Interlocking nailing of distal femoral fractures

28 patients followed for 1–2 years

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We treated 28 fractures of the distal femur with a Grosse-Kempf interlocking nail, and the patients were followed for at least 1 year. Five fractures did not unite, and the rest healed after 5 (3–7) months. Nail breakage was the most serious complication; and the more distal the fracture was, the more easily the nail broke. With the addition of a cast brace and protected weight bearing, a locked nail is a good type of fixation for distal femoral fractures down to 4 cm above the condyles.

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Treatment of distal femoral fractures has long been controversial; and over the past few decades, there has been a trend towards surgical treatment (Johnson and Hicken 1987). The invention of interlocking nails extends the range of indications for intramedullary nailing, because the distal end of the femur can be stabilized with two transverse screws (Acker et al. 1985, Kempf et al. 1985, Browner 1986, Klemm and Borner 1986).

We report a prospective series of distal femoral fractures treated with interlocking nailing.

Material and methods

From December 1986 through June 1988, 28 (23 men and 5 women aged 36 [16–61] years) consecutive distal femoral fractures were treated at our hospital with closed reduction and internal fixation with a Grosse-Kempf interlocking nail. The majority of the fractures were due to motorcycle accidents, and associated injuries were common. Only three fractures were caused by moderate trauma after a fall at ground level. Six open fractures, Type I or II (Gustilo and Anderson 1976), were debrided and treated with intravenous antibiotics for 3 days. All the fractures were treated with upper tibial skeletal traction for about 1 week, after which time the fractures were operated on electively.

We divided the femur from below the lesser trochanteric to above the condylar area into five zones (Figure 1), and fractures in zones 4 and 5 were included provided the fracture in zone 5 was at least 4 cm above the condyle (Figure 1).

The patients were operated on in the supine or lateral position depending on the surgeons' preferences. All the nailings were performed closed. If the fracture was intraarticular, closed Knowles pinning was performed to stabilize condylar fragments initially. In 15 fractures the nail was locked at both ends (static fixation), and in the rest only distally (dynamic

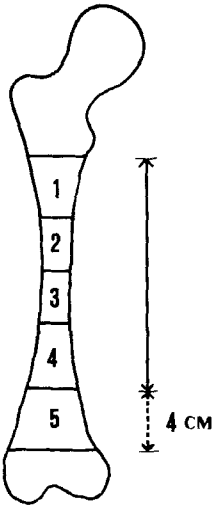

Figure 1. Five zones are divided from below the lesser trochanteric area to above the condylar area.

