Gamma nail vs compression screw for trochanteric femoral fractures

15 reoperations in a prospective, randomized study of 378 patients

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A total of 378 trochanteric and subtrochanteric femoral fractures were randomized to treatment with Gamma nail (177) or Hip Compression Screw (HCS) (201). After a median follow-up time of 17 (10–27) months, 15 patients needed reoperations; 13 had been treated with Gamma nail and 2 with HCS. 10 patients, all treated with Gamma nail, were reoperated because of a femoral shaft fracture. 5 of these fractures occurred 8 (4–10) days postoperatively and were related to intraoperative complications. The other 5 shaft fractures occurred a median of 2 (1–3) months postoperatively after falls, and may be related to stress concentration at the tip of the solid nail. The lag screw cut out or penetrated the femoral head in 5 patients, 3 of them treated with Gamma nail and 2 with HCS.

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Several methods have been used in the treatment of trochanteric fractures, but the hip compression screw (HCS) has gained increased use during the last decade. The clinical and biomechanical characteristics of the HCS and other sliding nail-plate systems are well known (Kyle and Wright 1980, Jensen 1981, Antin 1983). The results after treatment of stable trochanteric fractures have been good, with failure rates of 6 percent or less (Jensen 1981, Laros 1990). However, the failure rates with this device have been 5–12 percent in unstable per- and subtrochanteric fractures (Jensen 1981, Rao et al. 1983, Laros 1990, van der Schilden et al. 1990). Most of the failures are caused by the lag screw cutting out from the femoral head or by a telescoping displacement with medialization of the femoral shaft due to lack of lateral support for the proximal fragment (Jensen 1981, Davis et al. 1990, Ekeland et al. 1990a).

The newly introduced Gamma nail was supposed to have advantages in the treatment of unstable, trochanteric fractures. The femoral shaft fixation is nearer to the center of rotation of the hip with Gamma nail than with HCS, resulting in a shorter lever arm and lower bending moment on the device (Kaufer 1980). In addition, a telescoping displacement of the proximal fragment is prevented by the intramedullary placement of the nail (Ekeland et al. 1990b).

So far, studies comparing sliding nail-plate systems and Gamma nail in the treatment of trochanteric fractures have failed to show differences in the final clinical outcome (Bridle et al. 1991, Leung et al 1992). Therefore, the incidence of major complications becomes important. The purpose of this prospective, randomized study was to report the failures requiring reoperation.

Patients and methods

During 1990–92, 378 trochanteric fractures were randomized to treatment with Gamma nail (Howmedica) (177) or HCS (Smith & Nephew) (201). The randomization was done by drawing one among mixed envelopes containing information allocating the patient to either treatment. The study was approved by the Ethics Committee, University of Trondheim. A division of the treatment according to age, sex and fracture types is shown in Table 1. Fracture type was assessed by the methods of Jensen (1981) and Zickel (1976). The median follow-up time was 17 (10–27) months.

The operations were performed on a traction table under image intensifier control by residents with varying experience in intramedullary nailing. The surgeons were familiar with the HCS, as this device had been used as the standard method prior to the study.

All the Gamma nails were modified to a 6 degree valgus angle, 4 degrees less than in the standard nail. The slot for the lag screw had a 131 degree angle in

Table 1. 378 patients treated with Gamma nail or hip compression screw (HCS)

Treatment	Age	Women	Men	Stable trochanteric	Unstable trochanteric	Sub-trochanteric
Gamma nail	82 (49–96)	109	66	84	76	14
HCS	78 (45–93)	114	89	89	98	17
Total	81 (45–96)	223	155	173	174	31

relation to the shaft. The diameters of the nails used were 12 or 14 mm. The medullary canal was over-reamed 2 mm. In 119 of the 177 nailings (67 percent), distal locking screws were inserted through a jig.

A major complication was defined as a failure requiring reoperation, either a refracture of the femur or a cut-out of the lag screw causing increasing pain and disability. No other patients met these criteria without being reoperated.

