TIBIAL TUBEROSITY FRACTURES IN ADOLESCENTS

S A Buhari, S Singh, H P Wong, Y P Low

ABSTRACT

Tibial tuberosity fracture is uncommon. We reviewed five patients with the injury, presenting over a two-year period. All of them were adolescent boys who sustained the injuries during sport. They were treated with open reduction and internal fixation using cancellous screws with additional tension band wiring for comminuted fragments. Results were excellent, with complete union of fracture site, full range of movement by three to five months and no evidence of complication on follow-up for thirty months.

Keywords : *fracture, tibia, adolescent, avulsion, tibial tuberosity.*

SINGAPORE MED J 1993; Vol 34: 421-424

INTRODUCTION

Avulsion fracture of the tibial tuberosity is uncommon, accounting for less than 3% of all epiphyseal injuries[1]. Up to 1986, there were only 150 reported cases in 145 patients[2]. Recently, there has been a greater number and frequency of reported cases[3]. Most of the patients were adolescent boys, 12 - 16 years of age[4-6].

The mechanism of injury is a violent active extension of the knee or passive flexion against a contracted quadriceps muscle[5-7]. A leap with a bad landing appears to be the commonest cause[8].

Fig 1 - In avulsion fracture, the fracture line is along the physis whereas in Osgood-Schlatter's disease, it is more anterior.

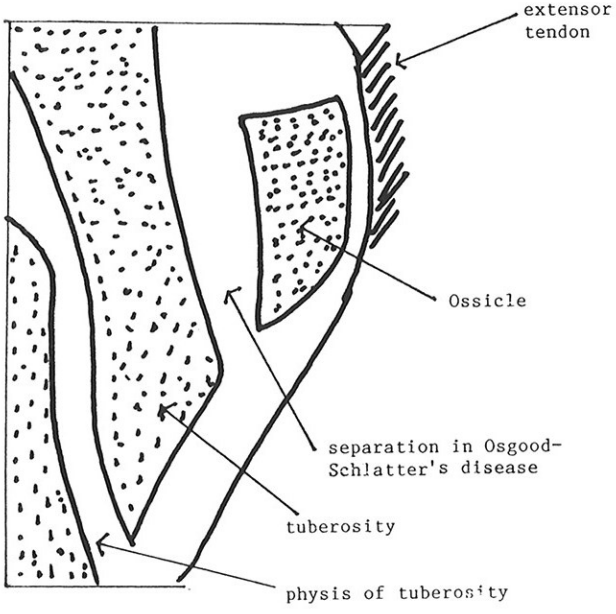

Table I - Clinical details of five patients with tibial tuberosity fractures

Case	Age	Mechanism	Side	Type	Race	Treatment
1	13	soccer (tackled)	right	IB	Chinese	Cancellous screw
2	11	high jump	right	IIA	Malay	Cancellous screw
3	15	long jump	right	IIIA	Chinese	Cancellous screw
4	16	soccer (tackled)	left	IIIA	Chinese	Cancellous screw + tension band
5	16	shuttle run	left	IIIB	Indian	Cancellous screw + tension band

The fracture line is through the physis of the tuberosity, deep to its ossific nucleus (Fig 1). This physis is the weakness link between the tuberosity and the tibia[1]. In contrast, in Osgood-Schlatter's disease, there is avulsion of only the anterior part of the physis of the tuberosity, superficial to the ossific nucleus. Furthermore, Osgood-Schlatter's disease tends to be chronic and often asymptomatic, whereas avulsion fracture is acute and invariably symptomatic[6-9].

METHOD

We retrospectively reviewed 5 patients with tibial tuberosity avulsion fracture from Tan Tock Seng Hospital over a 2-year period. All of them were adolescent boys, age between 11 and 16 (mean 14.2) and they were followed-up postoperatively up to 30 months.

The fractures were classified according to Ogden (1980)[9] (Fig 2), which is a modification of Watson-Jones classification (Wilson 1976).

