Fixation of 220 femoral neck fractures

A prospective comparison of the Rydell nail and the LIH hook pins

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220 patients with femoral neck fractures were randomly treated with either a Rydell nail (n 110) or two LIH hook pins (n 110). The age, sex, and displacement patterns were similar in both group. All the patients were operated on by orthopedic specialists and followed clinically and radiographically for 2 years or until death. The mortality at 2 years was similar (28 percent) in both groups. Among 154 survivors, early redisplacement or nonunion was recorded in 19 percent of the Rydell-nailed fractures and 32 percent of the LIH-pinned fractures. In nondisplaced fractures, complications occurred in 8/30 Rydell cases compared with 3/16 in the LIH group. In displaced fractures, complications occurred in 21/48 Rydell cases compared with 28/60 in the LIH group.

Recently, comparative studies of osteosynthesis of femoral neck fractures have reported large differences in early complications between the fixation methods tested (Frandsen and Andersen 1981, Norkild et al. 1985, Elmerson et al. 1988). Strömqvist et al. (1984) have reported twice as many early complications for the Rydell (1964) four-flanged nail as compared with LIH pins (Hansson, 1982). The Rydell nail, however, has previously proven to produce relatively few early complications (Holmberg et al. 1987). In the present study, we have compared the Rydell nail with the LIH pins.

Patients and methods

All 220 patients admitted between February 1, 1986 and March 31, 1987, for nonpathologic intracapsular femoral neck fractures were included in the study. The patients were randomly allocated to either Rydell nail or LIH osteosynthesis; randomization was performed in the operation theater after reduction of the fracture. The fractures were classified as undisplaced, Garden (1961) Stages I and II, or displaced, Stages III and IV. All the patients were operated on by an orthopedic specialist as soon as possible after arrival at the hospital, usually within 24 hours. The Rydell osteosynthesis, being the routine method at our department, did not require any special practice. Six months before the study, the staff started to use the LIH pins in order to become familiar with this method.

The reduction of the fracture was defined as good when the Garden (1971) angle was 160°–185° and the lateral projection angle was < 5°. The reduction was considered fair with one of these indicators and poor with none.

All the patients were encouraged to begin with early weight bearing the day after the operation. Radiographic follow-up was performed by one of the authors (M.D.) 6, 12, and 24 months after the operation or before reoperation; most cases of redisplacement and nonunion occur within 12 months (Holmberg et al. 1987).

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Results

The two treatment groups were comparable as regards age, sex, displacement, and fracture reduction (Table 1).

Table 1. Distribution of patients with a femoral neck fracture

	n	Mean age	Male/ female	Admitted from		Displaced		Reduction			Dead within 24 months
				Home	Institution	–	+	Good	Fair	Poor	
Rydell	110	78	28/82	84	26	41	69	45	20	4	30
LIH	110	79	27/83	80	30	37	73	46	23	4	31
Total	220	79	55/165	164	56	78	142	91	43	8	61

Table 2. Complications of survived patients at 2 years related to osteosynthesis and the fracture displacement. Two Rydell-nailed and three LIH-pinned patients could not be retrieved for follow-up

	N	Nondisplaced				Displaced			
		n	Displace-ment	Nonunion	Osteo-necrosis	n	Redisplace-ment	Nonunion	Osteo-necrosis
Rydell	78	30	2	1	5	48	6	6	9
LIH	76	16	0	1	2	60	13	10	5

Within 12 months of the operation, 44 patients (20 percent) had died, and within 24 months another 17 patients had died, increasing the mortality to 28 percent, and 5 patients could not be retrieved for follow-up, leaving 154 patients for evaluation (Table 2).

