

# Function after hook-pin fixation of femoral neck fractures

## Prospective 2-year follow-up of 191 cases

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Totally, 191 consecutive patients with femoral neck fractures during 1984 and 1985 had internal fixation with hook-pins and were prospectively investigated. Within 2 years, 62 patients had died and 47 had developed healing complications, 30 of whom had been treated with total hip replacement. Thus, 82 healed without complication. Forty-one of 47 patients without other handicaps affecting their walking ability considered their gait as good as it was preoperatively; 45 used no walking aids or a cane. Nine of 35 patients with a nonfracture-related disease affecting their walking ability managed to walk with or without a cane; 13 considered their walking ability unaltered compared with their prefracture state. Three of 82 patients complained of pain on walking and 2 of pain at rest. All but 1 could flex their hip 90° or more.

We believe that the function after internal fixation of cervical hip fracture with uncomplicated healing is superior to that achieved by primary hip replacement; primary replacement is recommended only in rheumatoid patients with displaced fractures.

Complications after internal fixation of femoral neck fractures will be encountered in 20–40 percent of the cases (Kofoed and Alberts 1980, Høgh et al. 1982, Holmberg et al. 1987, Strömqvist et al. 1987). In displaced fractures there still is a treatment controversy; many favor primary arthroplasty with a hemiprosthesis or total hip replacement. However, internal fixation may be preferred if (1) function with a healed fracture is superior to that achieved with a prosthesis; (2) secondary arthroplasty can be performed without excess mortality and gives good function; and (3) even when secondary procedures are included, internal fixation requires fewer hospital resources than does primary arthroplasty. The latter two criteria have proven to be met (Søreide et al. 1980, Hägglund et al. 1984, Nilsson et al. 1989). We have studied the function in patients with uncomplicated femoral neck fracture healing 2 years after internal fixation.

### Patients and methods

During the period May 1984 through October 1985, 204 consecutive patients from our catchment area (population 225,000) were admitted to our department with a fresh nonpathologic femoral neck fracture. Except for one displaced fracture in a rheumatoid patient, no primary arthroplasties were performed during this period; closed reduction was possible in all displaced fractures. Two patients died before osteosynthesis, and 10 patients were excluded because of lack of follow-up; thus 191 patients were left for analysis. Their mean age was  $79 \pm 10$  (34–98) years. The female/male ratio was 3.3/1, and one third of the fractures were undisplaced. The median hospital stay was 17 (1–131) days. Seventy percent of the patients were discharged to the same habitat as they came from. Sixty percent were admitted from independent living; of these, 71 percent were discharged to their original habitat, 7 percent to a convalescent home, 20 percent to geriatric hospitals or other departments, and 2 percent died before discharge.

Preoperative routines included pin traction through the tibial tuberosity in displaced fractures at admission, no prophylactic antibiotics, MacroDEX® anti-thrombotic prophylaxis, and operation on the day after

Figure 1. Hook-pinning of subcapital fracture.



Table 2. Number of reoperations (total hip replacement, nail extraction due to nonunion) and mortality in different age groups

Age	≤50	51-60	61-70	71-80	81-90	>90	Total
Patients (n)	5	7	22	61	84	12	191
Reop (n)	0	2	6	14	14	1	38
Fraction	-	0.3	0.3	0.2	0.2	0.1	0.2
Dead/2 y (n)	0	0	2	14	41	5	62

Table 1. Number of healing complications and reoperations after internal fixation for femoral neck fracture. Two years' follow-up

	No. of patients	Nonunion			Segmental collapse			Total		
		n	THR	Nail extr	n	THR	Nail extr	n	THR	Nail extr
Undisplaced	58	2	2	-	2	-	-	4	2	-
Displaced	133	41	23	8	10	5	-	51	28	8
Total	191	43	25	8	12	5	-	55	30	8

admission if no contraindications existed. Perioperative routines included general or spinal anesthesia, fluoroscopy, usually biplane, and an extension operating table. In all the cases, fracture fixation was performed by one of the 35 staff orthopedic surgeons with two hook-pins (PSAB, Gothenburg, Sweden; Figure 1) inserted in predrilled channels and retained with a hook (Strömqvist et al. 1983).