Table 1. Type of fixation in 28 distal femoral fractures

	Zone 4	Zone 5	Total
Static	11	4	15
Dynamic	8	5	13
Total	19	9	28

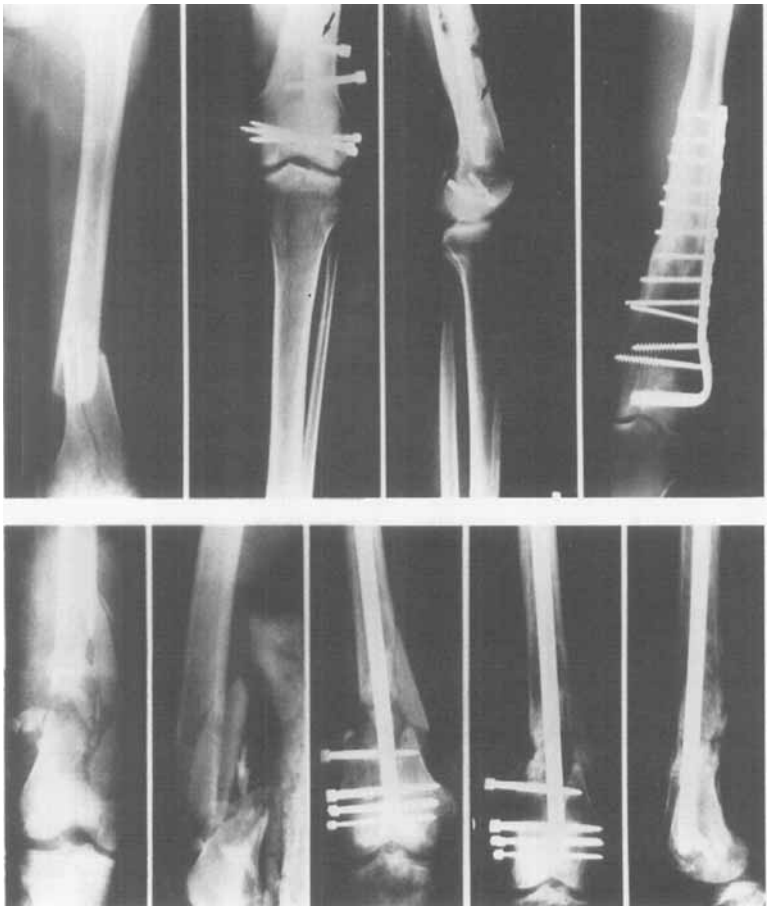

Figure 2. A 19-year-old man sustained a distal femoral fracture engaging zones 4 and 5. Knowles' pins were inserted after closed reduction, then static interlocking nailing followed. Too early full weight bearing broke the nail at the first distal hole. Revised with AO-angle blade plate and supplemented with a cancellous bone graft. Solid union after 7 months.

Figure 3. A 25-year-old man sustained a distal femoral fracture in zones 4 and 5. Knowles' pins were inserted after closed reduction, then static interlocking nailing followed. Delayed healing after 9 months was treated with a cancellous bone graft. Solid union after 6 months.

fixation; Table 1). The nail diameter was 12 or 13 mm, and the duration of the operation was 70 (40–150) minutes. If rigid fixation was not achieved, a cast brace was used. Patients with dynamic fixation were allowed partial weight bearing, but patients with static fixation were not allowed weight bearing until there was bridging callus formation.

The patients were followed up after 20 (12–30) months, and the clinical results were classified according to Schatzker and Lambert (1979).

Results

There were 4 cases of nail breakage: 1 in zone 4 and 3 in zone 5. They all united after fixation with an AO-angle blade plate and iliac cancellous bone grafting (Figure 2). Three fractures with intact nails did not heal: two in zone 4 and one in zone 5. They were treated with iliac cancellous bone grafting and two united (Figure 3). There were no deep infections or malalignments (angulation or rotation > 10°) and shortenings (> 2 cm).

Twenty-three fractures healed after 5 (3–7) months, with no difference in union rate between zones 4 and 5, and between static and dynamic fixation (Figure 4). The median range of knee motion was 120° (110°–140°) of flexion and 5° (0°–10°) of flexion contracture.

Excellent or good results were achieved in 22 patients (Table 2).

Discussion

Fractures of the distal femur constitute only 4 percent of all the femoral fractures (Kolmert and Wulff 1982). There are two peak incidences: one in young men after

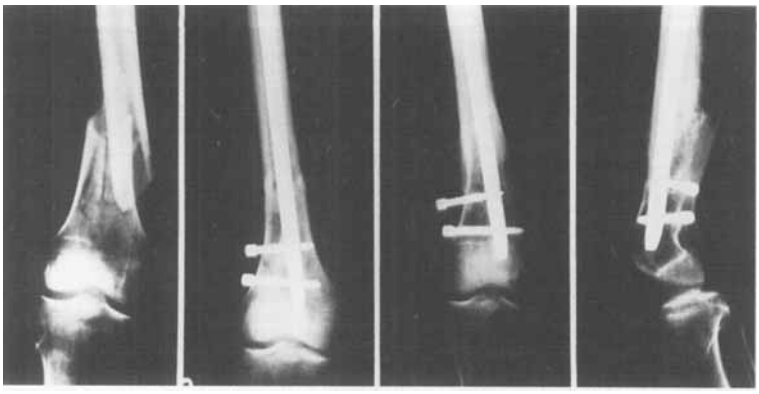

Figure 4. A 51-year-old man sustained a comminuted fracture in zone 5. A static interlocking nail was inserted after closed reduction. Bony union after 6 months.