Among the patients who died within 2 years, 1 in the Rydell group and 3 in the LIH group had developed redisplacement, and 4 in the Rydell group and 1 in the LIH group had developed nonunion. At the end of 2 years, 25 percent of the fractures had not united in the surviving 154 patients. Redisplacement had occurred in 14 percent of the fractures with 8/78 in Rydell cases and 13/76 in LIH cases, and nonunion was established in 12 percent of the fractures with 7/78 in Rydell cases and 11/76 in LIH cases (Table 2). Osteonecrosis had developed in 14 percent of the fractures with 14/78 in Rydell cases and 7/76 in LIH cases (Table 2).

Of the 30 nondisplaced fractures in the Rydell group, 8 had developed complications compared with 3/16 in the LIH group. In displaced fractures, 21/48 in the Rydell group and 28/60 in the LIH group had developed complications (Table 2). Thirty-four of the fractures were reoperated on with an endoprosthesis (15 in the Rydell group and 19 in the LIH group) or two Girdlestone resections in the Rydell group (Table 3).

Discussion

Displaced fractures account for the highest failure rate after internal fixation of femoral neck fractures. The rate of early complications (redisplacement and nonunion) among displaced fractures in our study did not differ significantly between the Rydell group (31 percent) and the LIH group (38 percent), or from previous studies (Strömqvist et al. 1984, Elmerson et al. 1988). The complication rate recorded for LIH-pinned displaced fractures in our study, however, was almost twice as high as that reported by Strömqvist et al. (1984; 22 percent), but was consistent with similar investigations by Rehnberg (1988; LIH pins) and Elmerson et al. (1988; Gouffon pins). The reoperation rate of complications following internal fixation of displaced fractures was 65 percent in the present study. This corresponded well with that of Strömqvist et al. (1984; 70 percent of LIH-pinned fractures) and Elmerson et al. (1988; 71 percent of Rydell-nailed fractures). Reoperation rate, however, is probably a poor measurement of the fixation ability of an osteosynthesis method.

Our high complication rate for the Rydell osteosynthesis in nondisplaced fractures confirms that of Strömqvist et al. (1984) and Elmerson et al. (1988), emphasizing the adverse effect on the femoral head circulation by this type of osteosynthesis.

The reduction quality of displaced fractures was fair or better in more than 90 percent of the cases (Tables 1 and 3). In spite of that, still almost every

