FRACTURE OF THE TIBIAL TUBERCLE IN THE ADOLESCENT

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We have reviewed 16 patients with avulsion fractures of the tibial tubercle, mostly boys who sustained left-sided injuries during sport. Two-thirds had type I or II injuries and were treated conservatively. Fractures involving the knee joint (type III) had internal fixation. The final results were good except for minor complications such as a prominent and uncomfortable tibial tubercle.

Avulsion fracture of the tibial tuberosity in the adolescent is uncommon: up to 1986, 150 fractures had been reported in 145 patients (Sibley 1853; Levi and Coleman 1976; Ogden, Tross and Murphy 1980; Ogden 1982; Roberts 1984; Bolesta and Fitch 1986; Polakoff, Bucholz and Ogden 1986). There has been some concern about potential disturbance of growth and arthritic change after this injury, since the fracture involves a growth plate and occasionally involves an articular surface.

PATIENTS AND METHODS

We retrospectively reviewed the 16 patients admitted to Queen Mary Hospital, Hong Kong, with avulsion fracture of the tibial tuberosity from 1976 to 1987. Follow-up had been for an average of 3.7 years (four months to 11 years). The fractures were classified according to the Ogden et al (1980) modification of the Watson-Jones method (Wilson 1976), based on the extent of injury and the amount of displacement (Fig. 1):

Type IA – fracture through the ossification centre of the tuberosity;

Type IB – as IA with displacement;

Type IIA – fracture-separation of the whole tuberosity;

Type IIB – as IIA with comminution of the ossification centre;

Type IIIA – fracture extending into the knee with some displacement;

Type IIIB – as IIIA with comminution.

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Fig. 1

Types of injury of the tibial tuberosity (Ogden et al 1980).

Table I. Clinical details of 16 patients with avulsion fractures of the tibial tubercle

Case	Sex	Age (yr)	Mechanism of injury	Injured side	Type	Extensor function	Follow-up yr mth	Complication
1	M	14	Soccer	R	IA	+	7 0	Prominent tuberosity
2	M	15	High jump	L	IA	—	5 0	Pain on squatting
3	F	10	Fall	R	IA	+	2 0	Tender, calcified patellar tendon
4	F	13	Long jump	L	IA	+	0 6	—
5	M	11	Hurdling	L	IA	+	0 6	—
6	M	14	Hurdling	L	IB	+	2 0	Numb below tuberosity
7	M	13	Traffic accident	R	IIA	+	11 0	Tender over tuberosity
8	M	16	Fall	L	IIA	+	10 0	—
9	M	13	Traffic accident	L	IIA	+	0 10	Posterior cruciate laxity
10	M	13	Running	L	IIA	+	5 0	—
11	M	13	Running	L	IIA	+	1 0	—
12	M	14	Handball	L	IIB	—	3 0	Numb below tuberosity
13	M	15	Basketball	L	IIIA	—	0 4	—
14	F	11	Hurdling	L	IIIA	—	1 0	—
15	M	14	High jump	L	IIIB	—	9 0	—
16	M	14	Soccer	L	IIIB	—	2 0	—

Clinical details of the patients are shown in Table I. Thirteen of the 16 were boys; 14 patients were injured during sport and two in traffic accidents. All patients were right-handed but 13 of the fractures were on the left side. Only one patient had symptoms suggestive of Osgood-Schlatter's disease for about six months before the injury.

All patients had presented with swelling, pain, and tenderness over the tibial tuberosity. All but one of the six type I and six type II patients could actively extend the knee, the one exception had a concomitant rupture of the patellar tendon.

The 10 patients with type IA and IIA injuries (with no displacement of an articular fragment or proximal displacement of the tuberosity) were treated in plaster for about six weeks, though the ruptured patellar tendon did require surgical repair. The other six patients had open reduction and internal fixation, with plaster for about six weeks.

RESULTS

The final results were good in all patients with full range of movement and good strength. Only one patient chose not to return to vigorous sports activities. Complications, each seen in one patient, included residual discomfort over the tuberosity, pain over a calcified patellar tendon, discomfort on squatting in the patient with a repaired patellar tendon, a prominent tuberosity, and grade 1 anterior cruciate laxity. Two of the patients had residual numbness over the tibial tuberosity after open reduction, presumably due to surgical injury to the infrapatellar branch of the saphenous nerve.

