



## Simultaneous bilateral tibial tubercle avulsion fracture in an adolescent : A case report

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**Bilateral simultaneous avulsion fractures of the anterior tibial tubercle (ATT) are extremely rare. Since the first description in 1954, 15 similar cases have been reported. We report a further case in a 16-year-old boy who sustained simultaneous bilateral tibial tubercle avulsion fractures (Watson-Jones Type III) from jumping during a gymnastics session. The right knee presented an associated partial avulsion of the patellar tendon. Both knees were treated successfully by open reduction and internal fixation with two cannulated screws. The recovery of the patient was complete ; the screws were removed six months later. After one year follow-up, the patient had no complaint and had resumed his sporting activity.**

**Keywords :** tibial tubercle ; avulsion fracture ; bilateral.

### INTRODUCTION

Avulsion-fracture of the anterior tibial tubercle (ATT) occurs in adolescents, predominantly male ; the injury is generated by an abrupt traction of the patellar tendon and is facilitated by local conditions related with skeletal immaturity.

Avulsion fracture of the ATT represents 3% of all injuries of the proximal tibia and 0.4 to 2.4% of all epiphyseal fractures (3,13). From 1853 till now, more than 250 cases have been reported in the literature.

Simultaneous bilateral avulsion fractures of the tibial tubercle are very uncommon. Since the first description by Borsch-Madsen in 1955 (4), fifteen similar cases have been reported (1,5,7,8-12,14-17,21).

Associated patellar ligament avulsion is also uncommon (7).

We report another bilateral case featuring these two rare injuries. We will also discuss the appropriate classification, the aetiopathogenesis of this injury and the proposed treatment.

### CASE REPORT

Following a jump on both feet in a gymnastics session, a 16-year old boy presented an immediate sharp pain in both knees ; he fell down and could no longer stand up.

On physical examination, both knees were swollen and presented marked tenderness over the tibial tubercles. Active extension was impossible bilaterally.

Plain radiographs demonstrated a bilateral avulsion fracture of the tibial tubercle, type 3A according to Ogden's classification (Fig. 1).

The patient was immediately transferred to our institution and was operated on the following day.

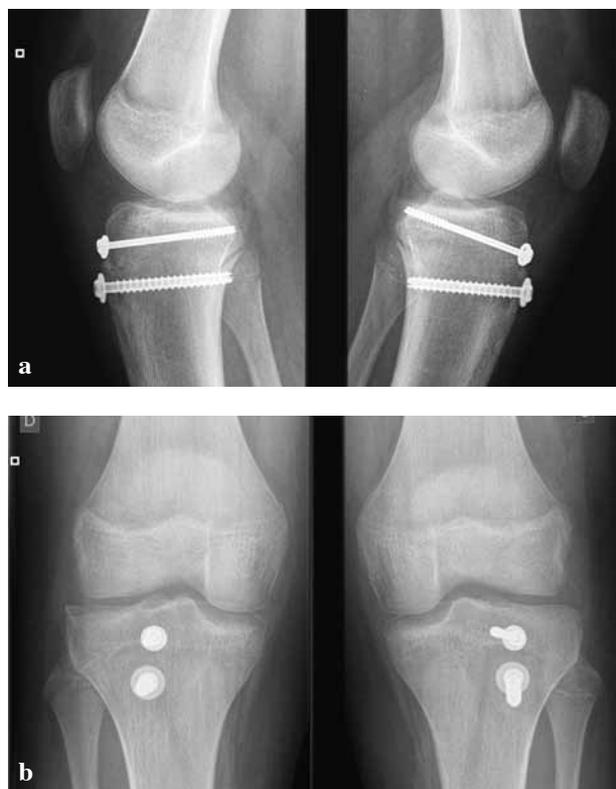
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**Fig. 1.** — Lateral radiographs showing bilaterally a typical Type III avulsion fracture of the tibial tuberosity.



**Fig. 2.** — Lateral (a) and AP view (b) of both knees postoperatively.

During surgery, we discovered a partial disruption of the patellar ligament on the right knee. There were no other associated lesions. On the left knee, there was a complete avulsion of the tibial tuberosity with an intact patellar ligament.



**Fig. 3.** — Radiographs at one year follow-up, showing anatomical restitution of the tibial plateau on lateral (a) and AP view (b).