Table 3. Observations in 220 patients operated on for femoral neck fracture

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	M	40	2	1	1	4	2		1	1	3	14				
2	M	43	1	1	1	1	2		1	1	1	6	1	5	4	6
3	F	51	1	1	1	1	2		1	1	2	9	1	1	1	1
4	M	55	2	1	1	6	1	7	0	0	4	16	1	1	1	1
5	F	55	1	1	1	1	2		1	0	1	11	1	3	9	8
6	M	56	1	1	1	6	2		1	1	4	9	1	1	1	1
7	F	58	2	1	1	1	2		1	1	1	9	1	1	1	4
8	F	60	1	1	1	1	2		0	1	3	11	1	1	1	1
9	F	63	2	1	1	3	2		1	0	4	22	1	1	1	1
10	F	64	1	1	1	1	2		1	0	1	9	2	2	6	6
11	M	64	1	1	1	1	2		1	1	2	9	1	1	1	1
12	F	65	1	1	1	1	2		1	1	3	10	1	1	1	1
13	F	66	1	1	1	1	2		1	1	1	13	1	1	1	1
14	F	67	1	1	1	4	2		0	1	3	12	1	3	4	6
15	F	68	1	1	1	1	2		1	1	4	12	1	5	1	1
16	F	69	2	1	4	4	2		1	0	4	3	4	3	6	6
17	M	69	1	1	1	1	2		1	1	4	20	4	1	1	1
18	M	70	1	1	1	1	2		1	1	2	10	1	1	1	1
19	F	70	1	1	1	2	2		1	1	4	8	1	5	1	1
20	F	71	1	1	1	4	2		1	1	4	8	1	3	3	5
21	M	71	1	1	1	1	2		1	1	4	15	1	1	1	8
22	F	72	2	1	1	4	2		1	1	2	9	1	4	6	6
23	M	72	1	1	1	1	2		1	1	4	15	1	5	1	1
24	F	72	1	1	1	1	2		1	1	2	8	6	1	1	1
25	F	73	1	1	4	6	2		0	0	3	4	4	4	4	4
26	F	73	1	1	1	1	2		0	1	2	15	1	1	1	1
27	F	73	2	1	1	1	2		1	0	4	29	1	3	1	1
28	F	74	2	1	1	2	2		1	1	2	9	1	1	1	1
29	F	74	2	1	1	4	2		1	0	4	20	1	3	6	6
30	F	74	2	1	1	4	2		1	1	4	12	1	5	3	3
31	M	74	1	1	1	4	2		1	1	1	8	1	5	3	4
32	M	74	1	1	1	1	1	4	1	1	2	12	1	9	9	9
33	F	74	1	1	1	4	1	2	1	1	4	13	1	9	9	9
34	F	74	2	1	4	1	1	4	1	1	4	3	4	9	9	9
35	F	75	1	1	1	1	2		1	1	2	16	1	5	1	1
36	M	75	1	1	1	1	2		1	1	2	15	1	1	1	8
37	F	75	2	1	1	1	1	16	1	1	3	22	1	3	1	9
38	F	75	2	1	1	1	2		1	1	1	36	4	1	1	1
39	F	76	2	1	4	1	2		1	1	3	3	4	1	1	1
40	F	76	1	1	1	1	2		1	1	1	26	5	1	1	1
41	M	77	1	1	1	1	2		1	1	1	5	5	5	3	1
42	F	77	2	1	1	1	2		1	1	3	21	1	1	1	1
43	F	1	1	1	1	2			1	1	3	15	1	1	1	1
44	F	77	1	1	1	6	2		1	1	1	10	8	5	3	4
45	F	78	2	1	1	1	2		1	1	0	3	17	1	5	1
46	F	78	2	1	1	1	2		1	1	4	17	1	5	1	1
47	M	78	2	1	4	3	2		1	1	0	4	1	4	2	6
48	F	78	2	1	1	1	2		1	1	1	4	27	4	5	1
49	F	78	1	1	1	6	2		1	1	1	1	20	4	5	4
50	M	78	2	1	1	1	1	2	1	1	1	4	25	5	9	9
51	F	78	1	1	1	1	2		1	1	1	4	12	1	1	1
52	M	79	2	1	1	4	6	1	14	1	1	3	2	4	3	3
53	F	79	2	1	2	1	1	1	1	1	1	2	1	2	9	9
54	F	79	2	1	1	4	1	2		1	1	2	3	4	1	1
