

Radiographic prediction of failure after fixation of cervical hip fracture

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During 1984–1985, 410 patients with cervical hip fracture were randomized between 2 methods of internal fixation—a single nail (Rydell) or 2 LIH hook pins (LIH). The patients were followed-up prospectively for at least 2 years. Radiographs were taken after 1 week, 1, 3, 6, 12, and 24 months. The radiographs of the 295 patients alive 2 years postoperatively were examined by one of the authors. The sliding and the diversion of the pins and the nail in the anteroposterior projection and the diversion in the lateral projection were measured. In the failure

group (non-union, late segmental collapse), the greatest sliding was noted within 1 month postoperatively and the diversion increased up to 3 months. Significant differences between the failure and the non-failure groups could be seen even after 1 week. We also found that the degree of sliding of the LIH pins and the Rydell nail 1 month postoperatively is comparable to the scintigraphic pattern 2 weeks postoperatively in predicting failure after internal fixation of cervical hip fractures.

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Submitted 92-12-26. Accepted 93-12-13

The treatment of cervical hip fractures is controversial and the high number of fractures can make it necessary to concentrate follow-up on patients at risk of having complications after internal fixation, in order to detect the failures early. In a previous study we compared 2 methods of internal fixation—the single nail (Rydell) versus the 2 hook pins (LIH) and these methods had a similar failure rate (Sernbo et al. 1990). Scintigraphy 2 weeks postoperatively is a well-known method for predicting failure (Strömqvist et al. 1987) but is expensive and technically demanding.

We studied whether the sliding and the diversion of the 2 pins/the sliding of the single nail could be used as a method for early prediction of failure after internal fixation of cervical hip fracture.

Patients and methods

During 1984–1985, 410 patients with cervical hip fracture were randomized between 2 methods of internal fixation—LIH hook pin versus the single nail (Rydell). The patients were followed-up prospectively for at least 2 years and radiographs were taken postoperatively after 1 week, 1, 3, 6, 12, and 24 months. To get a standardized hip rotation, the feet were placed in a box.

The radiographs of the 295 patients alive after 2 years were re-examined by one of the authors who did not know whether the patient had been classified as a failure or a non-failure. The sliding of the nail and the pins on the AP projection was measured (Figure 1). The relative length of the implant that was outside the cortical bone of the femur on the first postoperative roentgenogram was compared with the following postoperative radiograph and the difference was used in comparing failures with non-failures. We also measured any diversion of the pins and called the angle between the pins alpha on the AP projection and beta on the lateral projection.

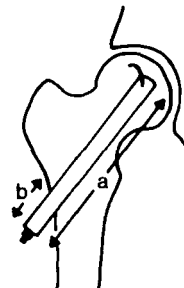


Figure 1. Measurements of the implant on the radiographs.

Table 1. Changes in the relative length of the implant outside the cortical bone of the femur on the AP projection of the postoperative radiographs (1 week, 1, and 3 months) compared with the immediate postoperative radiographs. Median (1st-3rd quartile)

Implant	Time	Sliding of the implant (%)		P-value ^a
		Non-failure	Failure	
Single nail	1 week	0.033 (0.02-0.05)	0.051 (0.04-0.075)	< 0.001
	1 month	0.054 (0.033-0.088)	0.095 (0.068-0.13)	< 0.001
	3 months	0.058 (0.044-0.081)	0.12 (0.81-0.14)	< 0.001
Proximal LIH pin	1 week	0.032 (0.011-0.053)	0.055 (0.025-0.089)	< 0.001
	1 month	0.049 (0.026-0.09)	0.09 (0.061-0.13)	0.001
	3 months	0.064 (0.032-0.11)	0.11 (0.094-0.16)	< 0.001
Distal LIH pin	1 week	0.031 (0.012-0.053)	0.052 (0.029-0.083)	0.003
	1 month	0.061 (0.026-0.08)	0.089 (0.071-0.12)	< 0.001
	3 months	0.072 (0.032-0.11)	0.12 (0.089-0.16)	< 0.001

^aMann-Whitney test

Patients with failures (non-union or late segmental collapse) within 2 years were compared with those without failures. The patients who were considered to be failures or had a reoperation with a hip prosthesis have already been classified in our previous randomized study (Sernbo et al. 1990).

The fractures were classified according to Garden (1961). The difference between the immediate postoperative position of the implant was compared with the position at 1 week, 1, 3, 4, 6, 12, and 24 months. 2 weeks postoperatively, a scintigraphic examination of the hips was performed in 175 patients.

Results

Using the Mann-Whitney rank summation test, we compared the differences between the sliding of the implant on the AP projection for each period of time and each implant (Table 1). We compared patients considered as non-failures versus failures. The differences remained after 6, 12, and 24 months.

The alpha angle increased in the failure group and became higher than in the non-failure group after 3 months ($P < 0.01$). The beta angle in the failure group was higher even after 1 week ($P < 0.05$) but, as a prognostic tool, the sliding of the implant on the AP projection was more useful.