Postoperative routines included full weight bearing from the first postoperative day except in patients under 50 years of age with displaced fractures; these were prescribed a 6-week period of nonweight bearing. The follow-up protocol consisted of radiographic and clinical examinations at 1 week, and 4, 12, and 24 months.

The preoperative radiographs were staged according to Garden (1961); distinction was made between undisplaced Stages I and II fractures and displaced Stages III and IV fractures. Redisplacement/nonunion of the fracture (referred to as nonunions) and segmental collapse of the femoral head were designated radiographic healing complications.

The criterion for uncomplicated healing was solid union without alteration of the femoral head contour at

24 months. In mobile patients with symptomatic healing complications, a secondary total hip arthroplasty was performed; in immobile symptomatic patients, pin extraction only was carried out.

At follow-up, pain at rest and pain on walking were recorded as well as walking distance (stairs, long distance [ $>200$  m], short distance, none) and walking aids (none, cane, quadraped [including crutches and walker]). Disorders not related to the fracture impairing walking capacity and the patient's opinion of walking ability as compared with the prefracture status were also evaluated.

## Results

No mortality within 24 hours of the operation was recorded. Eleven patients died within 1 month and 62 (32 percent) within 2 years, 4 of whom with nonunion and 2 with segmental collapse diagnosed before death (Tables 1 and 2).

Six patients were reoperated on with hook-pins

Table 3. Walking capacity of patients without healing complications 2 years after primary osteosynthesis. Patients with disease compromising walking capacity are recorded as sick

Walking distance	Healthy	Sick	Total
Long	47	9	56
Short		17	17
Not walking		9	9
Total	47	35	82

Table 4. Function 2 years postfracture as compared with prefracture. Patients with disease compromising walking capacity are recorded as sick

Disease	Function		Total
	Unaltered	Deteriorated	
Healthy	41	6	47
Sick	13	22	35
Total	54	28	82

Table 5. Walking aids used by 82 patients without healing complications two years after internal fixation. Patients with disease compromising walking capacity are recorded as sick

Age	Healthy					n	Sick					Total
	None	Cane	Quadrapped	Bed	n		None	Cane	Quadrapped	Bed	n	
<50	3				3			1	1	2	5	
50-60	4				4			1		1	5	
60-70	11	1			12		2	1		3	15	
70-80	9	9			18	1	4	3	5	13	31	
80-90	3	3	2		8		2	10	2	14	22	
>90	1	1			2			1	1	2	4	
Total	31	14	2	0	47	1	8	17	9	35	82	

owing to early redisplacement. One of these was undisplaced and had healed at 2 years. Of the 5 cases of repinned displaced fractures, 2 healed, 1 died after 1 month, 1 had a late infection and died in connection with a revision 18 months postoperatively, and 1 had a nonunion at 2 years but denied symptoms. These six fractures are recorded as nonunions.

Deep infection occurred in a 76-year-old male with hemiparesis, and a 94-year-old woman with diabetes. The wounds were debrided and the patients were treated with systemic antibiotics for several months. The male died 1 year after the operation without signs of infection, and the woman developed an infected pseudarthrosis.

A woman aged 77 years had prolonged wound secretion with negative cultures and was treated with antibiotics for 1 month. At follow-up 2 years later, there were no signs of infection.

One case of subtrochanteric fracture through the distal pin entrance healed after plate osteosynthesis.

*Undisplaced fractures.* Of 58 patients with undisplaced fractures, 21 died within 2 years after the fracture (36 percent), 1 of whom had a segmental femoral head collapse. At 2 years, one additional segmental collapse was seen, but it did not require reoperation. There were two nonunions, and both had a total hip

arthroplasty. Thus, healing complications were seen in 4 of 58 cases (7 percent), or in 8 percent of the 2-year survivors.

*Displaced fractures.* Of 133 patients with displaced fractures, 41 died within 2 years after their fracture (31 percent). Six of these had a nonunion, and 1 had a segmental femoral head collapse. Of the 92 survivors, 35 developed nonunion and 9 segmental collapse. Arthroplasty was performed or planned in 23 patients with nonunion and in 5 with segmental collapse. Healing complications were thus recorded in 38 percent of all the displaced fractures and in 48 percent of the 2-year survivors, and total hip arthroplasty was performed in 21 percent of the fractures.