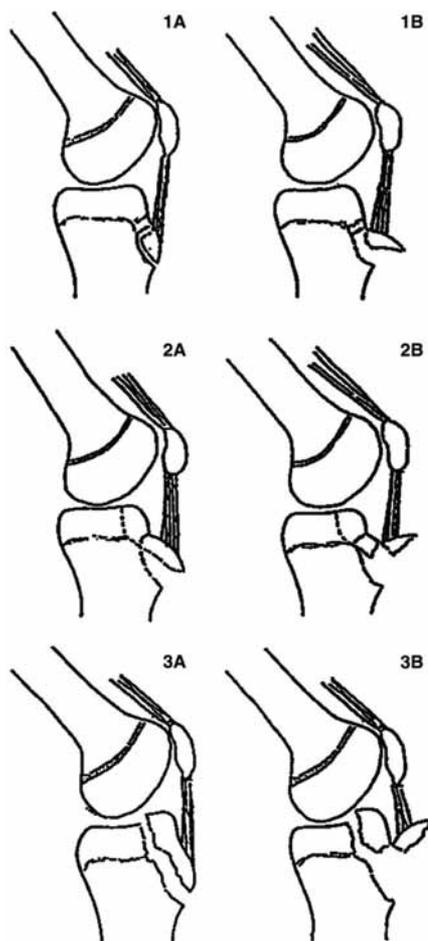
After debriding and cleaning the fracture site, the fragments were anatomically reduced and fixed with two cannulated screws parallel to the tibial plateau (6.3 mm for the metaphysis and 4.5 mm for the epiphysis) (Fig. 2). The right patellar ligament was repaired.

Both knees were immobilized in an above-knee cast in complete extension for 4 weeks, then in a knee orthosis for another 4 weeks with progressive return to full weight bearing.

Physiotherapy was immediately started with isometric quadriceps exercise and full mobilization was progressively authorized after cast removal.

Six months later the cannulated screws were removed in one day surgery.

After one year follow-up, the patient had no pain, no functional limitation and had resumed his sporting activity (rugby). The latest radiograph showed a complete remodeling of the tibial tubercle. The proximal tibial epiphysis was anatomically restored (Fig. 3).

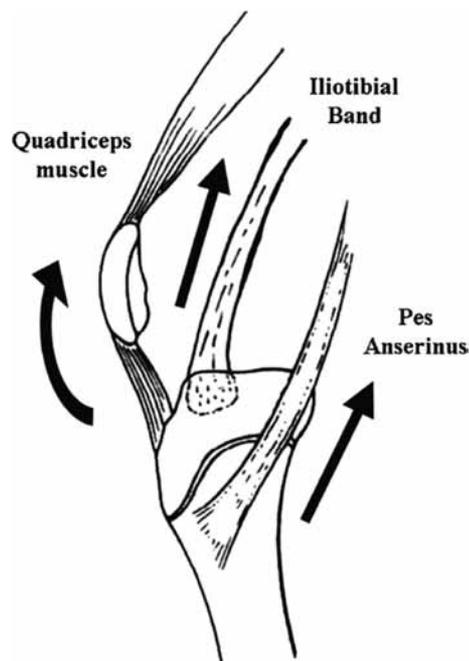


**Fig. 4.** — The Ogden modification of the Watson Jones classification. Reproduced with permission from Zrig, M *et al.* Acute tibial tubercle avulsion fractures in the sporting adolescent. *Arch Orthop Trauma Surg* 2008 ; 128 : 1437-1442.

## DISCUSSION

Since 1935, several classifications have been proposed for avulsion-fractures of the ATT. In 1976, three types were described by Watson-Jones (23) : type I, an avulsion fracture of the distal part of the tibial tubercle ; type II, a displacement of the lip of the anterior part of the tibial epiphysis ; type III, a fracture of the base of the lip with propagation into the knee joint.

In 1980, Ogden (18) modified the classification by creating three subgroups A or B, taking into account a possible intra-articular extension of the fracture as well as comminution of the fragment (Fig. 4).



**Fig. 5.** — Mechanical forces applied on the anterior tibial tubercle while jumping or landing. Reproduced with permission from Yoo JH *et al.* An en bloc avulsion fracture of tibial tuberosity and Gerdy's tubercle in an adolescent basketball player : a case report.

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In 1990, Frankl *et al* (7) described two cases of ATT avulsion-fracture associated with avulsion of the patellar ligament. They proposed an addition to the classification to include avulsion of the patellar ligament (Type I-C).

Ryu and Debenham (18) subsequently added a fourth type corresponding to an extension of the fracture to the posterior cortex through the growth plate (Salter Harris type 2).

The mechanism of injury is usually an indirect force caused by sudden contraction of the quadriceps muscle. During take-off for a jump, the quadriceps mechanism forcefully contracts against the patellar tendon insertion. When the force exceeds the strength of the tibial tubercle physis, a fracture is generated, leading to avulsion of the tibial tubercle. Acute passive flexion of the knee against a contracting quadriceps, such as in landing after a jump (as in our case) is another mechanism of injury (Fig. 5).

