

Subtrochanteric femoral fractures treated with locked intramedullary nails

Experience from 31 cases

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We treated 31 proximal femoral shaft fractures, where the trochanteric area was intact, with Grosse-Kempf locked intramedullary nails. There were 19 men and 12 women with a median age of 24 (14-79) years. Sixteen fractures were comminuted and 11 were a component of severe multiple injury. No infections or other serious complications occurred. All the fractures healed within 40 weeks, with 16 results graded as excellent, 7 as good, 7 as fair, and 1 as

poor. Six fair results were due to difficulties in aligning the short proximal fragment. One patient with a fair and 1 with a poor result had excessive shortening of the femur.

We conclude that locked intramedullary nailing is a good alternative in these fractures and that the statical variant is preferable whenever the stability is uncertain.

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Subtrochanteric femoral fractures tend to be malaligned in varus by conventional intramedullary nailing (Sage 1968). Even strong nail plates have failed in these fractures, again with varus as the result (Johnson et al. 1968). The Zickel nail has given improved results, but seems to involve technical difficulties (Thomas and Villar 1986). Locked intramedullary nailing has also been used (Lansinger et al. 1988).

We analyzed our results of treatment of subtrochanteric femoral shaft fractures with locked Grosse-Kempf intramedullary nails.

Patients and methods

From 1982-1988 inclusive, we treated 156 femoral shaft fractures with Grosse-Kempf locked nails. Thirty-three of these fractures were located in the proximal shaft. One patient died of multiple injuries during the hospitalization. One patient was lost for follow-up after changing residence.

The series thus comprised 19 men and 12 women with a median age of 24 (14-79) years. Table 1 gives details on trauma energy, wound, fracture type, injury severity score, and the like.

The operation seance was started immediately after admission in 12 patients, 6 of them being multiply injured. Seven further operations were performed

during the first day, 8 during the first week, and the remaining 4 during the first month. Preoperatively, the fractures were kept in tibial pin traction in a Braun splint.

Operative technique. This was as described previously for femoral fractures (Alho et al. 1991). Some details need emphasizing concerning the subtrochanteric fractures. The proximal fragment has a tendency to undergo flexion and varus malalignment. The former tendency is due to the muscle forces. It may be prevented by elevating the knee support so that the distal fragment also becomes flexed. This gives a further advantage, which is a reduced need for adduction. It is also important to get the introduction point of the nail right by using a curved awl for the cortical perforation and by checking its position in the image intensifier.

All our nailings could be done closed. A proximal locking screw was used in all the cases. In 12 cases, two distal screws were inserted by manual targeting. Twenty-eight nailings were done using the slotted nail and three using the nonslotted variant as a part of a comparative randomized study (unpublished results).

Aftercare. In the cases of multitrauma or open fracture, cefalotin or dicloxacillin was used for 3 days. All the patients received dextran-70 to prevent deep venous thrombosis. When the other injuries allowed, the patient was mobilized on a walker on the second postoperative day. Full weight bearing was allowed according to the pain assessment.

Table 1. Thirty-one proximal femoral fractures treated with Grosse-Kempf intramedullary nails