Clinical details are summarised in Table I.

All patients were engaging in sports activities at the time of injury and presented within 6 hours of injury. Invariably there were swelling, pain, localised tenderness and inability to extend the knee. Patients with type III fractures (fracture line extending into the joint) also had haemarthrosis.

All patients were treated with open reduction and internal fixation with cancellous screws (Fig 3-8). Two patients had additional tension band wiring (to hold the comminution) (Fig 7, 8) and one had additional 'K' wire. The periosteal flap was reattached with absorbable sutures in each case. Postoperatively, they were put on long above-knee plaster cast in extension for six weeks.

All patients had excellent recovery with full range of knee movement by 3 to 5 months postoperatively. They were pain free by 6 months postoperatively and were able to return to sporting activities by then. With intensive physiotherapy, both in hospital and at home, the quadriceps power and bulk were back to normal by 6 to 8 months. There was no evidence of genu recurvatum when followed-up for up to 30 months.

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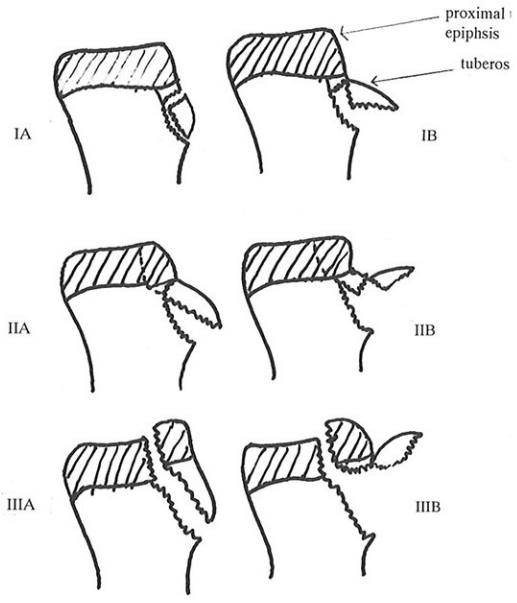
Fig 2 - Types of injury to the tibial tuberosity



Type IA : The fracture is distal to the proximal tibial epiphysis with minimum displacement.
Type IB : The fragment is displaced anteriorly and proximally.
Type IIA : The fracture extends at the junction of the ossification of the proximal tibia and the tuberosity.
Type IIB : The fragment is comminuted and displaced proximally.
Type IIIA: The fracture extends to the knee joint.
Type IIIB: The fragment is comminuted.

Fig 3 - Type IB fracture - The fracture is distal to the proximal tibial epiphysis and the fragment is displaced anteriorly and proximally.

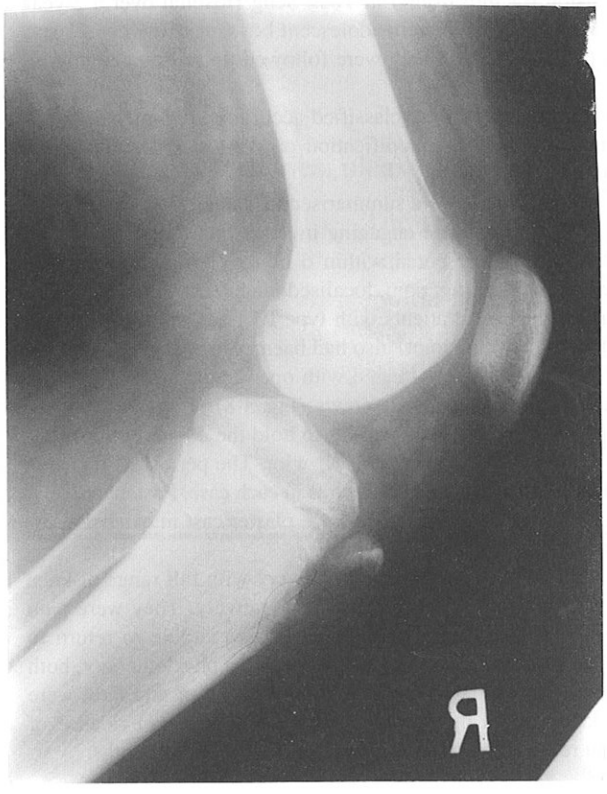


Fig 4 - Type IB fracture after fixation with two cancellous screws.

