

Internally fixed femoral neck fractures

Early prediction of failure in 203 elderly patients with displaced fractures

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After internal fixation of a femoral neck fracture, 3 months is the critical time for planning rehabilitation of the patient. Most failures in the elderly occur within this time. In a series of 165 patients, we followed 127 women and 38 men with a median age of 81 (63–97) years from an examination at 3 months to reoperation or survival of the hip. 36 patients had radiographic signs of disturbed healing at the 3-month follow-up—change in fracture position by 10 mm, change in screw position by 5%, backing of the

screws by 20 mm, or perforation of the femoral head by the screw. These signs had a high association with local complications and need for a later reoperation. High age and male sex increased this association. Signs of impaired healing made nonunion likely, but did not predict late segmental collapse of the femoral head. Patients with signs of disturbed healing and those closest to them should be informed about the value of early check-ups in case of pain and impaired function.

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Internal fixation of displaced femoral neck fracture in the elderly remains a widely used treatment. Although failures resulting in secondary prosthesis replacement are frequent, the method has yielded satisfactory overall results in large series of patients (Barnes et al. 1976, Stappaerts 1985, Nilsson et al. 1988, 1993, Rehnberg and Olerud 1989). The alternative—primary prosthesis replacement—is also associated with complications (Skinner et al. 1989, Parker 1992) and costs more (Søreide et al. 1980, Rodriguez et al. 1987). When internal fixation is chosen, the risk of complications should be foreseen to avoid delaying a salvage operation.

We analyzed the postoperative radiographic course of internally fixed, displaced femoral neck fractures to detect factors predictive of failure necessitating reoperation.

Patients and methods

225 consecutive patients with a displaced femoral neck fracture were treated with closed reduction and internal fixation. The fixation implants were either a Richards sliding screw plate (SSP) supplemented with a proximal, parallel AO 6.5 mm cancellous screw (Alho et al. 1980) or two parallel Olmed hip screws (Rehnberg and Olerud 1989). All patients were operated on within 3 days of injury. 22 patients

died within 3 months postinjury. 31 internal fixations failed during the same period and were excluded from the study. The reoperations for these early failures included: new internal fixation 1, cemented bipolar hemiendoprosthesis 21, cemented total hip replacement 6, and removal of implant 3. Two debridement operations were performed to treat a postoperative infection.

The remaining 132 women, median age 81 (63–97) years, and 40 men, median age 81 (63–89) years were included in the study. Clinical and radiographic examinations were performed at the 3-month follow-up. Impaired healing was defined as a change in position of the femoral head by 10 mm varus translation, change in the angle between the fixation screws by 5%, backing of the screws by 20 mm or perforation of the femoral head by the screws (Figures 1 and 2).

A change in fracture position and persistent fracture gap associated with pain were classified as nonunion. Excessive impaction of the fracture, expressed as sliding of the screws (Alho et al. 1988) or change in the sphericity of the femoral head, was considered a sign of late segmental collapse of the femoral head (LSC). The decision to reoperate because of these two complications—nonunion and LSC—was based on the intensity of pain, reduction in function and general state of the patient. 5 debilitated women and 2 men died after the decision to reoperate but before surgery. They were excluded from the final analysis.

Table 1. Impaired healing, local complications and reoperations in 165 patients

Impaired healing at 3 months	Reoperation		Total
	Yes	No	
Local complication			
<i>Secondary redislocation</i>			<i>20</i>
Nonunion	13	5	18
LSC ^a	0	2	2
<i>Backing of screws or perforation of the femoral head</i>			<i>16</i>
Nonunion	5	0	5
LSC	2	4	6
None	0	5	5
<i>No</i>			<i>129</i>
Nonunion	7	1	8
LSC	18	0	18
None	0	103	103

^a LSC late segmental collapse

At the 3-month follow-up study, the patients were advised to contact the hospital in case of pain in the hip. Otherwise, they were examined yearly, latest median 39 (22–51) months after the operation. 92 patients who had not been reoperated on were examined clinically and radiographically.

Statistics

Descriptive statistics were computed for categorical data as percentages and for continuous data as median and range. Pearson's chi-square with Yates' correction was used for testing the association between categorical data. Stepwise logistic regression analysis was used to build statistical models for identification of risk factors (Hosmer and Lemeshow 1989). Survival rate was estimated using the Kaplan-Meier method.

