KÜNTSCHER INTRAMEDULLARY REAMING AND NAIL FIXATION FOR NON-UNION OF FRACTURE OF THE FEMUR AND THE TIBIA

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Rigid stability has long been the accepted major principle for treatment of non-union of shaft fractures (Müller, Allgöwer and Willenegger 1965; Böhler 1966; Müller 1966; Küntscher 1967). Until recently, methods of gaining stability have usually combined internal fixation by osteosyntheses and external fixation by plaster or traction (Boyd, Anderson and Johnston 1966). These methods have the disadvantage of further increasing the joint stiffness and muscle atrophy which usually accompany non-union. Moreover, the fixation does not allow weight-bearing, an important stimulus to fracture union. It was therefore interesting that Küntscher (Fischer 1965, Küntscher 1967) was able to improve on his method of intramedullary nail fixation by reaming the shaft to uniform diameter, thus ensuring such rigid fracture fixation that immediate joint movement and weight-bearing could be allowed even in cases of non-union (Maurath and Christ 1963).

This paper reports a consecutive series of thirty-five cases of non-union of femur or tibia, treated by the modern Küntscher method. Before operation some of these limbs were subjected to transfixation distraction for correction of shortening or mal-alignment (Küntscher 1967, Christensen 1970).

MATERIAL

During the period 1966–72 twenty femurs and fifteen tibias were operated upon (Tables I and II). The patients were young or middle aged. All the fractures were due to severe trauma, usually from traffic accidents. Two femurs and three tibias had open fractures. Six femoral fractures and three tibial fractures were comminuted. About half of the patients with femoral fractures sustained additional fractures. Most of the patients were referred from other hospitals and had had one or more operations before referral. The interval from initial injury to the operation here was from ten months to three years in most cases. The cause of non-union could not always be determined; inadequate initial internal fixation or infection was clearly responsible in some cases.

METHOD OF OPERATION

The Küntscher distractor was used before operation in four femurs and six tibias, usually for two to three weeks, to correct angulation or shortening.

Küntscher's (1967) technique was generally followed, but we found it easier to operate on the femur with the patient prone on the traction table rather than in the side position.

The guide wire, the reamer and the intramedullary nail were introduced through a 3–5 centimetre incision over the greater trochanter or the tibial tuberosity. The fracture area was opened only when necessary for passage of the guide wire or removal of internal fixation material from previous operations. The nail diameter was 14 to 18 millimetres for the femur and 11 to 14 millimetres for the tibia. Nine femurs and six tibias were nailed by the closed method.

Resection of bone in the area of non-union was never done. Grafting was done only once, two months after operation for a double fracture of the femur and then as treatment of residual rotational instability. The fibula was divided in ten of the patients with tibial fractures.

Post-operative treatment—Sufficient stability for full weight-bearing was gained in fourteen of twenty femurs and in nine of fifteen tibias. Three patients with stable femurs were restricted from walking because of infection or risk of infection. Six patients after femoral nailing

and six after tibial nailing had restrictions because of insufficient stability associated with double fractures or other residual rotational instability. Three of these femurs were supported with a plaster; one was treated with traction because of fracture of the proximal fragment associated with the nailing procedure. Four of the six tibias with inadequate stability were supported in plasters.

COMPLICATIONS

Post-operative infection occurred in five cases, at least three of which had had infection associated with the primary treatment. Four infections cleared up without removal of the nail until the fracture was soundly healed. In one case in which the nail end impeded knee movements the nail was extracted before full fracture healing. Treatment of the infections included excision of sinuses at the fracture site, and where the nail had been introduced, removal of sequestra and administration of antibiotics both systemically and locally through an irrigation tube introduced along the nail.

RESULTS

All fractures united. Operation performed in addition to the nailing procedure was directed against infection (see above), which could be kept quiet while the pseudarthrosis healed, but generally not eliminated until the nail was removed. After that time no flare-up of infection was observed. In one case, a grafting procedure was performed two months after nailing of a double femoral pseudarthrosis. Illustrative radiographs are reproduced in Figures 1 to 10.

DISCUSSION

The method of reaming to secure stable intramedullary nail fixation has been used by Küntscher for at least fifteen years (Fischer 1965) but seems to have won little response outside Germany until recently (Böhler 1966, Laurent and Langenskiöld 1967). One explanation may be the experience of failures after nailing without reaming (Palmer 1951, Koslowski and Weller 1962). For example, nine of our patients with non-union had primarily been treated with simple Küntscher nailing, five with Rush pins. Another reason may be reluctance to apply such radical treatment of the medullary cavity, the consequences of which have been demonstrated in animal experiments (Danckwardt-Lillieström 1969). There is, however, no clinical evidence that reaming has any adverse effect on the healing of fractures. As regards the soft tissues the method is considerably less traumatic than other open procedures.

If the Küntscher procedure is used only in cases of mid-shaft fractures with good soft-tissue coverage and without infection, few problems are likely to arise. In this series the indications were widened to include previously infected cases (MacAusland and Eaton 1963), double fractures, shortened fractures, and fractures relatively close to the hip, knee or ankle joints. In these cases we found it necessary to modify the treatment before and after the operation to counteract shortening or infection and in some cases to provide additional stability by external fixation with plaster, particularly in patients with severe osteoporosis. Provided these individual problems are adequately handled, the Küntscher method compares favourably with earlier methods. However, the operation may demand considerable technical skill and patience (Koslowski and Weller 1962, Laurent and Langenskiöld 1967). Undoubtedly experience facilitates a successful operation. It is necessary to be fully acquainted with the technique and the details of the instruments: a complete set of nails in all available lengths and diameters must be at hand.