| A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S |
|----|----|---|---|----|---|---|---|---|---|----|---|---|---|----|-----|-----|---|---|
| 1 | 78 | F | 1 | 9 | 0 | 2 | 1 | 2 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 2 | 55 | M | 2 | 9 | 0 | 3 | 1 | 2 | 0 | 14 | 0 | 0 | 0 | 0 | -3 | 0 | 1 | 1 |
| 3 | 56 | M | 2 | 13 | 2 | 3 | 1 | 1 | 0 | 41 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 4 | 18 | M | 2 | 9 | 0 | 1 | 1 | 1 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 5 | 20 | F | 2 | 9 | 0 | 3 | 1 | 1 | 0 | 36 | 0 | 0 | 1 | -7 | -5 | +15 | 1 | 3 |
| 6 | 72 | F | 2 | 9 | 0 | 3 | 1 | 1 | 0 | 24 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 |
| 7 | 21 | M | 2 | 25 | 0 | 3 | 1 | 1 | 0 | 30 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 8 | 28 | F | 1 | 9 | 0 | 3 | 1 | 1 | 0 | 24 | 0 | 0 | 2 | 0 | -16 | 0 | 1 | 3 |
| 9 | 85 | M | 1 | 9 | 0 | 3 | 1 | 2 | 2 | 31 | 1 | 1 | 4 | -9 | 0 | 0 | 1 | 4 |
| 10 | 23 | F | 2 | 25 | 0 | 3 | 1 | 2 | 0 | 34 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 11 | 17 | M | 1 | 9 | 0 | 1 | 1 | 1 | 0 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 12 | 24 | M | 1 | 13 | 0 | 1 | 1 | 1 | 0 | 12 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 13 | 79 | F | 1 | 22 | 0 | 2 | 1 | 1 | 0 | 12 | 1 | 0 | 6 | 0 | 0 | 0 | 1 | 3 |
| 14 | 14 | F | 1 | 41 | 0 | 1 | 1 | 1 | 0 | 12 | 0 | 0 | 1 | +2 | 0 | 0 | 1 | 1 |
| 15 | 78 | F | 2 | 9 | 0 | 3 | 1 | 2 | 0 | 12 | 0 | 0 | 1 | -9 | +20 | 0 | 1 | 3 |
| 16 | 16 | M | 1 | 9 | 0 | 1 | 1 | 1 | 0 | 14 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 17 | 17 | M | 1 | 27 | 0 | 3 | 1 | 2 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 18 | 33 | M | 1 | 29 | 0 | 3 | 1 | 2 | 1 | 38 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 |
| 19 | 26 | M | 2 | 9 | 0 | 1 | 1 | 1 | 0 | 19 | 0 | 0 | 0 | -5 | 0 | 0 | 1 | 2 |
| 20 | 20 | M | 1 | 22 | 0 | 1 | 1 | 1 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | +20 | 1 | 3 |
| 21 | 17 | M | 1 | 9 | 0 | 3 | 1 | 2 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 22 | 74 | F | 2 | 9 | 0 | 1 | 1 | 1 | 0 | 17 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 23 | 19 | M | 1 | 9 | 0 | 1 | 1 | 1 | 0 | 42 | 0 | 0 | 0 | -9 | 0 | 0 | 1 | 3 |
| 24 | 17 | M | 1 | 9 | 0 | 2 | 2 | 1 | 1 | 19 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 25 | 24 | M | 2 | 22 | 0 | 3 | 2 | 2 | 0 | 12 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| 26 | 28 | M | 2 | 18 | 0 | 2 | 2 | 2 | 0 | 13 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| 27 | 21 | F | 1 | 13 | 0 | 3 | 1 | 2 | 0 | 18 | 1 | 0 | 1 | -9 | +9 | 0 | 1 | 3 |
| 28 | 61 | F | 2 | 9 | 0 | 2 | 1 | 2 | 0 | 29 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 29 | 18 | F | 1 | 22 | 0 | 1 | 1 | 1 | 3 | 43 | 0 | 0 | 0 | 0 | -9 | 0 | 1 | 2 |
| 30 | 28 | M | 1 | 25 | 0 | 1 | 1 | 1 | 4 | 27 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| 31 | 17 | M | 1 | 27 | 0 | 1 | 1 | 1 | 0 | 13 | 0 | 0 | 0 | -5 | 0 | 0 | 1 | 2 |

A Case no., in chronologic order of operation

B Age

C Sex

D Trauma energy
1 high
2 low

E Injury severity score
(Greenspan et al. 1985)

F Wound grade
0 closed fracture
2 open, Type II

G Type of fracture
1 transverse
2 oblique/spiral
3 comminuted

H Type of nail
1 slotted
2 nonslotted

I Type of locking

1 dynamic
2 static

J Complications

1 hematoma
2 fracture of the proximal locking screw
3 intraoperative splintering
4 peroneal neurapraxia

K Follow-up time, months

L Pain
0 no
1 moderate

M Edema
0 no
1 moderate

N Shortening, cm

O Malalignment, degrees.

- varus
+ valgus

P Malalignment, degrees

- antecurvature
+ recurvature

Q Malrotation, degrees

- internal rotation
+ external rotation

R Motion of the hip

1 full
2 flexion restricted by 30°

S End results

1 excellent
2 good
3 fair
4 poor

Follow-up. The patients were examined by the authors a median of 19 (12-43) months after the injury. Radiographs were used for the measurement of angular alignments. Otherwise, the result evaluation was clinical. The result was graded as excellent, good, fair, or poor (Alho et al. 1991).

Results

Fifteen patients could bear weight fully and without pain within 1 month, whereas the remainder regained full weight bearing between the second and fifth months.

Radiographic consolidation with solid callus, which surrounded most of the fracture, took place after a median of 14 (9-40 weeks). No nails were changed, and no bone grafts were used.