Fig 5 - Type IIIA fracture - the fracture line extends into the knee joint, but there was no comminution

Fig 6 - Type IIIA fracture - after fisation with two cancellous screws.

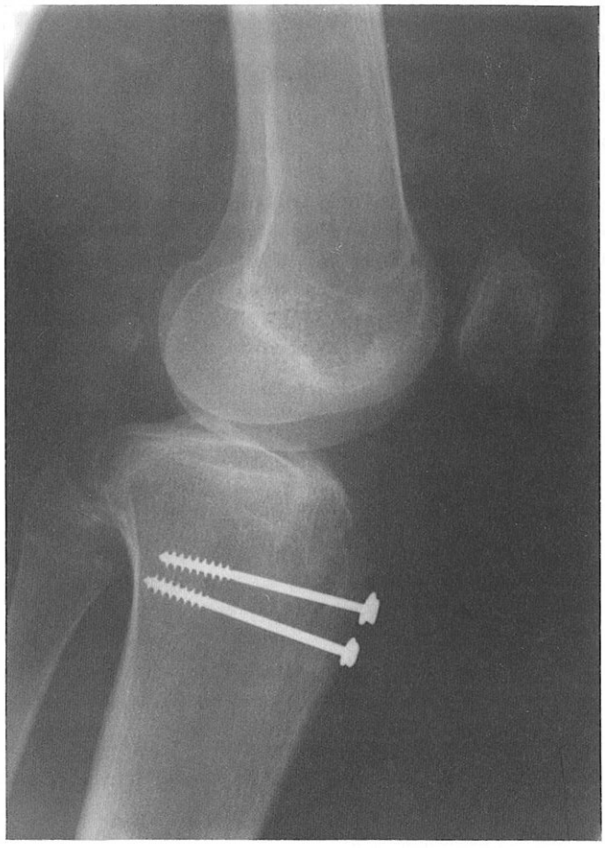
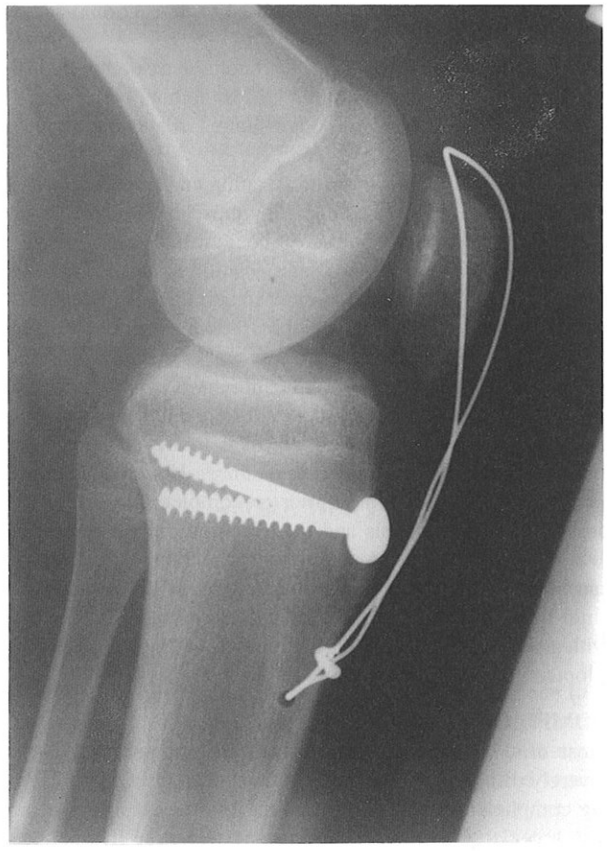


Fig 7 - Type IIIB fracture - the fracture line extends into the knee joint and there is comminution of the avulsed fragment.