55	F	79	1	1	1	4	3	2		1	0	4	4	4	2	6
56	F	80	1	1	1	1	1	2	1	1	2	14	5	9	9	9
57	F	80	1	1	1	1	2		1	1	3	15	1	5	1	1
58	F	80	1	1	1	1	2		1	1	3	11	1	5	1	1
59	F	80	1	1	1	3	2		1	1	4	14	1	3	4	6
60	F	80	2	1	1	4	2		1	1	3	7	6	5	4	6
61	M	80	2	1	1	5	2		1	1	2	10	4	2	6	6
62	M	80	2	1	1	1	1	1	1	1	2	23	1	9	9	9
63	F	80	2	1	1	1	2		1	0	4	10	7	5	1	1
64	F	81	2	1	1	1	2		1	1	3	11	6	5	1	1
65	F	81	1	1	1	1	2		1	1	2	8	6	1	1	1
66	F	81	1	1	1	1	1	2	1	0	3	21	4	9	9	9
67	F	81	1	1	1	1	1	11	1	1	1	14	1	1	9	9
68	F	82	2	1	1	1	2		1	1	3	16	1	5	1	1
69	F	82	2	1	1	1	2		1	1	3	20	7	5	1	4
70	F	83	1	1	1	1	2		1	0	1	8	8	5	1	1
71	F	83	2	1	4	5	2		1	1	1	4	3	5	3	6
72	F	83	2	1	4	6	1	9	1	1	4	3	4	3	9	9
73	F	83	2	1	1	6	1	14	1	1	4	18	4	3	3	9
74	F	83	1	1	1	4	2		1	1	4	10	1	2	2	2
75	M	83	1	1	1	1	1	3	0	1	4	19	1	9	9	9
76	F	83	2	1	1	1	2		1	1	2	13	1	1	1	1
77	M	83	2	1	1	1	1	3	0	0	4	24	9	9	9	9
78	M	84	2	1	1	1	1	3	1	1	2	29	4	9	9	9
79	F	84	2	1	1	3	3	2		1	1	3	26	5	2	6
80	F	84	1	1	1	2	2		1	0	3	4	6	5	1	1
81	F	84	2	1	1	1	2		1	1	1	23	4	1	1	1
82	F	85	1	1	4	1	2		1	0	3	3	4	5	1	1
83	F	85	1	1	4	1	1	2	1	1	4	3	4	9	9	9
84	F	85	1	1	4	1	1	18	1	1	3	25	5	1	1	9
85	M	86	1	1	4	1	1	7	0	1	4	1	4	1	9	9
86	F	86	2	1	3	3	2		1	1	4	26	4	5	1	4
87	F	86	1	1	4	1	1	23	1	1	3	5	4	5	1	9
88	F	86	1	1	1	1	2		0	1	3	0	1	5	1	1
89	F	86	1	1	1	3	2		0	1	1	11	6	2	6	6
90	F	87	2	1	1	1	2		1	1	1	17	1	1	1	1
91	F	87	1	1	4	1	1	6	1	1	4	1	4	1	9	9
92	F	88	2	1	1	4	2		1	0	4	7	6	2	6	6
93	F	88	2	1	4	1	2		1	1	3	15	1	3	1	1
94	F	88	1	1	4	6	2		1	0	4	3	4	3	3	3
95	F	89	1	1	1	1	1	3	1	1	4	25	5	9	9	9
96	F	89	2	1	1	3	2		1	1	3	21	5	5	3	6
97	F	90	1	1	1	4	1	11	1	1	2	33	4	2	9	9
98	F	90	1	1	4	1	1		1	1	2	12	9	9	9	9
99	F	90	1	1	4	1	1	6	1	1	2	1	4	1	9	9
100	F	90	2	1	1	1	1	2	1	1	3	28	5	9	9	9
101	M	90	2	1	1	1	2		1	0	3	16	1	1	1	1
102	M	91	2	1	1	6	2		1	0	1	42	1	1	1	4
103	M	91	1	1	3	6	2	1	1	1	3	18	9	9	9	9
104	F	92	1	1	2	1	1	3	0	1	4	30	4	9	9	9
105	F	92	2	1	1	1	1	3	0	0	1	6	1	9	9	9
106	M	92	1	1	1	1	2		1	0	3	14	5	1	1	1
107	M	93	1	1	1	1	2		1	1	4	16	1	5	1	1
108	F	94	2	1	1	1	2		1	1	2	11	4	1	1	1
109	M	97	1	1	3	6	2		1	1	4	6	6	5	4	7
110	F	98	1	1	1	1	2		1	1	3	28	4	5	1	1

