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TIBIAL SHAFT FRACTURES

The Frequency of Local Complications in Tibial Shaft Fractures Treated by Internal Compression Osteosynthesis

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Ninety-two tibial shaft fractures in 90 patients over the age of 15 were treated by compression osteosynthesis according to the AO method, but using plates and screws of Vitallium®. Fifteen fractures (14 patients) were excluded, because the follow-up period was less than 12 months. The frequency of complications in the remaining 77 fractures, 44 per cent comminuted and 30 per cent open fractures, were: skin necrosis over the osteosynthesis material: 5.2 per cent, osteitis: 1.3 per cent, delayed osseous healing necessitating secondary operation: 2.6 per cent, loosened screw (not requiring secondary operation): 5.2 per cent, loosened screw + refracture: 1.3 per cent, plate bending: 1.3 per cent, plate fractured: 1.3 per cent, and refracture after removal of the plate (new relevant traumas): 4.8 per cent. In this series there was a markedly high frequency of complications in comminuted fractures with laceration of skin and muscles, whereas an increased tendency for complications to develop in the remaining injury groups was not seen.

Key words: AO compression osteosynthesis; delayed healing; infection, postoperative; refracture; tibial shaft fractures

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There is no ideal method of treatment for tibial shaft fractures but there are several apparently equally valuable methods available (Sarmiento 1974, Bauer & Hulth 1973, Karlström & Olerud 1973). The various methods of treatment should therefore be subjected to critical examination based on experience with large groups of patients but comparison is complicated by the different choice of treatment in the various centres. For this reason it is necessary that a greater number of smaller series be used to assess a method of treatment, despite the known difficulties in obtaining clear definitions.

This is a retrospective investigation of tibial shaft fractures treated by compression osteosynthesis according to the AO method (Müller et al. 1965, 1970), but using plates and screws of Vitallium®. The purpose has been to examine the frequency of osteitis, delayed osseous healing, and refractures prior to and after removal of the plate. According to some reports (Wade 1970, Bauer & Hulth 1973, Sarmiento 1974, Brown 1974), these complications occur with an unacceptable frequency.

PATIENTS AND METHODS

During the 9-year period 1968–1976, 183 fractures of the shaft of the tibia, in patients over the age of 15, were treated at the Department of Orthopaedic Surgery, Hjørring Hospital, Denmark. Ninety-two (50.3 per cent) were treated by compression osteosynthesis, 30 (16.4 per cent) were treated with other operative methods [osteotaxis with the Hoffman apparatus (13 cases),

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lag-screws, Rush pins, Eggers plates and one primary amputation] and 61 (33.3 per cent) were treated conservatively with, if necessary, closed reduction and immobilization in a high plaster cast.

Of the 92 tibial shaft fractures (90 patients) treated by compression osteosynthesis 15 in 14 patients were excluded because they had not been followed for at least 12 months. There were nine "tourists" who received secondary treatment elsewhere, three older patients (four fractures) who were dependent on continuous nursing care and two patients who died for reasons other than the fracture and the osteosynthesis. After exclusion of the above patients the material comprised 77 fractures.

The age and sex distribution is shown in Figure 1. Sixty-six fractures (85.8 per cent) were purely diaphyseal fractures; nine (11.7 per cent) also involved the distal metaphysis and two (2.6 per cent) the distal articular surface. All the 77 fractures were displaced. Table 1 lists the classification according to Edwards (1965). Longitudinal fractures were defined as fractures in which the fracture line formed an angle of less than 45° with the long axis of the diaphysis; transverse fractures were those with an angle of more than 45°. Almost 60 per cent were transverse fractures. Comminuted fractures were defined as fractures with a least one intermediate fragment larger than half the diameter of the diaphysis. Six (17.6 per cent) of the comminuted fractures were segmental. Twenty-three (29.5 per cent) were open fractures. 16 (20.8 per cent) with skin perforation and 7 (9.1 per cent) with skin and muscle laceration. Forty-seven per cent of the comminuted fractures were open, mainly transverse fractures.

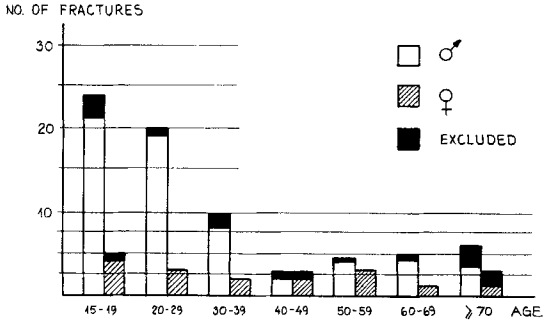

Figure 1. Age and sex distribution.

Eighty-two per cent of the fractures were operated on within 10 hours after the accident. Osteosynthesis in the remaining fractures was performed within 14 days. The operations were performed by 12 surgeons. Plates and screws of vitallium were used as axial compression plates or lag-screws combined with neutralization plates. Most of the plates were applied to the lateral tibial surface. In two comminuted fractures cancellous bone autografts were used in the primary operation to fill bone defects. In open fractures systemic antibiotics (penicillin, ampicillin) were administered beginning pre- or peroperatively and continuing for about 5 days or longer postoperatively. Most patients had postoperative supplementary plaster splintage for 10 days. After that a complete exercise programme was started. Full weight-bearing was allowed when the fracture clinically and roentgenologically was considered to be solid enough for walking without crutches.

