Comminuted simultaneous bilateral tibial tubercle avulsion fractures: a case report

GP Slobogean, KMulpuri, CM Alvarez, CW Reilly
Department of Orthopaedics, University of British Columbia, Vancouver, Canada
Department of Paediatric Orthopaedics, British Columbia’s Children’s Hospital, Vancouver, Canada

ABSTRACT

A 16-year-old male had simultaneous bilateral tibial tubercle avulsion fractures after making a sudden stop while running at full speed. The left knee injury (type V) was minimally displaced, was treated conservatively with closed reduction, and the patient recovered uneventfully. The right tibial tubercle injury was unusual. The tuberosity and anterior aspect of the proximal epiphysis remained as one, but there was severe intra-articular comminution posterior to the displaced tubercle fragment. The right knee injury (type III) required open reduction and internal fixation to reduce the apophyseal fragment and 2 intra-articular displaced fragments. The patient’s recovery was complicated by a severe, persistent flexion deformity on the right side. Eventually, the patient required manipulation under anaesthesia, extensive continuous passive mobilisation and a turnbuckle extension splint. A residual 5-degree flexion deformity remained at 16 months post-injury.

This case highlights the importance of identifying any intra-articular fragments, their careful anatomical reduction, and aggressive mobilisation when treating tibial tubercle avulsion fractures.

Key words: fractures, comminuted; tibial fractures

INTRODUCTION

Avulsion fractures of the tibial tuberosity are uncommon, comprising only 0.4 to 2.7% of all epiphyseal injuries.1,2 There have been 230 published cases with tibial tuberosity avulsion fractures,3 but simultaneous bilateral tibial tubercle avulsions are uncommon, with only 11 cases reported.3–13

CASE REPORT

In July 2003, a 16-year-old male made a sudden stop while running at full speed. He immediately experienced intense anterior pain bilaterally and was
unable to bear weight on either leg. A physical examination revealed bilateral swelling, tenderness, and loss of active knee extension. A patella alta was observed on his right knee. Radiographs demonstrated bilateral tibial tubercle avulsion fractures (Fig. 1). The left knee had a type-V avulsion injury; the tibial tubercle was displaced along with a Salter-Harris type-II fracture extending through the posterior physis. The right tibial tubercle was anteriorly and superiorly displaced, but remained as one large fragment extending to the joint surface (Fig. 2).

The left knee was managed with closed reduction and cylinder casting in full extension. The right knee injury was managed with an open reduction and internal fixation. A fracture fragment near the anterior cruciate ligament insertion was successfully reduced with a suture. The large apophyseal fracture and remaining intra-articular fragment were reduced using 2 cancellous screws and one cannulated screw, respectively. An above-knee cast with mild flexion was used to immobilise the right knee. The patient was instructed not to bear weight for several weeks.

One month after the initial procedure, one of the fixation screws was removed due to its proximity to the articular surface. At 3 months, a full range of motion had been achieved in the left knee; however, the right knee demonstrated a flexion deformity of 30° and an arc of 30° to 50° flexion. Very little progress was made with physiotherapy. At 5 months post-injury a manipulation under general anaesthesia was performed on the right knee with continuous passive motion postoperatively. A fixed flexion deformity of 30° and an arc of 30° to 110° were present at 7 months post-injury. The patient was managed with ongoing therapy, a home stretching programme, and a turn-buckle splint. At 16 months post-injury the patient functioned well with a 5° fixed flexion deformity (Fig. 3).

**DISCUSSION**

Watson-Jones\(^4\) originally classified tibial tubercle fractures as 3 types: type 1 occurs within the tubercle allowing a fragment to avulse; type 2 occurs through the proximal tibial physis allowing the entire tubercle to displace; and type 3 crosses the physis into the epiphysis and exits in the joint allowing tubercle

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![Figure 1](image1.png) Preoperative lateral radiographs of (a) the left knee showing a type-V tibial tubercle avulsion fracture extending to the joint surface and through the posterior physis (arrow); (b) the right knee showing a type-III avulsion fracture with intra-articular comminution and step within the joint (arrow).

![Figure 2](image2.png) Preoperative computed tomography of the right knee demonstrating a comminuted fragment posterior to the intact apophysis and a prominent articular step in the joint surface (arrow).

![Figure 3](image3.png) Lateral radiographs of (a) the left knee and (b) right knee taken 16 months postoperatively.
and articular displacement. Ogden et al.\textsuperscript{4} modified the classification with the addition of groups A and B to describe the level of displacement and comminution of the fragment. Ryu and Debenham\textsuperscript{15} described a type-IV avulsion fracture that extends posteriorly through the physis and may displace the entire epiphysis with the tubercle. Frankl et al.\textsuperscript{16} proposed a group-C fracture to include possible avulsion of the patellar ligament. McKoy and Stanitski\textsuperscript{5} added a type-V fracture that describes a combination of types III and IV.

An avulsion of the tibial tubercle represents a substantial injury to the extensor mechanism. Our patient had severe tibial tubercle injuries on the right side requiring open reduction and internal fixation due to intra-articular comminution. He was expected to recover quickly if his course followed that described in previous studies on the treatment of tibial tubercle injuries.\textsuperscript{1,4,16–19} In most series, patients regained a full range of movement within a mean of 15 months or sooner.\textsuperscript{1,4} Unfortunately in our patient, the right knee required surgical mobilisation 5 months after surgery.

Open reduction and internal fixation is recommended whenever the apophysis is severely displaced or comminuted (types IIIB, IIIA, IIIB, IV).\textsuperscript{5} The goals of management are to restore the extensor mechanism, and the articular surface if involved. In our patient, radiographs of the right knee showed a large, single apophyseal fragment extending into the joint, resembling a type-IIIa injury. CT scans revealed a prominent intra-articular fragment and step posterior to the displaced apophyseal fracture. Both injuries involved fractures that extended into the joint, yet the right knee, with comminuted fragments, had a worse outcome in a patient undergoing the same rehabilitation programme on each leg. This severe intra-articular comminution contributed to the patient’s slow recovery and persistent flexion contracture. Although the intra-articular portion was managed with an open reduction, it was an articular injury in a non-meniscal portion of the tibial plateau in which fibrosis led to a flexion contracture.

We recommend the use of CT to evaluate patients with type-III fractures, which should be reduced anatomically and stabilised to allow an early range of movement to avoid development of a flexion contracture. Postoperative immobilisation should be in full extension and an early range of movement should be adopted.

REFERENCES