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## The Management of Fractures of the Tibial Spine in Children

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THE object of this paper is to define the place of conservative and operative treatment for fractures of the tibial spine in children. It is based on experience of 10 patients, 5 treated conservatively, 4 operatively and 1 untreated until he was first seen four years after injury.

**Clinical features.**—The children's ages ranged from 4 to 14 years. They had suffered either a rotational strain at the knee, or, more commonly, a blow applied to the front of the thigh with the knee flexed, as by the handle of a wheeled toy that had tipped back. The clinical findings were characteristic—a flexed, painful knee, signs of hæmarthrosis and possibly a bruise or abrasion on the front of the thigh. A lateral radiograph of the knee showed a flake of bone raised from the tibial plateau, not easily visible on antero-posterior films (Fig. 1).

**Pathology.**—The injury was always much more extensive than the radiographic evidence suggested. With the flake of bone, a large area of surrounding articular cartilage of the upper

surface of the tibia had been separated and displaced upwards and backwards by the anterior cruciate ligament (Fig. 2). The fragment, unlike that in adult fractures, was always attached posteriorly by a hinge of articular cartilage. In 3 out of 5 knees that were explored, the area of cartilage detached from the medial articular surface of the tibia was greater than from the lateral surface, and extended beneath the medial meniscus almost to the anterior or medial margins of the bone. The edges of the fragment were entangled with the medial meniscus, so that, when attempts were made to reduce it, the fragment "locked" over the upper surface of the meniscus. It was in these 3 patients that manipulation under anaesthesia before operation had revealed a block to the last 20 degrees of passive extension of the knee.

In one patient, in whom no such limitation was found, the fragment was smaller, did not involve much of the articular surface, and was

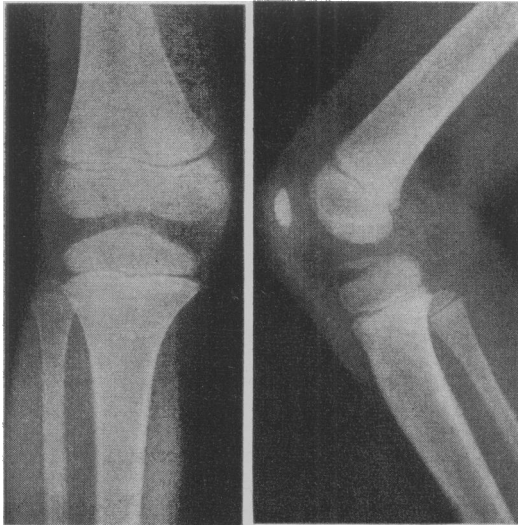


FIG. 1.—Fracture of the tibial spine in a child aged 8. The fragment did not reduce with simple extension of the knee, and there was some residual disability at follow-up examination.

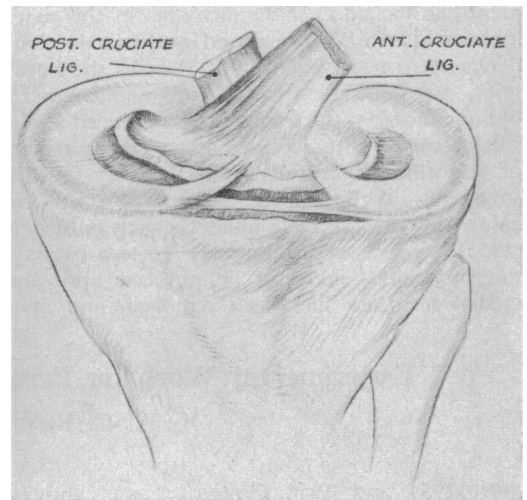


FIG. 2.—Diagram to illustrate the findings in fracture of the tibial spine. A large osteocartilaginous fragment is hinged posteriorly and is pulled upwards and backwards by the anterior cruciate ligament. Attempts to reduce the displacement may cause the fragment to lock on to the upper surface of one or other meniscus.

not displaced relative to the medial meniscus. In every case, the fragment was least displaced when the knee was slightly flexed; full extension, or flexion beyond 20 degrees, caused the anterior cruciate ligament to pull on the fragment.

#### *Treatment and Results*

*Conservative treatment.*—In all 5 cases the knee was aspirated if the effusion was tense, a Thomas' splint was applied for seven to ten days with the knee in slight flexion, followed by a groin to ankle plaster for about four weeks. General anaesthesia was only used when pain did not allow the knee to be extended. Maximum function was regained in every case not more than three weeks after removal of the plaster.

Follow-up examinations were made after periods ranging between one and five years. Two patients, aged 8 and 12, in whom the fragment had not been significantly displaced, had no disability and no clinical abnormality in their knees. Two patients, aged 4 and 12, with about 20 degrees of angular displacement of the fragment in the initial radiograph, had no disability but showed moderate anterior cruciate laxity and residual displacement of the united bone. One patient, aged 8, in whom there had been 40 degrees of angular displacement of the fragment (Fig. 1) and a block to the last 20 degrees of extension of the knee under anaesthesia, but whose knee had not been explored, had an unstable knee five years later and could not run. There was marked anterior cruciate laxity. It is very likely that the osteocartilaginous fragment had locked over the meniscus in this case, and would have been improved by open reduction.

*Operative treatment.*—In all 4 cases the knee-joint was opened through an antero-medial oblique incision, the fragment was reduced and a silk or catgut suture passed up from the region of the tibial tuberosity was used to fix the fragment. Although the suture traversed the epiphyseal plate, no late ill-effects such as Blount (1955) suggests were observed. In two patients the fragment could not be reduced until the medial meniscus had been removed, and in a

third the meniscus was removed because it had been torn by the injury. The fourth patient, in whom the detached fragment was not large enough to lock with the meniscus, would almost certainly have resolved well with conservative treatment, and in a much shorter time. Post-operatively the knee was immobilized in a Thomas' splint for ten days, followed by a groin to ankle plaster for five weeks. Maximum function was not regained until between three and five months after removal of the plaster.

At follow-up examination, all had no disability. Two patients, aged 9 and 14, had no clinical abnormality in the knee apart from the operation scar. One patient, aged 5, had mild anterior cruciate laxity, and another, aged 11, had no cruciate laxity but showed a few degrees of limitation of flexion of the knee.

The remaining patient, who was first seen four years after injury to his knee at the age of 9, proved at operation to have a large central fragment displaced almost vertically upwards but still hinged posteriorly. The fragment had overgrown, causing limitation of extension of the knee, and was removed.

*Conclusions.*—This investigation suggests that neither conservative nor operative treatment should be the rule in the management of tibial spine fractures in children. I agree with Watson-Jones (1957) that conservative treatment by manipulation into a position 10 or 20 degrees short of full extension gives a satisfactory result in a short time in cases where the fragment is not large, or much displaced or locked. Radiographic evidence of much displacement of the fragment, or the finding of a block to full extension of the knee under anaesthesia, indicates the need for operative treatment, in spite of the expectation that return to maximum function is likely to be prolonged.

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## Experimental Work on Femoral Neck Fractures [*Abridged*]

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IN 1957 and 1958 the writer was granted facilities for carrying out experimental work on fractures of the neck of the femur in the Faculty of Engineering at King's College, London. An outline of the study and certain conclusions reached on the structure, the strength and the mechanism of fractures of the femoral neck is herewith presented.

*Method of study.*—39 elderly cadaveric femora were fractured. 35 were subjected to static or shock loading in an Avery 30-ton testing machine (Fig. 1), being held in suitable wooden clamps, and 4 in an Izod impact testing machine. The experimentally produced fractures were compared with those seen in a clinical series comprising 58 cases.