Fig 8 - Type IIIB fracture after fixation with two cancellous screws and tension band wiring.



DISCUSSION

In older adolescents (age 15-17), the fractures were mainly of type III, while type I and II were common in younger adolescents (age 12-14)[3]. In our study, the 3 cases with type III fractures were either 15 or 16 years old, while type I and II were 13 and 11 years old respectively.

All of our 5 patients were boys. This is partly because of greater involvement among boys in vigorous sports and partly due to a later age of closure of the proximal tibial epiphysis. Henard et al (1983)[3] reviewed 72 patients from the literature and found 59(82%) of them were boys, 2(3%) were girls and 11(15%) were of unreported sex.

Type III fracture formed the majority group. Henard et al (1983)[3] reviewed 76 cases and found 19(25%) of them were type I, 8(11%) type II, 33(43%) type III and 16(21%) unreported type. Three of our patients had type III fractures and one each from type I and type II.

Several authors noted the predominance of non-dominant side[2,10,11]. Chow et al (1990)[2] had 16 right-handed patients and 13 of them had left-sided injury.

Osgood-Schlatter's disease is often associated with tibial tuberosity fractures and has been postulated as a possible predisposing cause, because the injury in these instances is usually trivial. Polakoff et al[12] had 5 out of 12 of his patients with this disease - a substantial figure to discourage teenage boys with the disease, symptomatic or otherwise, from participating in jumping sports.

TREATMENT

The aim of treatment is restoration of active extensor function of the knee[1,2,8] and in type III fracture, anatomical reduction to a perfect articular surface[2].

Most surgeons would treat type IA and IIA fractures conservatively, provided the extensor mechanism is intact[2]. This requires 6-8 weeks of immobilisation in an above-knee cast in extension[2,3,5,8]. Most patients would be back to normal activity by 3 months[3,5].

All type III fractures (Fig 5-8) should be treated with open reduction and internal fixation[2,5,9]. Most authors prefer screws with tension band wiring although sutures, staples, pins and K wires have been utilised[5,8].

Screw fixation allows secure fixation and hence early mobilisation, without the accompanying muscle atrophy[1]. Inadequate fixation with only one screw could result in reavulsion[8].

Tension band wiring facilitates fixation of small fragments that are too small or thin for screw fixation. It also neutralises tensile (distracting) forces and provides a buttress for these comminuted fragments. There is less fear of fracture displacement, and hence the patient can be mobilised early[8].

Compression with screws should be parallel to the proximal tibial growth plate, and not across it, to prevent epiphyseal arrest and subsequent genu recurvatum[2,8]. However since the fracture usually occurs just prior to complete closure of the proximal tibial epiphysis and there is little growth remaining to result in this deformity, intrafragmental transphyseal screws can be used safely[8]. In the rare occurrence of the fracture in a child below 10 years of age, the use of smooth wire fixation with a tension band and early removal of implant could be adopted[1].

COMPLICATIONS

Most of the complications reported are not permanently or severely disabling. None of our patients had any of the following complications. Genu recurvatum following epiphyseal arrest, especially in younger patients and with type III fractures, and limb length discrepancy are theoretical consideration and so far, there is no case reported yet[4,9].

Other complications include loss of flexion[11], non-union[2], skin erosion[12], patella baja[13], compartment syndrome[8], reavulsion[8], prolonged pain and discomfort, calcified patella tendon, prominent tuberosity and lax anterior cruciate ligament[2].

CONCLUSION

Tibial tuberosity fracture is an uncommon injury. Depending on the type, it can be treated conservatively or with open reduction and internal fixation, the most preferred being screw fixation and tension band wiring. Functional recovery is complete and there are very few serious complications.

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