

Fixation of femoral neck fracture

A randomized 2-year follow-up study of hook pins and sliding screw plate in 222 patients

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We compared fixation with hook pins or sliding screw plate in a prospective randomized study of 222 patients with a cervical hip fracture. Radiographic evidence of early redisplacement, nonunion, or late segmental collapse was found in 43 of 122 patients operated on with two hook pins and in 40 of 100 patients operated on with the sliding screw plate. According to the actuarial method, the failure

rate after 2 years was 38% with hook pins and 46% with screw plates, which not is a significant difference.

Due to early redisplacement, reoperation with an endoprosthesis was performed within 0.5 (2) years in 11 (22) patients in the hook-pin group and in 4 (17) patients in the sliding-screw plate group.

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Good results after treatment of femoral neck fracture have been reported for both hook pins (Strömqvist et al. 1983) and the sliding screw plate (Clawson 1964, Frandsen et al. 1984, Nordkild et al. 1985).

We compared these techniques in a prospective, randomized study.

Patients and methods

During 1 year, 1984–1985, 265 patients with femoral neck fracture were admitted to the Orthopedic Department, Sahlgren Hospital, Gothenburg, Sweden. There were 199 women with a mean age of 78 (50–99) years and 66 men with a mean age of 74 (50–94) years. 2 patients died before surgery was performed. 2 patients were excluded because of pathological fractures and 13 patients were treated with a primary endoprosthesis because we were unable to reduce the fracture.

In displaced fractures, preoperative tibial pin traction was applied on admission. Internal fixation was performed as soon as possible; most patients were operated on within 24 hours of admission. Internal fixation was performed according to a random numbers table. The operations were done by 24 surgeons, 13 of whom performed more than 10 operations each.

Of the 248 patients entering the study, 23 died within 3 months after the operation without evidence

of failure and 3 patients moved away and were lost to follow-up, leaving 222 patients who were followed for 2 years, or until death or until some radiographic healing complication occurred. Two hook pins (Hansson 1982) were used in 122 patients and the sliding screw plate (Ambi, Richards AB) in 100 patients.

9 patients refused a radiographic examination 2 years postoperatively, but 5 of them were examined clinically.

Operation technique

The operations were performed under spinal anesthesia, with the patients placed on an extension table. Displaced fractures were reduced by the closed method using fluoroscopy. The mean duration of the operation with the hook pins was 24 (*SD* 16) min and with the sliding screw plate 34 (14) min ($p < 0.001$).

The patients were mobilized on the day after operation with full weight bearing. Prophylactic antibiotics were not used, but antithrombotic prophylaxis with Orstanorm with heparin was given for 1 or 2 weeks.

Follow-up

The patients were followed with radiographs at 1 and 6 weeks, 3 and 6 months and 1 and 2 years postoperatively. Those who had a failure were not followed further.

Table 1. Gender, fracture displacement, postoperative reduction and position of the fixation device in percent (95% confidence limits) in 122 patients operated on with hook pins and in 100 patients operated on with sliding screw plate

Fixation device	Female sex	Displaced fractures	Good reduction	Good position of the fixation device
Hook pins	76 (\pm 8)	61 (\pm 8)	65 (\pm 8)	68 (\pm 8)
Sliding screw plate	75 (\pm 8)	62 (\pm 10)	62 (\pm 10)	62 (\pm 10)

Radiographic assessment

The initial fracture displacement was classified according to Garden (1961). From radiographs taken at the operation, the quality of the reduction and the internal fixation were evaluated. The reduction was satisfactory if the A-P Garden angle was 160°–185° and if there was no anterior angulation or no more than 15° posterior angulation in the lateral projection. The position of the hook pins was considered unsatisfactory if all pins were placed in the upper half of the femoral head or if the pins were angled forwards in relation to the axis of the femoral neck in the lateral projection.

The position of the sliding screw plate was considered poor if the screw was placed in the upper and/or anterior third of the femoral head, if the screw was angled forwards in relation to the axis of the femoral neck in the lateral projection or if it was evident that the screw had rotated the femoral head during insertion.

Radiographic union was defined by the presence of bony trabeculae across an obliterated fracture line. Healing complications were recorded as early redisplacement (within 3 months), nonunion, or segmental collapse. Nonunion was diagnosed when redisplacement of the fracture occurred later than 3 months postoperatively or when no signs of union were seen at the last follow-up 2 years after the fracture.

Segmental collapse was diagnosed from the appearance of a clearly visible depressed segment of the femoral head.

Table 2. Failure rates after internal fixation of femoral neck fracture using hook pins or sliding screw plate. Failure was defined as radiographic evidence of early redisplacement, nonunion and/or late segmental collapse

Method	Number of patients assessed (percent failures)	
	Hook pins	Sliding screw plate
After a 2-year follow-up or until failure	96 (45)	74 (54)
Actuarial method	122 (38)	100 (46)

Statistics

The results are presented according to the actuarial method (Armitage 1971) and also traditionally after a follow-up of 2 years or until failure in each case.