Table 2. Reports on distal femoral fractures

	No. of fractures	Severe trauma	Median or mean age	Non-union	Implant failure	Deep infection	Excellent or good results
Cast bracing (Neer et al.1967)	48	?	54	0	0	0	43
Condylar blade plate (Mize et al. 1982)	30	20	47	0	0	2	24
Supracondylar compression plate (Pritschett 1984)	19	11	66	0	0	1	14
Semielastic nail (Kolmert et al. 1983)	29	13	65	1	1	0	21
Derby IM nail (Papagiannopoulos and Clement 1987)	26	16	44	0	0	1	24
Interlocking nail (this report)	28	25	36	5	3	0	22

severe trauma (mostly traffic accidents) and one in elderly women after moderate trauma. A stable fixation of the fracture is difficult to achieve in the latter patients, and the etiology of the fracture and the age of the patients must be considered when comparing different series.

Satisfactory results were obtained in only 15 out of 24 patients after various types of internal fixation, but in 43 out of 48 patients after traction-plaster treatment by Neer et al. (1967). The closed method of treatment is time-consuming and expensive, which explains the recent tendency towards internal fixation (Mize et al. 1982, Johnson and Hicken 1987, Moore et al. 1987). Basically, there are two types of internal fixation: 1) with a plate and 2) with an intramedullary nail. A supracondylar compression plate or condyle blade plate can give more stability than an intramedullary nail, but each necessitates open reduction. A larger wound, extensive soft-tissue dissection, and periosteal stripping may result in higher infection and nonunion rates. Concomitantly, cancellous bone grafting to promote bony healing in comminuted fractures is usually imperative. Moreover, a plate is a stress-shielding device that increases the risk of implant failure and refracture. Richards et al. (1984) reported a complication rate of 25 percent, mainly after plate fixation.

For distal femoral fractures, no satisfactory three-point-fixation effect can be achieved with an Ender nail or a Rush pin (Zickel et al. 1986). Even when modified by adding condylar cancellous screws (Kolmert et al. 1983) to prevent the nails from backing out, the result is still not better (Table 2), and a supplementary cast brace is needed. A Huckstep nail usually requires open reduction, and it is time-consuming to insert the transfixing screws (Huckstep 1986).

The indications for treatment of distal femoral fractures with an interlocking nail are fewer than for the screw-plate device. Fractures near the distal end and displaced intraarticular fractures are not suited (Johnson and Hicken 1987). Excellent or good results were achieved in three quarters of our patients, which is comparable to other techniques, with the reservation that fracture types and indications may have been different (Table 2).

The proximal slot end and distal nail holes of an interlocking nail introduce the potential for high stress concentration. Moreover, nicking the metal while drilling distal screw hole increases the possibility of implant failure. The increasing torque when the upper hole is near the fracture site also increases the possibility of nail breakage. For these reasons, Bucholz et al. (1987) suggested that a distance of at least 5 cm is necessary from the upper nail hole to the fracture. We extended the indication to 4 cm above the condyle. The two nail holes are 2.5 cm apart, and the lower hole must be proximal to the condyle. If not, penetration of 5 mm through the medial condyle to prevent dislodgment of the screw (Browner 1986) will irritate the skin; about 4 cm of bone above the condyle is necessary to hold the two screws.

When the nailing is performed closed, the fracture gap is filled with a bone graft, and the periosteal vascularity is preserved. With a small wound and less surgical dissection, the rehabilitation program can be started early; but when the stability is doubtful, a cast brace should be used.

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