Illustrative case reports

Case 2. A 15-year-old boy had a left-sided type IA fracture with avulsion of the patellar tendon and tearing of the medial retinacular fibres and capsule. At operation, the

tubercle fracture was fixed with one screw and the patellar tendon was anchored slightly distal to its original insertion using an 18 gauge Bunnell pull-out wire and nylon sutures (Fig. 2). A plaster in extension with full weight-bearing was retained for six weeks, and the metal was removed at 22 months.

Over five years later he had regained a full range of movement and played basketball, but still had discomfort at the insertion of the patellar tendon in extreme flexion and especially on squatting, but this did not require active treatment. The alignment of the patellar tendon was good and there were no patellofemoral joint problems.

Case 14. An 11-year-old girl sustained a left-sided type IIIA injury during hurdling (Fig. 3a). At open reduction

Fig. 2

Case 2. Fixation of the fracture with a screw and repair of the patellar tendon with a wire.

Fig. 3a

Fig. 3b

Case 14. A type IIIA fracture, showing its intra-articular extension. The postoperative film shows good reduction of the articular surface.

by a lateral parapatellar approach the articular surface was reduced perfectly with the help of an arthroscope, and a cancellous-type screw was placed in the epiphysis without damaging the growth plate. This held the perfect reduction in slight compression. Two K-wires and a tension band were placed distally (Fig. 3b).

Continuous passive mobilisation (CPM) with gradually increasing magnitude was given for the first week, serial radiographs showing that the reduction was stable. Active non-weight bearing mobilisation was continued for six weeks, at which stage radiographs showed solid union and the implants were removed. Weight-bearing was then started, and at one year she has a full range of movement, and had resumed sport.

DISCUSSION

Our series and that of Bolesta and Fitch (1986) are the largest reported. There are some interesting findings.

Male predominance. We report only three girls and only two others have previously been reported (Levi and Coleman 1976; Ogden et al 1980). Apart from greater involvement in vigorous sport, boys have a later age for fusion of the upper tibial epiphysis (Osgood 1903; Hughes and Sunderland 1946; Ehrenborg 1962; Smillie 1978; Ogden 1984; Low and Kung 1985).

Left-sided predominance. All our patients were right handed, yet all but three sustained injury to the left knee. This preponderance on the non-dominant side is also reported in other series (Poland 1898; Christie and Dvonch 1981; Roberts 1984; Bolesta and Fitch 1986).

Relationship with Osgood-Schlatter's disease. In only one patient did we find Osgood-Schlatter's disease as a

possible predisposing cause, as suggested by Ogden and Southwick (1976). Nevertheless, in this case the history was important, because the fracture was caused by a trivial injury (Polakoff et al 1986).

Treatment. The aim of treatment is to restore the extensor mechanism and where necessary, a perfect articular surface. Conservative treatment is indicated for type IA and IIA cases, provided the extensor mechanism is intact. Type IB, with good power of extension and adequate reduction of the avulsed fragment, may also be treated conservatively.

For all type III cases, most authors agree that internal fixation is needed to maintain an anatomical reduction. Henard and Bobo (1983) consider that the final choice of fixation should be made according to the specific need in each case. We agree with Polakoff et al (1986) that tension band wiring with a screw confined to the epiphysis, as in our case 14, seems to be the treatment of choice. Compression should always be parallel to the growth plate and not across it (Clawson 1976).

Complications. Some minor complications were seen in our series, but no patient had genu recurvatum, as feared by Blount (1954) and others, even when the fracture occurred at an early age. No patient had a leg length discrepancy (Ogden et al 1980) and we saw none of the other reported complications such as loss of flexion (Christie and Dvonch 1981), non-union (Poland 1898; Gaudier 1905), skin erosion (Borch-Madsen 1955), or patella baja (Levi and Coleman 1976).

Conclusions. Avulsion fracture of the tibial tubercle is relatively rare and most cases can be treated conservatively. When surgical intervention is indicated, a cancellous screw and tension band wiring seems to be the

treatment of choice. Though complications are rare and functional recovery is usually complete, postoperative continuous passive movement may help to hasten recovery.

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