RESULTS

Local complications which prolonged the healing time are presented in Table 2. Circulatory disturbances did not give any problems. Compartment syndromes were not seen.

Skin necrosis over the osteosynthesis material was observed in four cases. In three patients the implants were removed earlier

Table 1. Classification of tibial shaft fractures

		No. of fractures	Percentage of whole material	No. of comminuted fractures	Percentage of whole material
Longitudinal	closed	24 (28)	31	10 (11)	13
	open	7 (9)	9	5 (6)	7
Transverse	closed	30 (36)	39	8 (8)	10
	open	16 (19)	21	11 (13)	14
Total		77	100	34	44

(—) before exclusion of 15 fractures.

Table 2. Local complications following compression osteosynthesis in 77 fractures

	Longitudinal fractures		Transverse fractures		Total	Per cent
	closed	open	closed	open		
Skin necrosis over osteosynthesis material	1		2	1	4	5.2
Osteitis				1	1	1.3
Delayed osseous healing	1			1	2	2.6
Loosened screw	2			2	4	5.2
Loosened screw + refracture		1			1	1.3
Bent plate	1				1	1.3
Fractured plate			1		1	1.3
Refracture after removal of plate*			3		3	4.8
Total	5	1	6	5	17	23.0

*62 fractures followed for at least 12 months after removal of the plate.

than planned. The healing course was prolonged in two patients.

Osteitis occurred in one patient with an open transverse comminuted fracture with skin laceration. The osteosynthesis was performed within a few hours. A deep infection developed into osteitis despite continued administration of appropriate antibiotics, in accordance with bacterial sensitivity, and removal of the implants. Bone revision was done three times in combination with cancellous bone autografts and transfixation leading to healing.

In Figure 2 it can be seen that after 5 months 50 per cent of the patients were bearing full weight on the fractured leg. All patients except the one with osteitis were allowed full weight-bearing within 15 months. The "healing time" for comminuted fractures was markedly prolonged. Fifty per cent had their osteosynthesis material removed 19 months after the accident (Figure 3).

Delayed osseous healing necessitating a secondary operation was observed in two cases. Both were comminuted fractures in

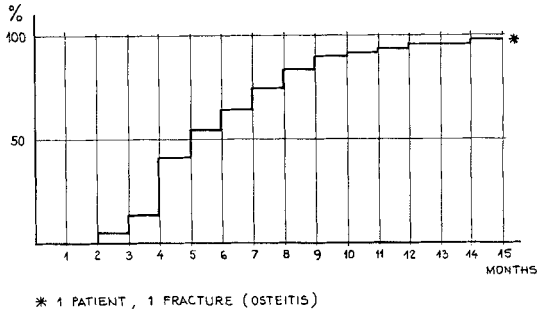

Figure 2. The time from accident to full weight-bearing (cumulated percentage).

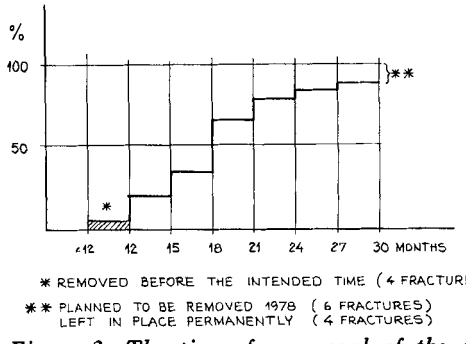

Figure 3. The times for removal of the osteosynthesis material (cumulated percentage).

elderly persons bearing weight on the affected limb earlier than intended. New osteosyntheses with bone grafts were done. Full weight-bearing was allowed 10 and 12 months after the injuries. Loosening of screws was brought about by weight-bearing before firm union. A new period without weight-bearing led to healing. Refracture and loosening of the implant was observed in one patient and was caused by a second injury 4 months after he had started full weight-bearing. Closed reduction and immobilization in a high plaster cast was followed by an uneventful course. Plate bending occurring before healing was caused by a new trauma. Secondary measures were not necessary. Plate fractures before solid union in a comminuted fracture occurred secondary to loosened screws and excessive weight-bearing. A second plating was performed without healing disturbances.

To assess the frequency of refracture after removal of the osteosynthesis material 12 months was chosen as the minimum observation time and only 62 of the 77 fractures had fulfilled this criterion. Refracture after removal of the implant was observed in three footballers and was caused by new relevant traumas during football matches 6 weeks, 5 and 11 months after removal of the implants, which were removed 12, 17 and 14 months after the injuries. In the first and second patient fissures had developed and high plaster casts were applied. The third showed a dislocation and a new osteosynthesis was performed. In this patient the screw holes had not healed in spite of the fact that a period of 11 months had elapsed since the removal of the implants. The three patients had not followed the advice which was given to all patients, i.e. to avoid forceful strain on the affected limb for $1-1\frac{1}{2}$ year after the removal of the implants.