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
111	F	42	2	2	1	7	2		0	1	4	14	1	5	3	1
112	F	53	1	2	1	4	2		1	1	4	12	1	5	4	6
113	F	57	2	2	1	1	2		1	1	3	3	2	1	1	1
114	F	58	1	2	1	1	2		1	1	3	14	1	1	1	1
115	F	60	1	2	1	1	2		1	0	3	9	6	6	1	1
116	M	61	2	2	1	1	2		1	1	3	24	4	5	3	1
117	F	62	1	2	4	1	2		1	1	4	7	6	1	1	1
118	M	65	1	2	1	1	2		1	1	3	17	1	5	1	1
119	F	65	2	2	1	1	2		1	1	4	19	1	2	2	7
120	F	66	2	2	1	1	2		1	1	3	15	1	1	1	1
121	F	67	2	2	1	4	1	4	1	1	3	9	1	2	9	9
122	F	69	1	2	1	1	2		1	1	1	5	1	1	1	1
123	M	69	2	2	1	1	2		1	1	3	7	6	1	1	1
124	M	69	1	2	4	1	1	2	1	1	2	3	4	9	9	9
125	F	70	1	2	1	1	2		1	1	1	11	1	1	1	1
126	F	70	2	2	1	1	1	14	1	1	1	15	1	1	1	9
127	F	70	1	2	1	1	2		1	1	3	15	1	5	1	1
128	F	70	2	2	1	4	2		1	1	4	11	1	5	3	6
129	M	70	1	2	1	4	2		1	0	3	12	1	2	6	6
130	F	71	2	2	1	1	2		1	0	3	9	1	1	1	1
131	F	71	2	2	1	1	2		1	1	1	11	7	1	1	1
132	F	71	2	2	1	4	2		1	1	4	11	1	2	6	6
133	M	71	1	2	1	1	2		1	1	3	8	6	1	1	1
134	M	71	2	2	1	4	2		1	1	3	10	1	5	1	4
135	M	71	1	2	1	4	2		1	1	3	10	1	5	1	1
136	F	71	1	2	1	1	2		1	1	2	15	1	1	1	1
137	F	73	2	2	2	1	1	2	0	1	1	3	2	9	9	9
138	F	73	2	2	1	1	1	15	1	0	3	13	1	1	1	9
139	F	74	2	2	1	1	2		1	1	3	42	6	5	1	1
140	F	74	1	2	1	4	2		1	1	3	13	1	5	4	6
141	F	75	1	2	1	1	2		1	1	3	13	1	5	1	1
142	F	75	2	2	1	4	2		1	0	4	7	6	5	3	6
143	M	75	1	2	1	1	2		1	0	3	26	5	5	1	1
144	F	76	1	2	1	1	2		1	0	4	19	5	1	1	1
145	F	76	1	2	2	1	1	11	1	1	3	8	2	1	9	9
146	M	76	2	2	4	4	2		1	1	4	0	4	2	6	6
147	F	77	2	2	1	3	2		0	0	1	25	1	1	1	3
148	F	77	2	2	1	4	2		1	1	3	5	6	3	3	6
149	F	77	2	2	1	4	2		1	1	1	7	2	4	4	4
150	F	77	1	2	1	6	2		1	0	4	27	1	5	3	3
151	F	78	2	2	1	4	2		1	0	4	18	1	5	3	6
152	M	78	2	2	1	3	2		1	1	4	9	1	3	3	6
153	M	78	1	2	1	1	1	14	1	1	4	23	5	5	1	9
154	M	78	2	2	1	1	2		1	1	1	7	4	1	1	8
155	F	78	2	2	1	6	1	13	0	1	1	14	1	5	3	9
156	M	78	1	2	1	4	2		1	0	4	10	6	2	6	6
157	F	79	2	2	1	4	2		1	1	3	8	6	3	3	6
158	F	79	1	2	4	1	2		1	1	2	3	4	1	1	1
159	F	79	2	2	4	1	2		1	1	3	4	4	1	1	1
160	F	79	2	2	1	4	2		1	1	3	8	6	5	1	4
161	M	79	1	2	4	1	2		1	1	4	4	4	2	2	1
162	F	80	1	2	3	1	2		0	1	3	33	4	1	1	1
163	M	80	1	2	1	6	2		1	1	4	14	4	5	3	1
164	F	80	2	2	1	1	2		1	1	3	4	1	5	1	1
165	F	80	2	2	1	3	1	4	1	1	1	13	1	9	9	9