The results are presented as the median with range. Differences were evaluated for statistical significance with the Fisher-Irvin test. $P < 0.05$ was considered significant.

Results

15 of the 378 patients (4 percent) needed reoperation, 13 treated with Gamma nail (7 percent) and 2 with HCS (1 percent) ($P < 0.003$) (Table 2). The median age of the reoperated patients was 77 (65–92) years, similar to the median of all the patients. 10 patients treated with Gamma nail (6 percent) were reoperated because of a femoral shaft fracture; 7 of them had distal locking (Table 2). Compared to the 119 of the 177 nailings where distal locking had been inserted, presence or absence of distal locking did not influence the femoral fracture risk. 5 fractures (3 percent) occurred early, 8 (4–10) days postoperatively and were related to intraoperative complications (Figure 1, Table 2). These fractures were localized along the nail or at the distal end of the nail. The fractures were caused by the wedge effect of the nail introduced by a hammer or through erroneously placed drill holes for distal locking. The other 5 fractures occurred a median of 2 (1–3) months postoperatively and were due to minor trauma (Figure 2, Table 2). These fractures were localized below the nail or at its tip.

The nail cut out of the femoral head in 5 patients, 3 treated with Gamma nail and 2 treated with HCS (Figure 3). This was due to an excessively high position of the lag screw in the femoral head.

Table 2. Complications requiring reoperation

A	B	C	D	E	F	G	H
1	65	M	1	1	1	7	1
2	72	F	3	1	1	8	1
3	82	F	2	1	1	10	3
4	87	F	2	1	1	10	1
5	88	F	1	1	1	4	2
6	74	M	1	2	1	66	4
7	76	F	2	2	1	30	4
8	79	M	1	1	1	100	4
9	88	F	1	2	1	67	4
10	92	F	2	1	1	43	4
11	77	F	2	1	2	180	5
12	70	F	1	1	2	30	5
13	76	M	1	1	2	84	5
14	73	M	2	3	2	370	5
15	89	M	1	3	2	132	5

A Case
B Age
C Sex
D Fracture type
  1 Stable trochanteric
  2 Unstable trochanteric
  3 Subtrochanteric
E Osteosynthetic device
  1 Gamma nail with distal locking
  2 Gamma nail without distal locking
  3 Hip compression screw (HCS)
F Type of complication
  1 Femoral shaft fracture
  2 Cut-out of the lag screw
G Time from operation to reoperation (days)
H Probable cause of failure
  1 Problems with distal locking
  2 Splintering during reaming
  3 Wedge effect of the nail. Use of hammer during introduction
  4 Minor trauma (fall)
  5 Lag screw position too high in the femoral head

8 of the femoral shaft fractures were treated with a modified Grosse Kempf intramedullary nail having standard distal locking and proximal locking with two 7 mm Ullevaal screws through the femoral neck and head.

None of the failures resulting in reoperations were related to infection.

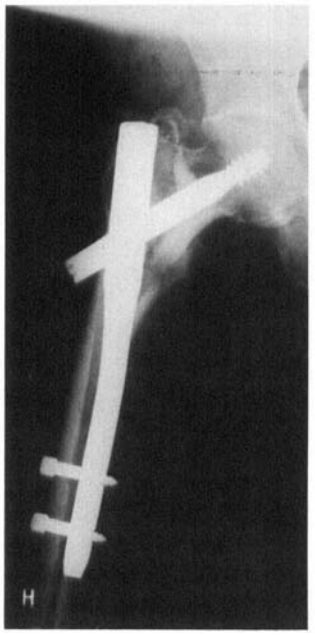

Figure 1. Case 3. Femoral shaft fracture in an 82-year-old woman detected one day after Gamma nailing. The femoral shaft was reamed 1 cm too short. The nail was hammered in the last cm and probably acted like a wedge.