*Total patient material.* Of 191 patients, 62 died within 2 years (32 percent). Healing complications were seen in 55 patients (29 percent), or in 36 percent of the 2-year survivors. Arthroplasty had been performed or was planned in 30 (16 percent) patients, or in 23 percent of the survivors.

*Function.* Of 82 patients without healing complication at 2 years, 47 were without disease affecting their walking capacity. All could walk outdoors at least 200 meters (Table 3); and of these, 41 had the same walking ability as before the fracture (Table 4). Two patients, 85 and 86 years old, used a quadrapped or walker

and 14 used canes, while 31 did not use any support (Table 5). All except 2 were able to walk up and down stairs. Function was inferior in the group of patients who had their walking capacity impaired by other diseases (Tables 3, 4, and 5); only 13/35 were able to walk up and down stairs. Three of the 82 patients had pain on walking, and 2 complained of a mild pain at rest, not indicating further treatment. With one exception, all of them could flex their hip 90°.

## Discussion

The mortality rate after hip replacement as primary intervention is higher than that reported for internal fixation (Raine 1973, D'Arcy and Devas 1976, Diercks and Hollander 1985, Härkönen et al. 1988). Approximately 30 percent of all the patients with cervical hip fractures are dead within 2 years (Jensen and Tøndevold 1979, Holmberg et al. 1986), and many of those destined to later complications will succumb before they develop symptoms.

The rate of healing complications after femoral neck fracture fixation is influenced by fracture reduction (Barnes 1976, Kofoed and Alberts 1980, Høgh et al. 1982), operative technique (Kofoed and Alberts 1980, Holmberg et al. 1987), and type of internal fixation, as shown in prospective comparative studies (Frandsen 1979, Strömquist et al. 1984, Nordkild et al. 1985, Christie et al. 1988). The rate of secondary arthroplasty for symptomatic healing complications has been reported to be below 15 percent in a large consecutive material of cervical hip fractures treated with hook-pins (Strömquist et al. 1987).

The majority of healing complications are due to an impaired circulation of the femoral head (Hulth 1965, Strömquist 1983). With low-traumatic internal fixation, the number of healing complications in undisplaced fractures are few. In displaced fractures, frequencies from 25 to 45 percent have been reported (Arnold et al. 1974, Strömquist et al. 1987, Nilsson et al. 1988).

Few studies of total hip replacement for femoral neck fracture have a long-term follow up, but it seems that the results deteriorate with time (Søreide et al. 1980, Greenough and Jones 1988). The functional re-

sults in this report seem to accord with those of Høgh et al. (1982), and also of those of Johnson and Crothers (1975), who stated in their comparative study that few patients with primary hip prosthesis for femoral neck fracture regarded their prosthetic hip as satisfactory, while patients mostly did well after uncomplicated nailing.

Hemiarthroplasty is afflicted with general complications, and the peroperative and postoperative mortality is increased (Hunter 1980). Hip function has been reported to be unsatisfactory and pain to be frequent after primary hemiarthroplasty (Whittaker et al. 1972, Jensen and Holstein 1975, Johnson and Crothers 1975, Søreide et al. 1980, Diercks and Hollander 1985, Dorr et al. 1986, Härkönen et al. 1988).

Total hip arthroplasty performed as a primary procedure for femoral neck fracture does not necessarily give results comparable with those obtained for arthroplasty of the hip. Greenough and Jones (1988) reported a 50 percent revision rate at 5 years in a series of total hip replacement for femoral neck fractures, whereas Häglund et al. (1984) reported good results of the salvage total hip arthroplasty. Søreide and Lillestøl (1980) found no excess mortality following secondary procedures, which agrees with our recent experience (Nilsson et al. 1989).

Søreide et al. (1980) reported that the cost of primary arthroplasty for femoral neck fractures was 2.4 times as high as for internal fixation in a prospective comparative series; the difference was mainly due to longer hospitalization. During the first 13-17 months, the difference in costs was reduced to 1.6 owing to more frequent outpatient visits and to secondary procedures in the internally fixated group. Because 80 percent of the complications after internal fixation develop within 2 years (Massie 1973, Holmberg et al. 1987) and the complications of arthroplasty increase with time, it is likely that the final cost pattern will favor internal fixation.

