Early loss of fixation of femoral neck fractures

Comparison of three devices in 244 cases

Torstein Husby, Antti Alho, Lars Nordsletten and Wilhelm Bugge

In successive series of displaced subcapital femoral neck fractures in the elderly, we operated on 75 cases with three Gouffon screws, 94 with three Mecron screws, and 75 with two von Bahr screws. Redisplacement within 3 months occurred in 20 Gouffon cases, 11 Mecron cases, and 12 von Bahr cases. Poor reduction contributed to the failures in all the groups. Although the reduction results in the three groups were similar, the Mecron group had better fixation and better social recovery than the Gouffon group. We concluded that, in addition to good reduction of the fracture, solid screws also contributed to the stability of the bone-implant construct.

No consensus has been achieved concerning the osteosynthesis implants in subcapital femoral fractures (Barnes et al. 1976, Frandsen 1979, Høgh et al. 1982, Stappaerts 1985). In long follow-up studies the results deteriorate gradually (Massie 1973), but the frequency of failure is greatest in the early postfixation phase in the elderly (Stappaerts 1985). Frequencies of early failure of retention between 14 and 24 percent have been reported (Barnes et al. 1976, Brown and Court-Brown 1979, Stappaerts 1985).

Because stable early fixation is essential for an optimal late result, we studied this problem in an elderly population with reference to the social prognosis.

Patients and methods

We analyzed three consecutive series of elderly patients treated in 1984–86. The study was prospective. All the patients were operated on with the same method in a limited time period, one series following successively the other. Seventy-five fractures were operated on with three Gouffon screws (Howmedica, shank diameter 4 mm, wing diameter 6.4 mm), 94 with three Mecron screws (Mecron, shank diameter 5 mm, wing diameter 7 mm), and 75 with two von Bahr screws (shank diameter 5 mm, wing diameter 7 mm). The operations were done through a 2-cm skin incision. Technically, we aimed at calcar support medially for the distal screw(s). The proximal screw was put in as a lag screw (Figure 1). The series were similar concerning sex distribution and age. The social status at admission showed marginal differences (Table 1). All the fractures were displaced Garden 3 and 4.

Seventy-eight percent of the patients were operated on within 24 hours, and 94 percent within 3 days after the injury, with the timing being equally distributed within the groups. All the patients were allowed to bear full weight on the fracture immediately after the operation.

The results of fracture reduction were evaluated from the postoperative radiographs. In the AP view the varus/valgus tilt was assessed. In addition, the calcar neb of the proximal fragment was considered engaged when flush or proximally reduced in relation to the distal fragment of the femoral neck. The neb was considered disengaged when displaced distally. In the axial view the reduction was assessed as neutral when the midline of the femoral head tilted less than 5° to either side in relation to the axis of the femoral neck (Table 2). The results of the treatment were controlled clinically and radiographically 1 and 12 weeks after the injury.

Results

The postoperative reduction results in the three groups showed only marginal differences in varus/valgus and posterior tilting (Table 2). The medial neb engagement

Orthopedic Service, Ullevål Hospital, University of Oslo, N-0407 Oslo 4, Norway

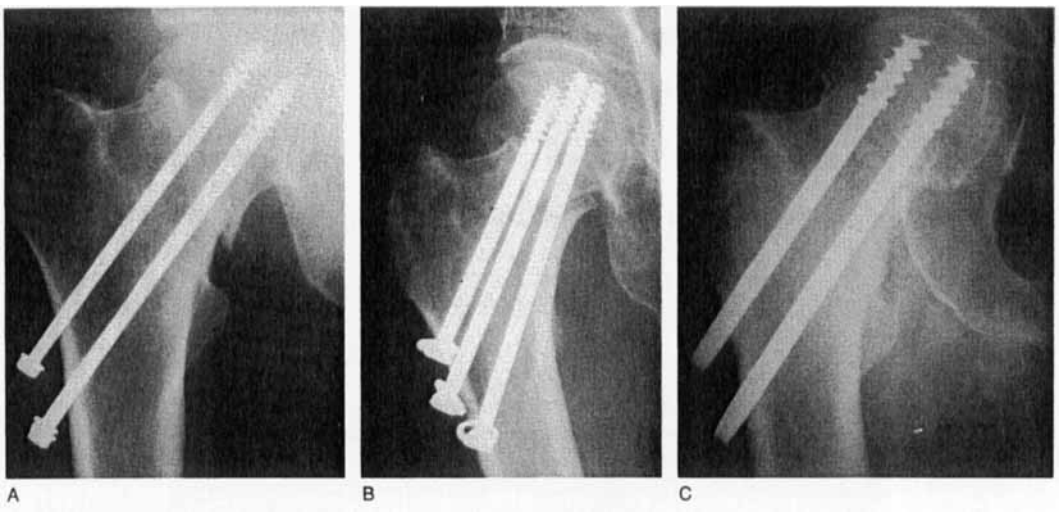

Figure 1. Three metal implants used in the fixation of femoral neck fractures.
A. Gouffon screws.
B. Mecron screws.
C. von Bahr screws.