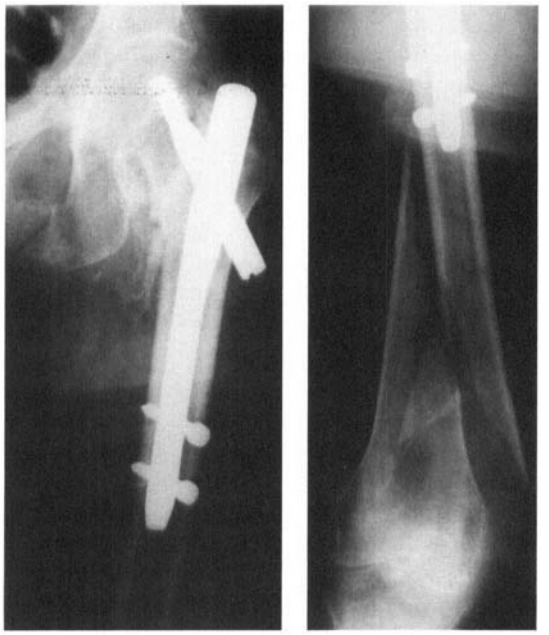

Figure 2. Case 10. A 92-year-old woman suffered a femoral shaft fracture after a fall 6 weeks after Gamma nailing.

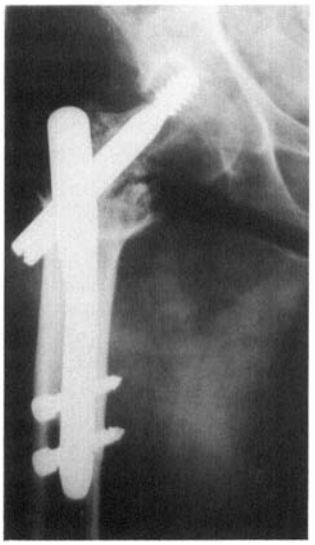

Figure 3. Case 11. Cut-out of the lag screw in a 77-year-old woman 5 months after Gamma nailing.

Discussion

In previous series, the incidence of a femoral shaft fracture after Gamma nailing has varied from 2–8 percent (Boriani et al. 1991, Bridle et al. 1991, Halder 1992, Leung et al. 1992). In our series, this complication was observed in 6 percent. The early postoperative fractures were due to technical, intraoperative errors. The drilling of erroneously placed holes for distal locking, the insufficient reaming and the introduction of the nail using a hammer can be reduced or abolished by greater familiarity with the implant system. However, trochanteric fractures are often treated by younger surgeons. Therefore, the learning curve becomes important, and insertion of HCS may have an easier learning curve than that of the Gamma nail. This is supported by our low rate of cut-out in the HCS group.

A modified nail where the mediolateral angle was reduced from the standard 10–6 degrees was used in this study (Benum et al. 1989). Additional modifications of the nail, as suggested by Leung et al. (1992), to one which is shorter and has a distal diameter of 11 mm, may reduce the intra-operative complications.

The drill holes for distal locking may reduce the torque strength of the femur. Burstein et al. (1972) reported a reduction in torsional strength of about 50 percent after drilling a 3.2-mm hole through the femo-

ral shaft. Located in the same area as the compressive load concentration, erroneously placed drill holes may increase the risk of femoral shaft fractures after Gamma nailing. However, the refracture rate was not increased after static (locked) nailings compared to dynamic nailings. Nor did the type of fracture influence the refracture risk.

The late postoperative femoral shaft fractures are more difficult to explain. Cadaver studies have shown that the solid Gamma nail imparts abnormal strains along the proximal femur. Thus, the compressive loads are low along the calcar and excessive around the end of the nail (Rosenblum et al. 1992). This reversal of the normal strain patterns of the intact femur is very similar to that seen with a femoral prosthesis (Oh and Harris 1978). The stress-riser situation may therefore be similar. In a Charnley-Hastings material, the frequency of femoral fractures under the prosthetic stem (2.6 percent) was about the same as that of the late fractures below the Gamma nails in the present study (Kok et al. 1992).

Cutting out of the lag screw seemed to be the result of a poor position of the screw high in the femoral head (Parker 1992). This complication occurred in 5–10 percent in previous reports (Davis 1990, Thomas 1991). Our rate was low (1 percent), and may be due to relatively few technical errors in this respect.

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