

Ender nails for segmental tibial fracture

Early weight bearing in 22 cases

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Twenty-two consecutive segmental tibial fractures were treated by Ender nails and early weight bearing. Sixteen fractures were closed and six open. All the fractures healed after an average time of 4 months. No infection was encountered. Slight malalignment of the distal metaphyseal segment occurred in 5 cases, but all of them had full knee and ankle function.

Since January 1979, we have used Ender nails and early weight bearing in all patients with a tibial shaft fracture, except when complicated by major vascular and nerve injuries. We report our experience with this method in segmental tibial fracture.

Patients and methods

There were 20 patients, 2 of whom had bilateral fractures; 12 were male and 8 female; the mean age was 44 (25-74) years. Sixteen fractures were closed and six were open. The fractures were also classified according to Figure 1. All were caused by traffic accidents (Table 1).

Surgical technique. Appropriate nail length was determined by measuring the distance between the knee joint and the medial malleolus on the intact leg. The nails were introduced through holes made with an awl on each side of the tibial tuberosity (Merianos et al. 1982). The reduction of the fractures was performed through a small skin incision over the intermediate fragment; and while keeping the reduction with a bone-holding forceps, we drove the nails into the distal fragment. In cases where there was a short intermediate fragment, one incision was enough for reduction of both fractures, while in cases with a larger fragment, we occasionally needed two

incisions for reduction. The position of the nails in the fractured tibia was verified radiographically.

Antibiotics were administered in open fractures for 2 weeks and in closed fractures for 1 week.

The patients were mobilized with crutches and encouraged to bear weight as tolerated. The majority of the patients started partial weight bearing approximately 10 days postoperatively, whereas those with bilateral fractures required 2 months to start partial weight bearing. All the patients remained hospitalized for 2 weeks and were subsequently followed at monthly intervals. The nails were removed after approximately 1 year. The mean follow-up time was 4 (1-5) years.

The evaluation of the results was made by assessing postoperative complications and the time required for fracture union. The criteria for healing was obliteration of the fracture by mature callus in at least three quarters of the circumference observed on anteroposterior and lateral radiographs (Figure 2; P. Merianos et al. 1985).

Results

All the fractures united; the average healing time was 16 (10-22) weeks. Open fractures and those with more than one segment required relatively long periods of time to unite (Figure 3). We did not observe any difference with regard to time of union between proximal and distal fractures (Figure 4).

No osteomyelitis occurred in this series (Table 1). Superficial infection occurred in 1 patient with

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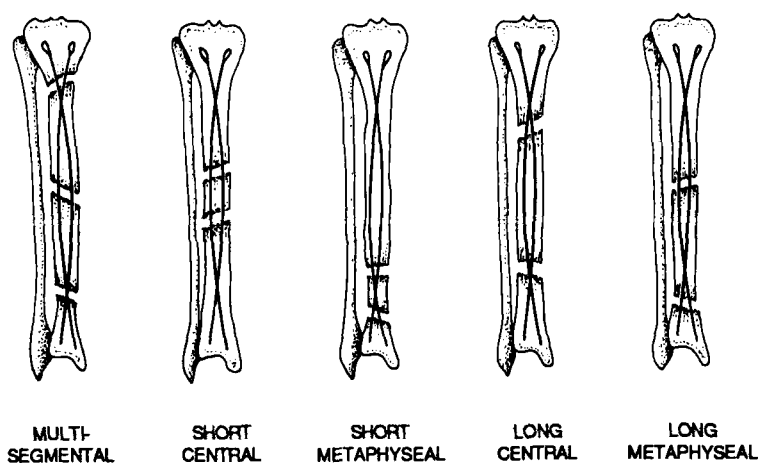


Figure 1. Different types of segmental fractures.

Table 1. Data from 20 patients with segmental tibial fractures

A	B	C	D	E	F	G	H	I
1	41	M	2	SMc	17	8	—	—
2	28	M	2	MLc	19	—	—	f
3	60	F	3	LCc	18	—	—	—
4	54	F	4	SCc	15	—	—	e
5	43	M	1	SMc	15	—	—	—
6	25	F	2	SCc	11	—	—	—
7	27	M	4	LCc	15	8	—	—
8	33	M	2	LMc	12	—	—	—
9	62	F	3	SMc	15	—	—	—
10	28	M	1	LMo	15	—	—	—
11	30	F	2	SCc	11	—	—	—
12	27	F	1	LCc	10	—	—	—
13	70	M	3	LMc	18	—	—	—
14	29	M	2	SCc	14	—	—	e
15	31	M	1	SMc	16	—	—	—
16	63	F	4	SMo	19	7	—	—
17	57	M	3	MLc	22	—	2	—
18	69	F	4	SMc	18	8	—	—
19	74	M	3	Sc	19	—	—	—
20	—	—	—	LCc	19	10	—	—
21	—	—	—	LMc	18	—	—	—
22	28	M	2	MLo	20	—	1.5	s

A Case number, | bilateral fractures.