If we measure the sliding of the implant on the AP projection (hook pins or single nail) and compare the quota $b/a < 0.05$ versus $b/a \geq 0.05$ 1 week postoperatively regarding failure and the number of reoperations with a hip prosthesis within 2 years, we found better results in those who have less sliding of the implant as early as 1 week postoperatively (Table 2). Sliding of more than 5 percent ($b/a \geq 0.05$) of the implant was more often seen in failures

after internal fixation of non-displaced cervical hip fracture. Sliding of the implant in the Garden 3-4 group was higher ($P < 0.01$) than in the Garden 1-2 group after 1 month.

Women over 80 had greater changes in the position of the implant than women under 80. In patients with only late segmental collapse, changing of the implant position seemed to stop 3 months postoperatively, whereas it continued in patients with non-union.

A stepwise logistic regression of the results showed that the 2-week scintigraphy had the same prognostic value regarding failure as our 1-month measure of implant-sliding (Table 3). Both scintigraphy and measurement of implant sliding 1 week and 1 month postoperatively were independently related to failure; if both the sliding and the scintigraphic results were used, the prediction of failure increased. Furthermore, the beta angle had, according to the

Table 2. The sliding of the implant 1 week postoperatively on the AP projection of the radiograph. Comparison of the quota $b/a < 0.05$ with $b/a \geq 0.05$ (Figure 1) regarding failure and reoperation with a hip prosthesis within 2 years

		Sliding at 1 week postop.		
		< 5%	$\geq 5\%$	P-value
Garden 1-2	n	73	20	
	Failure	9	10	< 0.001
	Reoperation	5	7	0.003
Garden 3-4	n	94	108	
	Failure	40	64	0.02
	Reoperation	30	46	0.1
All	n	167	128	
	Failure	49	74	< 0.001
	Reoperation	35	53	< 0.001

Table 3. Logistic regression regarding risk ratio of failure after internal fixation 2 years postoperatively for 1 SD change of the variables

	Risk ratio
Sliding of the single nail at 1 month	3.0
Sliding of the proximal hook pin at 1 month	2.3
Sliding of the distal hook pin at 1 month	3.0
The alpha angle of the hook pins at 1 month	1.4
The beta angle of the hook pins at 1 month	1.9
Scintigraphy 2 weeks postoperatively	2.4

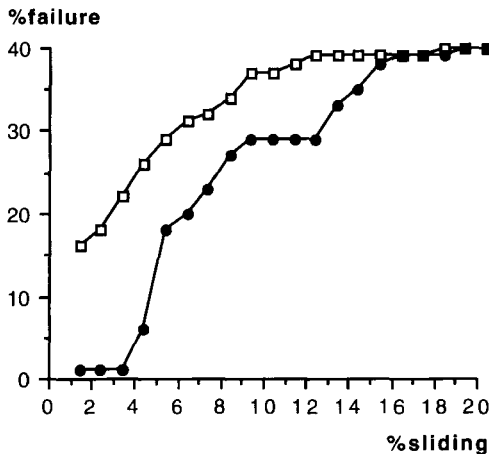


Figure 2. Percent failures related to the sliding of a hook pin in percent of total length of the pin on the AP projection after 1 week (open squares) and after 1 month (filled dots) postoperatively.

logistic regression, a better prognostic value regarding failure than had the alpha angle.

The failure rate after fixation with LIH hook pins increased with the sliding of the implant in the AP projection 1 week and 1 month postoperatively (Figure 2).

Discussion

Primary displacement or not (Eliasson et al. 1988) is the commonest prognostic classification regarding failure after internal fixation (Garden 1971, Elmerston et al. 1988, Sernbo 1988, Sernbo et al. 1990).

Alho and co-workers (1991) have also presented a radiographic prediction of early failure and found a primary fracture displacement of 20 mm or more to be important. Mathiesen and Zayer (1989) have made a prognostic algorithm by 4 different param-

eters of pre- and postoperative radiographs. A scintimetric analysis 2 weeks postoperatively shows the importance of blood circulation to the head of the femur and can be used to predict failure (Strömqvist et al. 1987), but our method seems equally good.

Other factors can influence the outcome after internal fixation of cervical hip fractures, such as the quality of fracture reduction (Alberts and Jervaeus 1990), skilled surgeons (Holmberg et al. 1987, Sernbo 1988), quality of the bone (Sernbo et al. 1990), and the method of internal fixation (Strömqvist et al. 1984, Olerud et al. 1991).

In Sweden, most cervical hip fractures are treated with internal fixation, most commonly hook pins (Sernbo and Fredin 1993), in spite of the high rate of complications leading to reoperation with a hip replacement (Sernbo et al. 1990). It is important to have a good prognostic sign of failure early after internal fixation and to be able to concentrate the follow-up on patients who run a risk of having a late segmental collapse or non-union.

We consider the method presented to be easy and inexpensive for detecting failure after internal fixation of cervical hip fractures by measuring the change of implant position on early postoperative radiographs.

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