Sufficient information about 13 ("tourists", patients dependent on nursing care) of the 15 excluded fractures has been obtained for periods from 10 to 48 months (on an average 18 months) after the traumas. On the basis of this information the only complication recorded was a case of delayed osseous healing necessitating a new osteosynthesis in an open comminuted fracture.

DISCUSSION

In the last few decades there has been a decreasing infection rate in both conservative and operative treatment of tibial shaft fractures (Karlström & Olerud 1974, Gustilo & Anderson 1976). Therefore comparison should be made between series from the same 5–10 year period. In this material one patient developed osteitis (1.3 per cent). In Olerud & Karlström's series from 1972 (135 fractures) four out of seven cases with deep infection developed into osteitis (3.0 per cent), and were treated by administration of antibiotics and seven secondary operations. Three of these occurred in open comminuted fractures. In the series of Solheim (1973), Thunold et al. (1975) and Jensen et al. (1977) the frequency of osteitis varied between 1 and 2 per cent. The frequency in rigid internal fixation of closed fractures is reported to be 1–4 per cent, whereas in open fractures it is 3–8 per cent (Karlström & Olerud 1974), in some series even higher (Gallinaro et al. 1974, 11 per cent; Rüedi et al. 1976, 11 per cent). Delayed rigid internal fixation 2–3 weeks after the injury reduced the frequency considerably when the soft tissue injuries were moderate (Solheim 1973, Aho & Hakkarainen 1974, Smith 1974, Gallinaro et al. 1974). In high-energy traumas with extensive injuries to the soft tissue, transfixation was recommended by Olerud (1973) and Gustilo & Anderson (1976).

The time from accident to full weight-bearing was a little longer in this material at the 50 per cent level (5 months) than in Olerud & Karlström's series (1972), which can be explained by a higher percentage of comminuted fractures in the material from Hjørring. At the 90 per cent level there was no difference. Delayed osseous healing, recorded as the number of fractures requiring secondary measures (osteosyntheses) to obtain bone union, was observed in 2.6 per

cent. This can be compared with Olerud & Karlström (1972) 4.4 per cent, Solheim (1973) 1.0 per cent, Thunold et al. (1976) 11.0 per cent and Rüedi et al. (1976) 1.9 per cent. In Solheim's series 50 per cent of the fractures were treated by delayed primary fixation and 13 per cent by secondary fixation because of delayed union after mainly conservative treatment. Smith (1974) showed that delayed osteosynthesis reduced the frequency of delayed union. This can explain the low frequency in Solheim's series. Thunold et al. classified the normal time to union as full weight-bearing stability within 4 months, which was gained by 75 per cent of the fractures. This could explain why 11 per cent needed a secondary internal fixation to obtain healing.

In the series presented here refractures were caused by new relevant traumas. One (1.3 per cent) was prior to removal of the plate and three (4.8 per cent) were observed after removal of the osteosynthesis material. In Olerud & Karlström's material (1972) these figures were 6.7 per cent and 4.1 per cent, respectively. The refractures before removal of the implant were caused by non-rigid osteosyntheses and excessive weight-bearing. Refractures after plate removal were caused by slight and moderate traumas, in one case the fracture had not been completely united at the time of removal of the osteosynthesis material. Solheim (1973) and Jensen et al. (1977) observed a high rate of refractures after the removal of the osteosynthesis material (11–12 per cent) due to minor and major traumas. In their series the implants were removed 1 year after the operation. The 50 per cent level for the time of removal of the implants was in the material from Hjørring 19 months and in that from Uppsala (Olerud & Karlström) 17–18 months. It is likely that removal of the osteosynthesis material 1 year after the operation will cause a higher percentage of refractures than when it is removed 6 months later.

The operations in this series, were performed by 12 surgeons, nearly 30 per cent of the

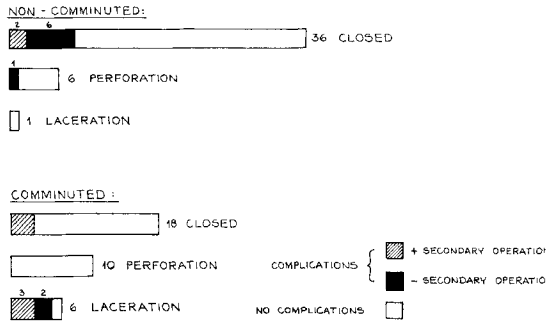

Figure 4. Comparison between the distribution of the complications in the whole material in relation to the extent of injury.

operations by younger residents, but under the supervision of an experienced orthopaedic surgeon. Several authors (for example Müller et al. 1970 and Olerud & Karlström 1972) have emphasized that the operation should be restricted to very experienced surgeons to reduce the frequency of complications.

In this series there was a markedly high frequency of complications in comminuted transverse fractures with laceration of skin and muscles, whereas an increased tendency for complications to develop in the remaining injury groups was not seen (Figure 4).

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