166	F	80	1	2	4	1	1	16	1	1	1	5	4	1	1	9
167	F	81	2	2	4	1	1	15	1	1	4	4	5	1	1	9
168	F	81	2	2	1	1	2		1	1	1	18	1	1	1	1
169	F	81	2	2	1	1	2		1	1	3	8	6	1	1	1
170	F	81	2	2	4	1	1	2	1	0	1	4	4	9	9	9
171	F	82	1	2	1	4	2		1	1	4	12	6	2	6	6
172	F	82	2	2	4	1	2		1	0	1	3	4	1	1	1
173	M	82	1	2	1	4	2		0	1	3	16	1	2	6	6
174	F	82	1	2	4	6	2		1	1	4	3	4	2	2	7
175	F	83	1	2	4	1	2		1	1	3	0	4	1	1	1
176	F	83	1	2	1	6	2		1	0	4	13	1	5	4	4
177	F	83	2	2	1	4	2		1	0	4	10	6	3	3	6
178	M	83	2	2	4	1	1	3	1	1	1	2	4	9	9	9
179	F	83	2	2	1	1	2		1	1	2	9	6	1	1	1
180	F	84	2	2	4	1	1	4	1	0	1	3	4	9	9	9
181	F	84	1	2	1	2	2		1	1	4	10	6	5	3	1
182	F	84	2	2	1	4	2		1	1	2	11	7	1	4	4
183	F	84	2	2	1	4	2		1	0	4	11	6	2	6	6
184	F	84	2	2	1	6	2		1	1	4	31	4	5	3	7
185	F	84	2	2	1	6	2		1	1	4	14	1	5	3	7
186	M	84	1	2	1	1	2		1	0	3	16	1	5	1	1
187	F	84	2	2	1	4	1	8	1	1	3	42	1	4	9	9
188	F	85	1	2	1	6	1	15	1	0	4	31	5	5	4	9
189	M	85	1	2	2	1	2		1	1	1	21	4	1	1	1
190	F	85	2	2	3	1	1	2	0	0	1	20	5	9	9	9
191	F	86	1	2	1	1	2		1	1	4	13	1	5	1	1
192	M	86	1	2	1	1	2		0	1	3	18	5	3	1	1
193	F	86	2	2	1	1	2		1	1	2	10	5	1	1	1
194	F	86	1	2	3	1	2		1	0	3	21	4	5	1	1
195	M	86	2	2	1	1	1	4	1	1	2	11	4	9	9	9
196	F	86	2	2	1	1	2		1	0	4	7	1	1	1	8
197	F	87	2	2	2	6	2		1	1	4	22	7	5	3	1
198	F	87	2	2	4	1	1	9	1	1	1	4	4	9	9	9
199	F	87	1	2	1	5	1	11	1	1	4	15	5	2	9	9
200	F	87	2	2	3	1	1	7	1	0	1	18	3	1	9	9
201	F	88	1	2	3	1	1	16	1	1	1	15	3	5	1	9
202	M	88	2	2	1	1	1	14	1	0	2	36	5	1	1	9
203	F	88	1	2	1	3	2		1	0	4	11	4	2	6	6
204	F	88	1	2	1	4	2		1	1	1	21	7	1	1	1
205	F	90	2	2	4	1	1	21	1	1	1	3	4	1	1	9
206	M	90	1	2	1	1	1	2	1	1	2	16	5	9	9	9
207	F	90	2	2	4	1	1	22	0	0	4	3	4	1	1	9
208	F	91	1	2	1	1	2		1	1	2	3	2	1	1	1
209	F	91	2	2	1	1	1	2	1	1	2	31	4	9	9	9
210	F	92	2	2	1	2	2		0	0	3	23	1	2	2	7
211	F	92	2	2	1	6	2		0	0	4	13	1	5	3	1
212	F	93	2	2	4	6	1	9	1	0	1	3	4	2	9	9
213	F	93	2	2	1	2	1		1	1	1	15	1	1	1	1
214	F	94	2	2	1	3	2		1	0	4	18	5	2	6	6
215	M	94	2	2	1	1	1	4	1	1	2	31	4	9	9	9
216	F	96	2	2	3	1	1	13	1	1	4	2	3	1	1	9
217	M	97	2	2	1	1	2		1	1	3	35	1	1	1	1
218	F	97	1	2	1	3	2		0	0	4	47	1	2	6	6
219	F	98	1	2	3	1	2		1	1	4	13	3	1	1	8
220	M	98	1	2	4	1	1	2	1	1	3	3	4	9	9	9

