FRACTURES OF THE TIBIA

A Report on Fifty Patients Treated by Intramedullary Nailing

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The earliest advocate of intramedullary nailing in this country was Hey Groves (1916). The technique of nailing in which the medullary space is reamed out was described by Küntscher in 1958.

In the Accident Service in Portsmouth nailing of fractures of the tibia was begun in 1962, using Hodgkinson's modification of the Lottes nail and the Bristol traction device as described

by Alms (1962). This technique was superseded by that using the clover-leaved Küntscher nail inserted by the closed method under radiographic control or with the aid of an image intensifier (Murray 1967). Lately the Müller nail has been found preferable, and intramedullary nailing has been found to be an excellent form of internal fixation for certain fractures of the tibia.

FIG. 1
Period of follow-up.

FIG. 2
Age of patients.

MATERIAL

Fifty patients were treated by nailing during the years 1962–69 and they have all been examined recently. The follow-up period varied from six months to seven years (Fig. 1). There were forty-one males and nine females. Thirty-one of the patients were below thirty years of age; the rest were evenly distributed (Fig. 2).

Twenty-eight fractures were closed and twenty-two open. Forty-one fractures were in the middle third, two were at the junction of the uppermost and middle thirds and seven were at the junction of the middle and lowest thirds (Fig. 3). The types of nail used were one Hodgkinson, thirty-three Küntscher and sixteen Müller. Nineteen patients had “blind” nailing and thirty-one had “open” nailing.

Twenty patients were operated on within the first twenty-four hours, usually soon after admission. Twenty-three patients were operated on two to seven days after admission and seven patients one week or more after admission. Forty-three of the patients had fractures of the fibula as well. Four had a fractured femur and two had fractures of both tibiae. The open fractures were—as is the practice in this Centre—divided into three types according to the severity of the wound and soft-tissue damage: *Type 1*: puncture wound, so-called technically open; *Type 2*: moderately compound with a 2.5–5 centimetre wound; the bone may or may not protrude; *Type 3*: severe lacerated wound with considerable tissue damage and possibly skin loss (Table I). *Type 1* fractures have been treated as though they were closed and there has been no hesitation in inserting a nail if indicated, with due attention to surgical toilet and antibiotic cover. In *Type 3* fractures a nail was used whenever possible because it was

thought that firm fixation of these fractures gave the soft-tissue injuries the best chance of primary healing, especially if a skin graft had been necessary. Nailing of Type 2 fractures is the subject of controversy. At this Centre recently they have been nailed more and more often, and the results have been encouraging. Originally they were treated conservatively in the first instance, with a view to nailing when the wound had healed. Difficulties were encountered with this delayed technique, mainly from shortening and from either inadequate or delayed healing of the wound (Tables II and III).

TECHNIQUE OF NAILING

Various techniques and various nails and appliances have been tried. We concluded that Müller nails and the Müller flexible reamer are much the easiest to use (Müller, Allgower and Willenegger 1965). The length of the nail is measured on the opposite leg before operation: it is taken as the distance between the tibial tubercle and upper end of the medial malleolus, or just above the joint line. We now always expose the fracture site and hold the fragments with forceps in the anatomical position with the knee bent over the end of the table at 90 degrees. It is advisable to use hand reamers before introduction of the olive-ended guide wire. After reaming, the plain-ended guide wire is substituted and the nail is introduced just proximal to the tibial tuberosity and the end is buried in the bone. The thread in the nail permits removal at a later date if indicated.

Reaming of the canal is usually carried out to admit an 11 or 12 millimetre nail, the diameter of the nail being 0.5 millimetre less than that of the drill. Adequate reaming is essential, otherwise the fracture will not be firmly held. A firm hold is all-important: if it is not achieved external splintage with a plaster is necessary and this defeats one of the main objectives of nailing—namely, early joint movement. Firm fixation is also necessary to prevent rotation of the lower fragment. If a butterfly fragment is present it may be advisable to fix this in position with a circumferential wire. At wound closure suction drainage is used.

FIG. 3
Sites of fracture.

MANAGEMENT AFTER OPERATION

The patient remains in bed for a few days with the leg elevated, and active joint movements are encouraged and supervised by a physiotherapist, nurses and surgeon. The wounds are left exposed on about the fourth day after operation. Primary wound healing is to be expected and the patient usually sits out of bed during the first week. Patients are allowed to bear weight as soon as they can do so comfortably, usually after ten to fourteen days. Early weight-bearing impacts the fragments, correcting any distraction which may be present, and may expedite union. The patient usually leaves hospital in the third or fourth week after operation.

TABLE I
TYPES OF FRACTURE

Type of fracture	Number of patients
Closed	28
Open	
Type 1 Mild . .	8
Type 2 Moderate	8
Type 3 Severe .	6
Total	50

TABLE II
DEGREE OF COMMINATION

Degree of comminution	Number of patients
None	15
Mild	15
Moderate	18
Severe	2
Total	50

TABLE III
DEGREE OF DISPLACEMENT

Degree of displacement	Number of patients
None	1
Mild	11
Moderate	26
Severe	12
Total	50

Early in the series fourteen patients had to have external splintage in the form of a back slab or full plaster in order to prevent rotation, the duration varying from one to eight weeks. This occurred if there was some rotation of the lower fragment after operation, usually from

inadequate reaming, or if there was not sufficient contact between the fragments—as occurs with some comminuted fractures.