Table 1. Totally, 244 displaced femoral neck fractures. When indicated the figures are mean (SD)

	Type of osteosynthesis		
	Gouffon (n 75)	Mecron (n 94)	vonBahr (n 75)
Female/male	60/15	83/11	62/14
Age of patients	81(6)	80(10)	82(6)
Living at home	59	72	47
Operation time, minutes	33(15)	46(23)	29(14)
Hospitalization,days	22(33)	24(50)	12(16)
Mortality within 12 weeks	10	6	5
Loss of retention within 12 weeks	20	11	12
Infections, deep	3	1	0
Ambulatory at 12 weeks	46	80	56
Returned home at 12 weeks	32	62	40

Table 2. Postoperative radiographic reduction results in 244 femoral neck fractures

	Type of osteosynthesis		
	Gouffon (n 75)	Mecron (n 94)	von Bahr (n 75)
AP view:			
Varus/valgus 0–10°/ valgus > 10°	5/68/2	6/86/2	8/66/1
Medial neb engaged Yes/No	66/9	76/18	52/23
Axial view:			
Tilting of caput < 5°/ > 5°	65/10	70/24	52/23

was somewhat better in the Gouffon and Mecron groups when compared with the von Bahr group ($P < 0.05$, chi-square test). The operation time in the Gouffon and von Bahr groups was shorter than in the Mecron group ($P < 0.001$, *t*-test, Table 1). The time used to reduce the fracture on the traction table was not recorded systematically.

The combined infection frequency was similar in the groups, average 2.2 percent; the deep infections were 1.6 percent (Table 1).

The quality of the osteosyntheses (screw positioning) showed marginal differences (Table 3). The most interesting difference was a better medial calcar support in the Gouffon group as compared with the Mecron and von Bahr groups ($P < 0.05$, chi-square test).

In the Gouffon group, there were 20 cases of early redisplacement due to mechanical failure (Table 1); this was more frequent than in the other groups ($P < 0.05$, chi-square test).

All but two of the redisplacements were reoperated on with a hemiendoprosthesis (32 fractures), total hip (5 fractures), or reosteosynthesis (4 fractures).

Six out of 20 fractures with early mechanical failures in the Gouffon group had a primary postoperative malalignment defined as varus/≥10° valgus and/or lack of medial neb engagement in the AP view and/or tilting in side view exceeding 5°. In the Mecron group 6/11 and in the von Bahr group 10/12 patients with early mechanical failure were primarily malreduced. Lack of an optimal primary reduction correlated positively with early redisplacement.

Table 3. Radiographic evaluation of screw position in 244 femoral neck fractures

	Type of osteosynthesis		
	Gouffon (n 75)	Mecron (n 94)	vonBahr (n 75)
APview: Screw position in femoral head (main vector), cranially/centrally/caudally	2/58/15	11/66/17	9/63/3
Axial view: Screw position in femoral head (main vector), frontally/centrally/dorsally	9/53/13	21/66/7	27/40/8
Angulation screws vs. femoral shaft <135°/135°–145°/>145°	2/53/20	4/71/19	5/57/13
Screw parallel ≤ ± 5°yes/no	65/10	87/7	58/17
Medial calcar support on distal screw (s), yes/no	67/8	65/29	51/24

At 3 months, 46 patients in the Gouffon group were ambulant with or without crutches. This was less than in the other groups ($P < 0.001$, chi-square test, Table 1).

In the Mecron and the Gouffon groups, 77 and 79 percent of the patients were admitted from their homes, respectively, as compared with 63 percent in the von Bahr group. After 3 months, only 43 percent of the patients in the Gouffon group and 53 percent in the von Bahr group were back in their homes, with significant difference from 66 percent of the patients in the Mecron groups ($P < 0.05$, chi-square test, Table 1).

Discussion

The healing disturbances in subcapital femoral neck fractures are often divided into nonunion and late segmental collapse. It is necessary to separate the early losses of retention within 3 months, also called early fixation failures, from the proper nonunions. They represent an entity in themselves, and appear in the early healing period where the term nonunion is not correct. The early losses of retention appear to have a relation to the method of fixation (Barnes et al. 1976, Brown and Court-Brown 1979, Stappaerts 1985). They appear also to have an association with the age of the patient (Stappaerts 1985), which nonunions may not have (Brown and Court-Brown 1979).