Key to data

A case
B sex: M male, F female
C age
D fracture side: 1 right, 2 left
E osteosynthesis: 1 Rydell, 2 LIH
F admitted from
  1 own home
  2 other clinic
  3 nursing home
  4 geriatric hospital
G reoperation
  1 not reoperated on
  2 nail extraction,
  3 hemiarthroplasty
  4 total arthroplasty
  5 Girdlestone resection
  6 planned reoperation
H dead: 1 yes, 2 no
I number of days at death after admission.
J Garden angle 160°–185°: 0 no, 1 yes
K angle in lateral position < 5°: 0 no, 1 yes
L Garden Stages I–IV (1–4).
M stay (days) in orthopedic department.
N discharged to 1–4, see F and
  5 convalescent home
  6 dead
O radiographic/clinical outcome at 6 months
P radiographic/clinical outcome at 12 months
Q radiographic/clinical outcome at 24 months
  1 healed or unchanged
  2 redisplacement
  3 nonunion
  4 osteonecrosis
  5 axial compression > 5 mm without displacement
  6 the patient reoperated on
  7 the patient planned for reoperation
  8 not retrievable patient
  9 the patient dead

second fracture (49/108) developed some healing complication regardless of the method of osteosynthesis. This was most common for early complications (redisplacement and nonunion), which are the most expensive complications regarding consumption of hospital resources (Holmberg and Thorngren 1988).

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References

Elmerson S, Andersson G B, Irstam L, Zetterberg C. Internal fixation of femoral neck fracture. No difference between the Rydell four flanged nail and Gouffon's pins. Acta Orthop Scand 1988; 59(4): 372-6.

Frandsen P A, Andersen P E Jr. Treatment of displaced fractures of the femoral neck. Smith-Petersen osteosynthesis versus sliding nail plate osteosynthesis. Acta Orthop Scand 1981; 52(5): 547-52.

Garden R S. Low angle fixation in fractures of the femoral neck. J Bone Joint Surg (Br) 1961; 43: 647-63.

Garden R S. Malreduction and avascular necrosis in subcapital fractures of the femur. J Bone Joint Surg (Br) 1971; 53(2): 183-97.

Hansson L I. Osteosynthesis with the hook pin in slipped capital femoral epiphysis. Acta Orthop Scand 1982; 53(1): 87-96.

Holmberg S, Kalén R, Thorngren K G. Treatment and outcome of femoral neck fractures. An analysis of 2418 patients admitted from their own homes. Clin Orthop 1987; (218): 42-52.

Holmberg S, Thorngren K G. Consumption of hospital resources for femoral neck fracture. Acta Orthop Scand 1988; 59(4): 377-81.

Nordkild P, Sonne-Holm S, Jensen J S. Femoral neck fracture: sliding screw plate versus sliding nail plate—a randomized trial. Injury 1985; 16(7): 449-54.

Rehnberg L. Subchondral screw fixation in treating cervical hip fractures. Thesis, Uppsala University, Uppsala, Sweden 1988.

Rydell N. Osteosynthesis of medial collum fractures with the "spring loaded nail." Acta Orthop Scand 1964; 35: 149-57.

Strömqvist B, Hansson L I, Nilsson L T, Thorngren K G. Two year follow-up of femoral neck fractures. Comparison of osteosynthesis methods. Acta Orthop Scand 1984; 55(5): 521-5.