The capacity for remodelling in non-union is astounding (Böhler 1966, Küntscher 1967). After rigid fixation and resumed function of the limb, healing was observed to proceed without additional stimulating measures even in severely sclerotic bone. Gaps were bridged and remodelling according to Wolff's Law was observed. Old "elephant foot" type pseudarthroses gave better fixation of the nail and healing seemed to proceed faster than in cases with lack of reaction in the fracture area and with osteoporosis.

TABLE I
RELEVANT DETAILS OF TWENTY CASES OF NON-UNION OF FEMORAL FRACTURES

Case number	Age (years)	Sex	Interval between accident and nailing for non-union	Earlier treatment	Distractor used	Closed nailing	Nail calibre (millimetres)	Infection Before operation	Infection After operation	Post-operative regime
1	18	Female	9 months	Intramedullary fixation		+	14	+	÷	Restriction (risk of infection)
2	19	Male	6 months	Closed			16			Weight-bearing unrestricted
3	19	Male	1 year	Intramedullary fixation + other metal	+		16	÷	+	Restriction (infection)
4	21	Female	14 months	Intramedullary fixation		+	16			Weight-bearing unrestricted
5	22	Male	13 months	Intramedullary fixation		+	17			Weight-bearing unrestricted
6	24	Male	15 months	Intramedullary fixation		+	17			Weight-bearing unrestricted
7	22	Male	8 months	McLaughlin nail-plate	+	+	17			Weight-bearing unrestricted
8	22	Male	10 months	Plate			16			Weight-bearing unrestricted
9	30	Male	9 months	Intramedullary fixation		+	18			Weight-bearing unrestricted
10	29	Male	9 months	Intramedullary fixation		+	15			Weight-bearing unrestricted
11	35	Male	15 years	Plate + wires	+		16	+	+	Restriction (infection)
12	41	Male	9 months	Closed reduction			15			Plaster cast (double fracture)
13	40	Female	3.5 months	Closed reduction	+		15			Traction
14	53	Male	4 months	Closed reduction			14			Plaster cast (double fracture)
15	61	Male	21 months	Intramedullary fixation + other metal			17	÷	+	Restriction (infection)
16	26	Male	5½ years	Intramedullary fixation			16			Weight-bearing unrestricted
17	22	Male	10 months	Closed reduction			15			Restriction (proximal, oblique)
18	39	Female	24 years	Intramedullary fixation	+		15			Weight-bearing unrestricted
19	61	Female	2½ years	Plate			15			Plaster cast (hip arthrodesis + osteoporosis)
20	18	Male	13 months	Intramedullary fixation			16			Weight-bearing unrestricted

TABLE II
RELEVANT DETAILS OF FIFTEEN CASES OF NON-UNION OF TIBIAL FRACTURES

Case number	Age (years)	Sex	Interval between accident and nailing for non-union	Earlier treatment	Distractor	Fibulotomy	Closed nailing	Nail calibre (millimetres)	Infection Before operation	Infection After operation	Post-operative regime
21	18	Male	7½ months	Closed		+	+	14			Weight-bearing unrestricted
22	22	Male	3 years	Closed	+	+		11			Weight-bearing unrestricted
23	24	Female	2½ years	Intramedullary fixation			+	12			Weight-bearing unrestricted
24	23	Male	22 months	Graft	+	+		13			Weight-bearing unrestricted
25	28	Male	10 months	Screws				?			Restriction
26	39	Male	21 months	Intramedullary fixation		+		13			Plaster cast
27	50	Male	10 months	Wires				14			Restriction
28	58	Male	3 years	Drilling	+	+		13			Weight-bearing unrestricted
29	56	Female	7 months	Closed				12		+	Plaster cast
30	61	Male	15 months	Screws	+	+	+	14			Weight-bearing unrestricted
31	64	Male	10 months	Closed		+		12			Weight-bearing unrestricted
32	18	Male	13 months	Intramedullary fixation			+	12			Weight-bearing unrestricted
33	51	Female	7 months	Transfixation	+	+	+	13			Weight-bearing in plaster
34	48	Female	11 months	Transfixation	+	+		13			Weight-bearing in plaster
35	66	Male	1½ years	Wires			+	12	+	+	Weight-bearing unrestricted

FIG. 1

FIG. 2

Case 30. Figure 1—Non-union fifteen months after injury in a man aged 61.
Figure 2—After treatment in distractor.

FIG. 3

FIG. 4

Case 30. Figure 3—Radiograph soon after operation. Figure 4—Radiograph one year after operation.

FIG. 5

FIG. 6

FIG. 7

Case 9. Figure 5—Non-union of femoral fracture nine months after injury in a man aged 30. Figure 6—Radiograph soon after operation. Figure 7—Radiograph seven months after operation.

FIG. 8

FIG. 9

FIG. 10

Case 1. Figure 8—Non-union of femoral fracture eight months after injury in a woman aged 18. Infection under control. Figure 9—Radiograph soon after operation. Figure 10—Five months after operation showing the gap partly filled. There was no recurrence of infection after operation.

SUMMARY

1. The Küntscher method of intramedullary reaming and nail fixation was applied to thirty-five cases of non-union of the lower extremity, twenty femurs and fifteen tibias. A bone graft was generally not used.
2. Most of the patients were allowed to bear weight and to exercise the joints within a few days of the operation. Additional measures such as pre-operative surgery for infection or distraction of shortening were used in some cases.
3. The pseudarthrosis healed in all cases, even when infection was present. The nails were generally not removed until after healing had occurred.
4. It is concluded that the Küntscher method gives remarkably rapid consolidation and restoration of function even in difficult cases of non-union of shaft fracture, particularly of the femur.

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