Table 2. Special features of femoral shaft fractures in different locations. The figures (percentages) are based on observations of 145 fractures

| | Proximal (n 31) | Mid-shaft (n 89) | Infraisthmic (n 25) |
|---------------------------|--------------------|---------------------|------------------------|
| Age (years) | 24 | 27 | 45 |
| range | 14-79 | 13-90 | 18-90 |
| Male | 61 | 59 | 36 |
| High-energy | 74 | 76 | 40 |
| Multiple injury | 35 | 27 | 20 |
| Open fracture | 3 | 11 | 20 |
| Comminuted | 48 | 40 | 40 |
| Varus 7°-9° | 13 | 4 | 0 |
| Shortening 2-4 cm | 13 | 6 | 20 |
| Recurvatum 11°-20° | 7 | 0 | 8 |
| External rotation 11°-20° | 7 | 6 | 8 |
| Excellent or Good | 73 | 88 | 78 |

The compilation is based, in addition to the present data, on our previously published results (Alho et al. 1991, Strømsø et al. 1990).

One or both distal screws were removed under local anesthesia because of local irritation in 3 patients after fracture consolidation. In 6 patients the nail was removed 18-24 months after the fracture. One nail was found broken at the upper end of the slot. This occurred after 1 year and after consolidation of the fracture.

Complications. One intraoperative splintering was associated with a 7° varus position of the proximal fragment. Two hematomas were evacuated 1 week after the operation. One peroneal neurapraxia due to intraoperative compression by a bar resolved totally. One proximal locking screw broke at 8 months, resulting in 9° varus. The lateral part of the screw was removed; but the varus could not be reduced, and a new screw was inserted and the fracture healed.

Outcome. In no case did the varus malalignment exceed 10°. Implant failure affected the result in only the 1 case with the broken screw and 9° varus.

The clinical results were graded as follows: excellent—16, good—7, fair—7, and poor—1. In 6 cases the fair results were due to malalignment in varus, recurvatum, or external rotation, or a combination of them. One dynamic nailing with gradual postoperative sliding of the nail resulted in a 6-cm shortening, and a fracture with comminution was nailed statically with a 4-cm shortening.

When malunion was defined as shortening > 2 cm, axial malalignment > 20°, internal rotation > 10°, or external rotation > 15°, the number of malunions was three. All three malunions occurred in the dynamically locked fractures.

Discussion

The pure subtrochanteric fractures with an intact lesser trochanter are obviously an entity more closely related to the mid-shaft fractures than to the trochanteric fractures, where the elderly dominate (Table 2). Although the fracture is often caused by high-energy trauma, wound complications are uncommon due to a voluminous muscle cover.

Locking of the Küntscher nail with screws has made it possible to align and stabilize fractures of the whole femoral shaft, even the comminuted ones (Küntscher 1968, Klemm and Schellmann 1972, Grosse, Kempf and Lafforgue 1978).

The results in the present series were not as good as the results of locked intramedullary nailing in the mid-shaft fractures (Alho et al. 1991). Although we had only one poor result, there were three malunions that could have been prevented by appreciating the malalignment tendency of the proximal shaft fractures and by taking full advantage of the locking of the nail, which should be made static whenever in doubt of rotational and longitudinal stability.

Although the distal shaft fragment is often long, allowing sufficient gripping by the nail, static locking should be preferred if any doubt of stability exists. Otherwise, an unstable fixation may unnecessarily postpone the weight bearing. Dynamic nailing can be recommended only in simple transverse fractures.

We had fewer implant failures than Thomas and Villar (1986), who used the McLaughlin nail-plate in one half of their subtrochanteric fractures. Also, we had fewer technical difficulties than they had in the other half of their series where they used the Zickel nail.

The healing of the proximal shaft fractures was unproblematic, and a radiographic union was obtained within 40 weeks in all the cases. Thus, the healing was more rapid than in our other femoral shaft fractures, where it could take 56 weeks (Alho et al. 1991). This explains why a late fatigue fracture of the slotted nail at the proximal end of the slot after the healing of the fracture did not affect the outcome.

Several types of locked nails are available and more are under development. For the proximal femoral shaft fractures, a slotted locked nail seems to be adequate. We did not find any advantage in using a nonslotted nail, which requires an extra millimeter of reaming (unpublished data). The stress riser point at the upper end of the slot may create problems if fracture healing is delayed, and improved construction of the upper end of the nail is needed.

We conclude that locked intramedullary nailing is a good alternative in high femoral shaft fractures provided that the trochanteric area is intact, so as to allow

adequate gripping by the nail and the screw, and provided that good alignment of the proximal fragment can be achieved.

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