateral radiograph of right knee after 12 months of follow-up

passive flexion of the knee against a tight contracted quadriceps mechanism. Such fractures often occur during athletics, and there is a male predominace.[1] It may be due to a greater involvement in vigorous sport and a later age for fusion of the upper tibial epiphysis. Types I and II fractures are most often noted in adolescents from 12 to 14 years of age, while type III fractures are most often observed in older adolescents from 15 to 17 years of age. Osgood-Schlatter disease has been suggested as a predisposing factor for tibial avulsion fractures but proof is lacking. Undisplaced type I or II fractures can be treated conservatively by managements such as castings. For displaced fractures, restorations of the extensor mechanism as well as anatomical reduction of the tibial articular surface are the treatments of choice. If growth potential in the proximal tibial fragment remains, the screws should be inserted parallel to the joint, thereby avoiding the physes.

Regarding pathogenesis, this injury was presumed to occur when the amount of traction by the patellar ligament exceeded the combined strength of the physis beneath the tubercle, or the surrounding perichondrium, or the periosteum adjacent to the tubercle. In our case, both roentgenographic and MRI yielded no evidence of fracture at the lower pole of patella, tibial tuberosity, or across the physis. During the operation, we appreciated that the avulsed patellar tendons were attached to a thin piece of periosteum instead of sizeable bony fragments. Muratli et al[18] described a similar case: the bilateral patellar tendon rupture in a child, but this involved the mid-part of the patellar tendon rather than the distal patellar tendon avulsion. We believe that the mechanism of injury and the pathogenesis of the case described in this report are similar to the well-recognised acute tibial avulsion fractures. A further subtype is therefore postulated (Fig 1), which entails tendon injury rather than bony injury.

For the treatment, we reattached the patellar tendon to its anatomical position with cancellous screws and soft tissue washers. We further augmented the fixation with Krackow stitches through tibial bone tunnels and protected the whole construct with figure-of-eight tension band wirings. Basically, we opted for soft tissue to bone healing rather than the bone-to-bone healing as in most such cases. The entire constructs were stable enough to allow early mobilisation and full weight-bearing and walking, which was unlike some previous case reports[5,9,10] that entailed cast immobilisation and non–weight-bearing walking for 6 weeks.

In conclusion, we report the first case of simultaneous pure bilateral patellar tendon avulsions from the tibial tuberosity, with no physeal injury, in an adolescent. It was managed successfully by the conventional practice with screw fixation, but Krackow stitches and tension band wiring were also used to augment fixation. The patient was allowed full weight-bearing walking and early knee mobilisation after the operation. He returned to his school life soon after the operation, recovered completely from the injury, and is now able to resume his usual sporting activities without limitation.

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