FIG. 4

Time taken for radiological union. Average four months.

FIG. 5

Time to return to work. Average four and a half months.

RESULTS

Clinical union occurred usually in the third month and the average time for radiological union was four months (Fig. 4). The average time which elapsed before return to work was four and a half months for forty-three patients (Fig. 5). The remaining patients were retired or housewives.

Authors' assessment—Results were graded as follows. *Excellent*: normal function with no remaining symptoms; *Good*: sound bony union in normal position and alignment without shortening but with occasional discomfort during certain activities, particularly kneeling; *Fair*: bony union in good position but with shortening and with prolonged discomfort; *Poor*: moderate loss of function with shortening. These results are shown in Table IV.

COMPLICATIONS

Four patients complained of moderate pain in the tibia and corresponding knee. Eight patients complained of tenderness over the site of introduction of the nail, usually on kneeling. In these the nail, which was not well embedded, was removed. There were three wound infections, all in open fractures. All subsided; none caused persistent signs of bone infection; and in two the nail was removed. One patient had persistent equinus deformity. Two patients developed clawing of the toes, ascribed to mild ischaemia. Two patients had temporary peroneal palsy.

TABLE IV
RESULTS—AUTHORS' ASSESSMENT

Result	Number of patients
Excellent .	39
Good .	8
Fair .	2
Poor .	1

Three patients had shortening of over 2.5 centimetres. Two of these had open fractures of the tibia with comminution and one had an open fracture of the femur as well. One had slight posterior angulation but good function. In another, a fibrous nodule which developed at the site of insertion of the nail was excised.

DISCUSSION

The excellence of the results of intramedullary nailing of femoral fractures is so impressive that it was thought that equally good results could be achieved by nailing appropriate tibial fractures.

The fact that non-union of fractures treated in this way seldom occurs is a great advantage. Patients who have developed non-union during treatment by other methods can obtain union expeditiously after reaming and insertion of a large nail, as practised on the Continent. Many surgeons like to avoid the use of plates and screws in the treatment of open fractures because, with their use, infection seems to be more prevalent. The use of intramedullary nails in large measure overcomes this difficulty. We were pleased to note that when infection did occur union took place readily and that after removal of the nail there was no residual bone infection.

Intramedullary nailing as a treatment for fractures of the tibia has not been widely used because of general satisfaction with closed methods, which are usually used on an out-patient basis. However, it is felt that the same indications for nailing should apply to the tibia as to the femur. The disadvantages, if any, are due to technical failure or over-ambitious use.

The trend towards this method in the treatment of open fractures is gaining ground. The advantages are obviously the absence of metal in the wound, the use of a relatively small incision and early mobilisation. By opening the fracture site one ensures more perfect reduction and rigid fixation. Quite often a piece of bone or flap of periosteum was found jammed between the fragments, making closed reduction difficult if not impossible. The theoretical possibility that interference with the blood supply by combined reaming and periosteal stripping would delay union has not materialised in practice. Nevertheless, the blind method may have certain indications, such as in pathological fractures.

It has also been found from experience that the upper end of the nail should be embedded in the bone because a slight protrusion often causes pain.

The fractures best suited for this kind of treatment are transverse mid-third fractures, as in the femur. In some cases a double fracture is ideally treated by this method. It is vital to hold both fracture sites rigidly to avoid disturbance of periosteal attachments during reaming and insertion of the nail, and the nail should be of a slightly smaller calibre.

It is a great advantage to obviate the use of external splintage, especially in the elderly. The early return of excellent joint function and the ability of patients to return to a nearly normal mode of life relatively soon after this injury constitute the attractive features of the method.

Some surgeons consider that it is dangerous to treat open fractures by internal fixation. We believe that in a modern theatre with modern techniques, drugs and after-care, intramedullary fixation for all groups of open fractures is not only safe and practical but the treatment of choice in early injury. At the beginning of this series we were so greatly encouraged by the ease and speed of recovery from nailing in the closed injuries that a few technically open fractures (Type 1) were also fixed in this way. The success of reduction and fixation of these fractures and the simplicity of the treatment of soft parts were equally good in these patients. Sepsis was not a problem. In Type 3 patients it was found that the difficulties and dangers in the treatment of soft parts greatly outweighed the risks of internal fixation. However, results in this series have shown that these risks were fully justified and that the rigid fixation of the fracture greatly facilitates skin cover, muscle function and mobilisation of joints. Having accepted that Types 1 and 3 should be nailed it is not a big step to sanction the fixation of Type 2 open fractures with metal which is not subcutaneous.

Indications for intramedullary nailing of the tibia—We believe that these are as follows: 1) Fractures in the middle third or junction of middle and lowest thirds. The procedure is best suited to transverse fractures but experience has shown that it is valuable also in oblique and spiral varieties. 2) Multiple injuries after adequate resuscitation: a) in patients suffering

from injuries to important internal organs, *b*) when the femur also is fractured in the same limb, *c*) with other multiple skeletal injuries. 3) Open fractures, as outlined. 4) Pathological fractures. 5) In elderly patients to avoid prolonged external splintage. 6) Fractures accompanied by extensive soft-tissue injuries.

SUMMARY

1. Fifty tibial fractures treated by intramedullary nailing during seven years have been presented. There were twenty-eight closed and twenty-two open fractures.
2. The use of the method for treating open (compound) fractures is discussed.
3. The indications for intramedullary nailing are outlined.

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