B Age.

C Sex.

D Cause of injury: 1 motorcycle; 2 motorcycle-car; 3 pedestrian-car; 4 car passenger.

E Fracture type: L long; S short; C central; M metaphyseal; ms multisegmental; c closed; o open.

F Weeks healing time.

G Degrees angular deformity.

H Cm shortening.

I Other complications: e extrusion of nail; f fat embolism; s superficial infection.

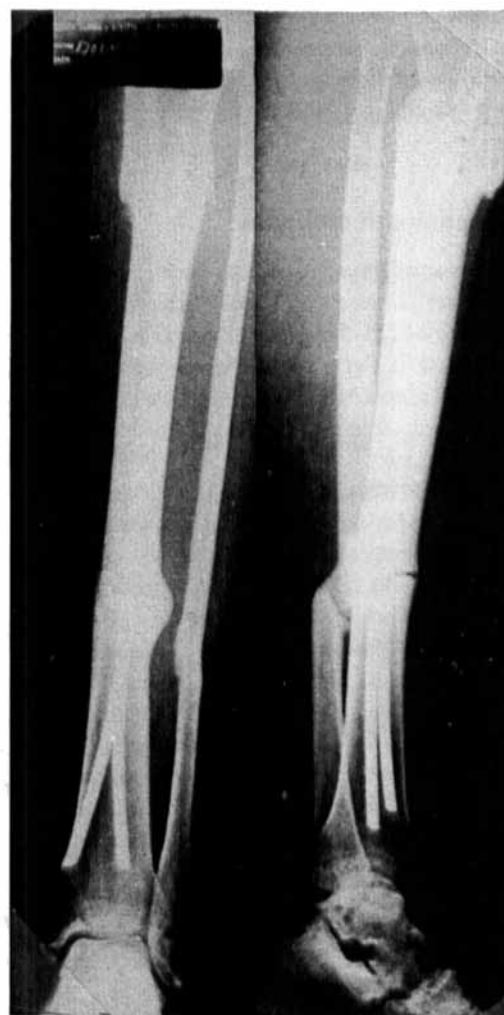


Figure 2. Case 3. The distal fracture has united at three-quarter's of the bone circumference.



Figure 3. Case 17. The multisegmental fractures healed in 6 months.

a compound injury; the infection subsided with antibiotics. A DIC syndrome was observed in 1 patient. In 2 cases the nail was too long and extruded through the medial malleolus. Angular deformity developed in cases with a short metaphyseal segment and in cases with a long central segment. No reoperations were performed and no nail failures were observed. At follow-up radiography an angular deformity $< 10^\circ$ was found in 3 cases, and clinical evaluation showed shortening of < 2 cm in 2 cases. No rotational deformity was observed. Knee and ankle motion were normal in all the cases. Slight discomfort at the fracture site was present in 2 cases.

Discussion

It has been shown clinically by several authors (Sarmiento 1972, Lanyon et al. 1982, Rubin 1982) and recently in an experimental work (Goodship and Kenwright 1985) that loading applied to a fracture may promote osteogenesis and formation of external bridging callus.

The method that we use for treating segmental tibial fracture does not seem to interfere with healing. In our series, we did not have a single case of nonunion. The mean healing time of 16 weeks compares favorably with that reportedly by others (Zucman and Maurer 1969, Langård and Bø 1976, Melis et al. 1981). We attribute the relatively



Figure 4. Case 6. These fractures healed in 3 months.

rapid healing to the formation of external callus promoted by the stimulus of movement at the fracture site during weight bearing.

No deep-wound infection was encountered in our cases, which may be attributed to the atraumatic handling of the soft tissues (Önnerfält 1978). The main advantage of the method is the functional use of the limb postoperatively permitting normal knee and ankle movement, preserving muscular power of the injured limb.

The most common complication observed with our method was slight malalignment of the distal

fragment, which, however, seemed functionally insignificant (Harvey et al. 1975, Nicoll 1964, Dehne et al. 1961). This happens because during the driving of the nail through the distal fragment the tip of the nail is pushed against the cortex causing slight angular deformity at the level of the distal fracture. Substantial malalignment in segmental fractures of the tibia is rare because the middle segment can adjust itself to any position provided that the proximal and distal segments are in good alignment (Merianos et al. 1985).

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