In conclusion, with few exceptions (Strömquist et al. 1988), we recommend that femoral neck fractures be treated with primary internal fixation and immediate weight bearing: viz., undisplaced fractures rarely develop healing complications; more than half of the displaced fractures heal without complications; and in cases with uncomplicated fracture healing, the functional outcome is satisfactory.

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Table 6. Patients' data...

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	
1	33	2	1	1	1	5	1	--	2	2	2	2	2	1	2	2	1	1	1	1	1	2	97	1	81	1	1	3	3	12	1	520	--	2	2	2	2	--	--	--	--	--	--	--		
2	1	38	1	1	1	1	8	3	--	2	2	2	2	1	2	2	1	1	3	1	1	98	1	81	1	1	1	1	16	10	556	--	2	2	2	2	--	--	--	--	--	--	--			
3	1	46	1	2	5	--	5	--	2	2	2	2	2	1	2	2	2	3	6	1	1	99	1	81	1	1	3	3	9	1	480	--	2	2	2	2	--	--	--	--	--	--	--			
4	1	46	1	1	1	1	10	1	--	2	2	2	2	1	2	2	1	1	1	1	1	100	1	81	2	1	1	1	18	1	--	2	2	2	2	1	2	2	1	1	2	1	2			
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30	2	69	2	2	5	4	10	3	544	--	2	2	1	2	--	--	--	--	--	--	--	126	1	83	2	2	4	4	4	1	--	5	2	2	2	--	--	--	--	--	--	--	--	--	--	
31	1	69	2	2	5	--	4	1	--	5	2	2	1	2	1	1	2	3	6	2	1	127	1	83	2	2	3	3	23	1	--	2	2	2	2	1	2	2	2	2	4	1	1	2	1	
32	1	70	2	2	1	1	8	1	--	2	2	2	2	2	2	1	1	1	1	2	2	128	2	84	2	1	1	4	115	2	--	5	2	2	1	2	--	--	--	--	--	--	--	--	--	
33	1	70	1	2	1	1	8	3	--	2	2	2	2	1	2	2	1	1	2	1	2	129	1	84	2	2	3	3	5	0	146	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
34	1	70	2	2	1	1	13	1	--	2	2	2	2	1	2	2	1	1	1	1	2	130	1	84	1	1	4	4	4	1	127	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
35	2	71	2	2	5	4	53	1	--	3	2	2	2	1	2	2	3	3	8	2	1	131	1	84	2	2	1	4	31	7	450	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
36	1	71	2	2	1	1	15	1	--	2	2	2	2	1	2	2	1	1	1	1	2	132	2	84	2	2	3	5	3	1	239	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
37	1	71	2	2	1	1	19	1	--	2	2	2	2	1	2	2	1	1	1	1	2	133	1	84	1	1	3	3	15	1	188	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
38	2	72	1	2	1	1	7	2	--	2	2	2	2	1	2	2	1	1	2	1	1	134	2	84	2	2	5	4	6	1	33	3	2	2	1	2	--	--	--	--	--	--	--	--	--	
39	2	72	2	1	1	1	13	2	--	5	2	2	1	2	--	--	--	--	--	--	--	135	2	84	2	2	1	1	12	1	--	2	2	2	1	2	2	1	1	2	2	2	2	2		
40	2	72	2	2	1	1	13	6	--	2	2	2	2	1	1	1	2	2	2	2	2	136	1	84	2	1	5	5	4	1	8	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
41	2	72	2	1	1	1	14	2	--	5	2	2	1	2	--	--	--	--	--	--	--	137	2	84	2	1	1	4	11	1	39	--	2	2	2	2	--	--	--	--	--	--	--	--	--	
42	2	72	1	2	3	4	12	4	527	--	2	2	2	2	1	2	2	1	1	1	2	138	1	84	2	2	1	4	34	4	175	--	5	2	2	1	2	--	--	--	--	--	--	--	--	--
43	1	72	2	1	1	1	17	1	--	3	2	2	2	1	2	2	1	2	2	1	1	139	1	85	1	3	4	22	2	280	--	2	2	2	2	--	--	--	--	--	--	--	--	--	--	
44	2	73	2	2	1	1	9	1	--	5	2	2	1	2	--	--	--	--	--	--	--	140	1	85	1	2	1	1																		