Our female-male ratio was about 4:1, or somewhat higher than in other reports (Linde et al. 1986, Engesæter and Søreide 1985). However, in an epidemiologic study of hip fracture in Norway including 2,109 patients, the female-male ratio was 4:1 (Falch et al. 1985).

The bone mineral content of the elderly is low compared with the average population (Husby et al. 1987b). The mechanical strength of the femoral neck is correlated with the bone mineral content, which is lower in women than in men (Alho et al. 1985). Thus, high age and high female-male ratio both accentuate the rate of primary mechanical failures, which are rare in the young.

We found that the Mecron technique was more time-consuming than the other devices, obviously because the Mecron screw is cannulated and has to be screwed over a guide pin. We also used three Mecron screws as compared with the two von Bahr screws. The operation time did not influence the morbidity postoperatively in our study (Table 1).

The difference in the retention results between the worst group (gouffon pins) and the best group (Mecron screws), in spite of similar reduction results in the three series, deserves attention. In our cadaver studies (Husby et al. 1987a), the fixation with two von Bahr screws with a wing diameter of 7 mm and a shank diameter of 5 mm was stronger than with three Gouffon screws (4-mm shank diameter, 6.4-mm wing diameter) and Knowles pins (shank diameter 3 mm, wing diameter 4 mm). Stappaerts (1985) reported a higher frequency of early fixation failures when less than six Knowles pins were used than when the number was six or more. It seems obvious that screws or pins with a diameter less than 5 mm are too resilient to maintain a strong fracture fixation.

Among the three types of osteosynthesis analyzed, three Mecron screws gave the best results, with 12 percent early fixation failures. In a series with a hip compression screw and a parallel AO cancellous screw, the frequency of early redisplacement was 7 percent (Alho et al. 1988), not significantly different from the present result. In our cadaver study (Husby et al. 1987a), two von Bahr screws gave as strong a fixation as the hip compression screw.

The follow-up period in this study was too short to be able to disclose all the healing problems. However, it seems obvious that an osteosynthesis that guarantees the best early result is favorable also in a longer follow-up.

References

Alho A, Husby T, Høiseth A, Fønstelien E. Bone mineral content and mechanical strength of the human femur. Finn J Orthop Traum 1985;8:56–7.

Alho A, Mölster A, Raugstad T S, Medby P C, Stray O. Sliding of the compression hip screw in femoral neck fractures. J Orthop Trauma 1988. In press.

Barnes R, Brown J T, Garden R S, Nicoll E A. Subcapital fractures of the femur. A prospective review. J Bone Joint Surg (Br) 1976;58(1):2–24.

Brown T I, Court Brown C. Failure of sliding nail plate fixation in subcapital fractures of the femoral neck. J Bone Joint Surg (Br) 1979;61(3):342–6.

Engesæter L B, Søreide O. Consumption of hospital resources for hip fracture. Discharge rates for fracture in Norway. Acta Orthop Scand 1985;56(1):17–20.

Falch J A, Ilebekk A, Slungaard U. Epidemiology of hip fractures in Norway. Acta Orthop Scand 1985;56(1):12–6.

Frandsen P A. Osteosynthesis of displaced fractures of the femoral neck. A comparison between Smith-Petersen osteosynthesis and sliding nail–plate osteosynthesis - a radiological study. Acta Orthop Scand 1979;50(4):443–9.

Frandsen P A, Andersen E, Madsen F, Skjødt T. Garden's classification of femoral neck fractures: An assessment of the interobserver variation in Garden's classification. Acta Orthop Scand 1986;57:596.

Husby T, Alho A, Høiseth A, Fønstelien E. Strength of femoral neck fracture fixation. Comparison of six techniques in cadavers. Acta Orthop Scand 1987a;58(6):634–7.

Husby T, Høiseth A, Fønstelien E, Alho A. Osteoporosis and stability of osteosynthesis of the femoral neck. Transactions 33rd Annual Meeting Orthop Res Soc 1987b;12:236.

Høgh J, Jensen J, Lauritzen J. Dislocated femoral neck fractures. A follow up study of 98 cases treated by multiple AO (ASIF) cancellous bone screws. Acta Orthop Scand 1982; 53(2):245–9.

Linde F, Andersen E, Hvass I, Madsen F, Pallesen R. Avascular femoral head necrosis following fracture fixation. Injury 1986;17(3):159–63.

Massie W K. Treatment of femoral neck fractures emphasizing long term follow-up observations on aseptic necrosis. Clin Orthop 1973;(92):16–62.

Stappaerts K H. Early fixation failure in displaced femoral neck fractures. Arch Orthop Trauma Surg 1985;104(5): 314–8