In the 2-year follow-up, all 83 patients with a known radiographic healing complication were counted as failures, even if they had died. Patients with a known healing complication were compared with the 87 patients who at the 2-year follow-up had a healed fracture without any signs of late segmental collapse. The results in these 2 groups of patients were used to study—by multivariate analysis with Pitman's test and Mantel's test—the association between healing and various factors, i.e., the initial fracture displacement, the quality of reduction and of the internal fixation, the interval from the fracture accident to operation and the age and sex of the patients.

The chi-square test with Yates' correction and Fischer's exact test were used to study univariate correlations.

Table 3. The cumulative success rate of 222 femoral neck fractures operated on with hook pins or sliding screw plate

Fixation device	Interval (years)	Number at start	Number failed ^a	Number withdrawn		Cumulative success rate	SE(Px) ^b
				dead	lost to follow-up		
Hook pins	0-1	122	35	8	1	0.70	0.060
	1-2	78	8	15	2	0.62	0.074
Sliding screw plate	0-1	100	32	11	5	0.65	0.076
	1-2	52	8	9	1	0.54	0.101

^a Failure, see text in Table 2.

^b SE(Px) was calculated by Greenwoods formula.

Table 4. Failure incidence in 96 patients operated on with hook pins and 74 patients operated on with sliding screw plate, followed for 2 years or until failure

Fixation device	Garden stage	n	Early redisplacement (reop.) < 3 months	Nonunion (reop)	Segmental collapse (reop.)	Total compl.
Hook pins	1, 2	35	1 (1)	2 (1)	5 (2)	8
	3, 4	61	15 (11)	9 (4)	11 (5)	35
Sliding screw plate	1, 2	26	1 (0)	3 (1)	3 (1)	7
	3, 4	48	7 (5)	15 (9)	11 (3)	33
Total		170	24 (17)	29 (15)	30 (11)	83

Results

No difference was noted between the 2 fixation methods regarding gender, initial fracture displacement, postoperative reduction or position of the fixation device or (Table 1).

The mortality rate was 9 percent (25/265) within 3 months, 17 percent (46/265) within 1 year and 28 percent (75/265) within 2 years, with no difference between the types of osteosynthesis.

Of the 222 patients followed, 43 died without any known radiographic healing complication and 9 were lost to follow-up, leaving 170 patients who were followed for 2 years or until some healing complication occurred.

After 2 years, 43 of 122 fractures treated with hook pins and 40 of 100 fractures treated with the sliding screw plate had failed. The cumulative failure rates according to the actuarial analysis were 38 and 46 percent, respectively, among patients operated on with hook pins or the sliding screw plate. This difference was not significant (Tables 2 and 3).

39 patients were reoperated with an endoprosthesis (22 in the pin group and 17 in the screw plate group), 1 with resection of the femoral head and in 3 patients only removal of the fixation device. Of these 39 patients, 11 patients in the pin group and 4 in the screw plate group were reoperated with an endoprosthesis due to early redisplacement (Table 4).

By multivariate analysis, 4 factors were found to be associated with radiographic healing complications: an initially displaced fracture ($p < 0.001$), unsatisfactory reduction ($p < 0.001$), unsatisfactory position of the fixation device ($p < 0.001$) and female sex ($p 0.04$).

Discussion

We found no significant outcome differences between the fractures operated on with the hook pins and those fixed with the sliding screw plate. To show

with 90 percent certainty that the slightly better result we observed with the hook pins was significant would have required about 1300 patients in the study.

Our result with the hook pin fixation is inferior to that of Strömqvist et al. (1987). They reported 11 percent (34/300) secondary arthroplasties in their total series. We performed 16 percent (22/135) secondary arthroplasties in the hook pin series. In the study by Strömqvist et al. (1987), the operations were performed by 6 specially trained surgeons, which can explain their good results. In a later study of patients operated on with the hook pin, Nilsson et al. (1989) reported a reoperation rate of 16 percent, the same as in our investigation. In both of these studies, the operations were performed by all the members of the clinical staff.

Like Hermgren et al. (1992) we had a high rate of early redisplacement among patients operated on with hook pins.

The complication rate in our study resembled those in many other reports (Elmerson et al. 1988, Holmberg et al. 1990, Sernbo et al. 1990).

In 5 patients operated on with the sliding screw plate, postoperative radiographs showed that the femoral head had rotated on the neck. All of these fractures failed later, probably because of a damaged circulation. If the sliding screw is driven into the bottom of the drill hole, a very high rotational momentum can be forced on the caput (Elmerson et al. 1987).

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