Table I. — Overview of patient data for all bilateral cases of avulsion fracture of the anterior tibial tuberosity reported in literature since 1954

Authors	Journal	Year	Sex	Age	N	Classification	Sports	Mechanism	Simultaneity	Treatment	Last Follow-up
Borch-Madsen	Acta Orthop Scand	1954	M	17y	1	W-J TYPE III				ORIF	
Ogden <i>et al</i>	J Bone Joint Surg	1980	M	14y	1	W-J TYPE III				ORIF	
Henrard <i>et al</i>	Clin Orthop Related Res	1983	M		1					ORIF	
Maar <i>et al</i>	Orthopedics	1988	M	16y	1	W-J TYPE III	Basketball	jump	YES	ORIF	3Y
Lepse <i>et al</i>	Clin Orthop Related Res	1988	M	14y	1	W-J TYPE III	Gymnastics	forward flip	YES	ORIF	1Y
Inoue <i>et al</i>	Br J Sports med	1991	M	16y	1	W-J Type IV					
Sibert <i>et al</i>	Sportverletz	1995	M	16y	1	OGDEN 1B L +SALTER 2 R	Athletics	starting	YES	ORIF	20W
Mirly <i>et al</i>	Orthopedics	1996	M								
Mosier <i>et al</i>	Orthopedics	2000	M	15y	1	OGDEN IIIB+ IV			YES		
Ergun <i>et al</i>	Knee Surg Sports	2003	M	16y	1	OGDEN 2B Bilat	Basketball	landing after forceful jump	YES	ORIF	27M
Hamilton <i>et al</i>	Knee	2006	M	13y	1	TYPE I R+TYPE II L	Soccer	jump	YES	ORIF	
Slobogean <i>et al</i>	J Orthop Surg	2006	M	16y	1	TYPE IV L+TYPE III R	Running	sudden stop	YES	L : Closed reduction R : ORIF	1Y 6M
Georgiou <i>et al</i>	Knee Surg Sports Traumatology	2007	M	17y	1	W-J TYPE III	Sport	jump	YES	ORIF	
Neugbauer <i>et al</i>	Eur J Emergency and Trauma	2007	M	16y	1	OGDEN 3A bilat	Gymnastics	jump	YES	ORIF	
Arredon-Gomez <i>et al</i>	Acta Ortho Mex	2007	M	14y	1	OGDEN 3 A R +OGDEN 3B G	Soccer	indirect	YES	ORIF	
Schaffer <i>et al</i>	Unfallchirurgie	2008	M	13y	1	SALTER 2 R+ SALTER 3 L	Long Jump	take off and landing	YES	ORIF	

ORIF : open reduction with internal fixation.

The tibial tubercle physis is in continuity with that of the tibial plateau. The physis progressively fuses from posterior to anterior, making it most vulnerable to avulsion in adolescents aged 13-16 years.

High jumping and basketball are the sports most frequently associated with this injury.

Preexisting Osgood Schlatter disease had been suggested as predisposing to fracture-avulsion of the ATT but this has not been proven.

Additional predisposing factors include patella infera, tight hamstrings and disorders involving physeal abnormalities.

Very few cases of bilateral ATT fracture-avulsions have been reported in literature : only 15 cases since 1955 (Table I).

In 2006, Hamilton *et al* (9) reviewed all the bilateral cases reported during that period : nine cases were reviewed.

Another five cases of bilateral ATT avulsion-fractures were subsequently added to the list and the frequency of these lesions seems to have increased during the last 5 years as compared with the previous 50 years.

Langley and Millington (12) published a case of a sequential bilateral ATT fracture-avulsion in a 15-year-old boy : first on the left knee while playing football and six months later on the right knee.

Brodie *et al* (5) presented a case of bilateral ATT with a unilateral recurrence one year after the original trauma.

All were males, aged between 13 and 17 years and most of the patients were close to skeletal maturity.

In most cases, the causal mechanism was a sudden jump with a landing on the ground while contracting the quadriceps muscle.

According to the Watson-Jones and Ogden classifications, most cases were type IIIA or B. The type III fractures involving a growth plate and extending through the articular surface, appear to do well following open reduction and internal fixation despite their bilateral nature.

In most of the series, there is no report of growth disturbance of the proximal tibial epiphysis after that type of injury.

Slobogean *et al* (22) recommend, in case of type III fracture, a CT scan to evaluate the intraarticular

surface. According to these authors, a fracture that extends into the joint with a comminuted fragment had a worse prognosis with a risk of flexion contracture. They recommend a postoperative immobilization in full extension and an early range of motion program.

Accurate diagnosis of the lesion is also important to determine the appropriate treatment in order to avoid malfunction of the extensor mechanism of the knee in case of avulsion of the patellar ligament (type 1-C).

Open reduction with internal fixation (screw, wiring or K-wire) has been the common treatment for this type of lesion. We believe that treatment should always include open reduction and internal fixation for all type II or III lesions.

It appears from the literature that the recovery and functional outcome of bilateral injuries is comparable to those of unilateral tibial tubercle avulsion fractures : results have been good to excellent in most of the cases.

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