



## Case Report

# Bilateral tibial tubercle avulsion fractures: A pediatric orthopedic injury at high risk for compartment syndrome☆☆☆



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## ABSTRACT

Adolescent tibial tubercle avulsion fractures represent an uncommon, but clinically significant condition for emergency medicine physicians. Early recognition of the signs and symptoms of this pediatric orthopedic diagnosis are important, as anterior compartment syndrome can occur in up to 10–20% of cases. Anterior tibial tubercle fractures are generally sport related injuries, occurring primarily in otherwise healthy adolescent males between the ages of 11–17. They account for less than 3% of all epiphyseal injuries in this age group and are rarely bilateral in nature. In this article, we present a case with two unique clinical features: bilateral sports related tibial tubercle avulsion fractures and subsequent development of bilateral clinical compartment syndrome. We briefly review the risk factors, presentation, and diagnosis of this rare but clinically important condition.

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## 1. Introduction

Tibial tubercle avulsion fractures are rare injuries, occurring primarily in athletic adolescents, that account for less than 3% of all epiphyseal injuries between the ages of 11–17 [1–4]. Bilateral tibial tubercle avulsion fractures are even more uncommon, with less than 25 cases reported in the literature [1,3,5]. The young athlete's tibial physis is vulnerable to high energy traction forces from sports like gymnastics, football, or basketball prior to physeal closure [6,7]. The injury results from sudden, forceful quadriceps contraction exceeding the strength of the unfused physis [8]. Patients generally present in sudden pain after an athletic event involving sprinting or jumping with tenderness, palpable deformity, ecchymosis, and swelling over the tibial tubercle with decreased leg extension functionality [1,4,5,7,9,10]. Rupture of the anterior tibial recurrent artery secondary to the fracture frequently leads to compartment syndrome of the lower leg's anterior

compartment [11]. Early recognition and orthopedic consultation for potential surgical management is imperative to avoid known potential complications like compartment syndrome, vascular compromise, non-union, and mal-union [3,11,12]. With early diagnosis and involvement of the orthopedic surgical team, patients have an excellent prognosis and can return to full function in 3.9 months (average) post-operatively [12]. In this case report we present sports related simultaneous bilateral tibial tubercle avulsion fractures in an adolescent male with subsequent development of bilateral clinical anterior compartment syndrome.

## 2. Case report

A previously healthy 15-year-old male presented to the emergency department with sudden onset of bilateral anterior knee pain and swelling, which occurred with abrupt deceleration during a football passing route. He could not bear weight or actively extend either knee immediately after injury. The proximal anterior tibial regions were exquisitely tender and swollen (Fig. 1). Diagnosis was quickly reached in the emergency department when lateral radiographs showed bilateral avulsion fractures of the tibial tubercle (Fig. 2). The patient noted significant progression of anterior tibial pain and swelling without paresthesia or pulse deficit during his emergency department course. Pediatric orthopedics was consulted and expressed significant concern for bilateral clinical compartment syndrome. Measurement of compartment pressures was

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Fig. 1. Bilateral proximal anterior tibial swelling.

deferred given high index of suspicion. The child was transferred to the operating room where he received bilateral anterior compartment fasciotomies and bilateral open reduction and fixation of both tubercles to the tibial metaphyses with 4.0 mm cannulated screws. He returned to playing football six months after surgery and at two years after injury, reported no adverse long-term effects.

### 3. Discussion

Compartment syndrome occurs in up to 20% of tubercle avulsion fractures, which is nearly double the rate found in tibial diaphyseal fractures [8,12–14]. Osgood-Schlatter disease is thought to be a predisposing factor for tibial tubercle avulsion; however, a compelling relationship remains unproven [4–6]. Maintaining a high suspicion for compartment syndrome can prevent complications such as vascular compromise, muscle necrosis, and nerve damage [10,15]. Diagnosis can be made based on clinical symptoms alone, intra-compartmental pressure, or both. A tense and distended compartment with the presence of pain out of proportion and paresthesia is sufficient for a clinical diagnosis. Although directly measured intra-compartmental pressures can facilitate the diagnosis of compartment syndrome, interpretation of these values can be challenging with healthy children having higher average lower leg compartment pressures than adults [16]. For this

reason, clinical diagnosis often obviates intra-compartmental pressure measurement, and treatment can proceed to fasciotomy based on a high index of suspicion [15]. Consequently, when the decision has been made for operative management under general anesthesia, fasciotomies are usually performed based on clinical impression, regardless of measured pressure, because of the high risk for progression [8,15].

A previous case series reported that only 4 of 40 patients exhibited hard symptoms of vascular compromise at initial presentation, but 54% (22 of 41 fractures) received fasciotomies because the surgeon felt that the patient was developing clinical compartment syndrome [8]. There were no reported adverse side effects reported in these anterior fasciotomies [8]. Of the other 23 reported bilateral fracture cases, only one case reported compartment syndrome, and it was in the right leg only [3]. Our case is unique because the patient received bilateral fasciotomies for bilateral clinical compartment syndrome, which has not been previously described in the literature. The approach to diagnosis of tibial tubercle avulsion fracture was classically plain radiographs alone [8,10]. However, this method often under-classifies the extent of injury and new recommendations suggest the additional use of CT or MRI to demonstrate the full extent of intra-articular involvement [8,9].

### 4. Conclusion

This case is one of the first to report bilateral tibial tubercle avulsion fractures with the development of bilateral clinical anterior compartment syndrome. While uncommon, this pediatric orthopedic diagnosis is important for emergency physicians given the high association with subsequent development of anterior compartment syndrome. Early detection can lead to prompt orthopedic consultation, potentially minimizing the long-term complications of neurovascular compromise in these otherwise healthy, active children.

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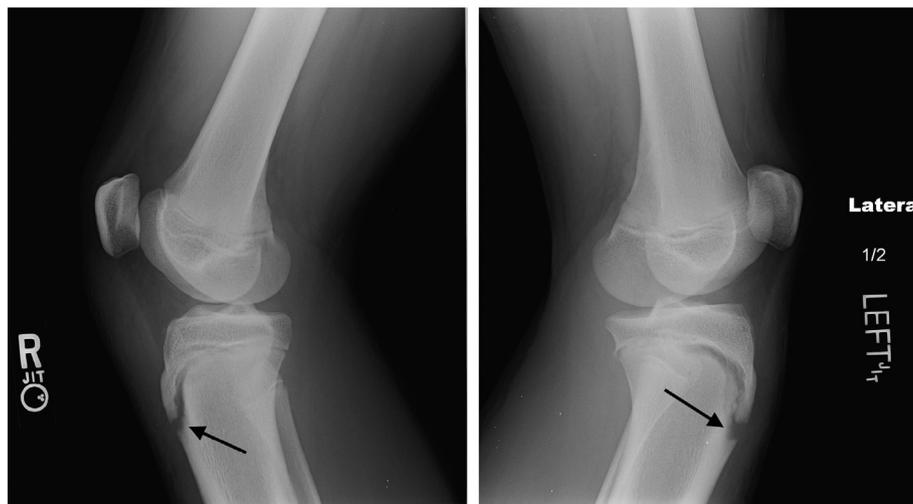


Fig. 2. Right and left lateral knee X-ray images through the proximal tibia. Arrows demonstrate physeal widening. No evidence of epiphyseal or intra-articular injury.

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