Results

Impaired healing was detected in 36 fractures on the radiographs at 3 months (Table 1). During the follow-up, 18 of them with secondary dislocation were designated as nonunions and 2 as LSCs. Of 16 cases with backing of the screws or perforation of the femoral head, 5 were nonunions, 6 LSCs and 5 had no local complication. 1 infection resulted in nonunion. 129 patients did not show early disturbances in healing, 8 of them developed nonunion and 18 LSC. 23 of 31 nonunions had impaired healing at 3 months vs only 8 of 26 LSCs. As suggested by the findings presented in Table 1, an early disturbance in healing was not predictive of LSC. On the contrary, patients with early disturbances in healing had a reduced risk of developing LSC (RR = 0.41 (95% CI 0.22–0.77)).

Table 2. Local complications and reoperations in 165 patients 3 months after internal fixation for a femoral neck fracture

Complication	Reoperation	No reoperation
Nonunion	25	6
Late segmental collapse	20	6

Impaired healing at 3 months was strongly associated with local complications diagnosed immediately or later ($p < 0.00005$; RR = 4.3 (3.0–6.2)). Sex was an effect modifier, the association being more than twice as strong for men as for women (RR = 9.4 (2.2–40), RR = 3.8 (2.7–5.5), respectively). Age was probably also an effect modifier, the association being stronger for those above 80 years than for those 80 years or less (RR = 6.6 (3.2–14), RR = 3.7 (2.5–5.5), respectively). The odds ratios in the logistic regression analysis corresponded to these findings. When a local complication was used as the dependent variable, the OR for impaired healing as the independent variable was 60 (15–233), for sex 56 (1.5–24), and for age 3.8 (1.4–810).

Local complications occurred in 57/165 patients (Table 2). 45 patients were reoperated on: cemented bipolar hemiendoprosthesis 19, cemented total hip replacement 15 and removal of protruding screws 11. There was no statistically significant association between the type of local complication and reoperation.

In the group of local complications, the Kaplan-Meier estimate of 3-year failure rate for nonunion was 81%. The median survival time was 12 months (95% CI 8–16). The failure rate for late segmental collapse was 77%, the median survival time being 24 (22–31) months. The Mantel-Cox test revealed a statistically significant difference between the failure rates over time with $p = 0.03$.

When the variables characterizing fracture reduction and fixation were analyzed by logistic regression, anterior position of the screw(s) in the side view was an independent predictor of local complication, as compared with a central screw position (OR = 2.8 (95% CI 0.92–8.6)).

Only 8 of 21 patients alive at the latest follow-up study who had had signs of impaired healing at 3 months had not been reoperated on. 1 of them had an early redisplacement of the fracture, which healed in the displaced position in 14 months. 3 fractures with backing of the screws by more than 20 mm healed within 6–9 months. 1 patient with painful nonunion declined a new operation. The remaining 3 patients with nonunion resided in nursing homes and were unable to walk.



Figure 1. Backing of screws and nonunion in fracture treated with two Olmed screws.

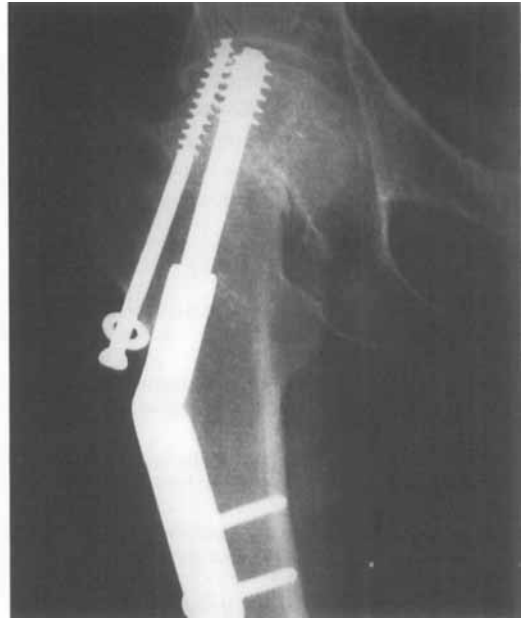


Figure 2. Secondary displacement and perforation of femoral head in fracture treated with HCS and one cancellous screw.

Discussion

In their extensive multicenter study, Barnes et al. (1976) recorded the subcapital femoral fractures as failed or united and reported the incidence of late segmental collapse of united fractures separately. Later, Stappaerts (1985) used the term “early fixation failure” for fractures where loss of the reduced position was present on radiographs within 3 months; the finding accorded with a need for reoperation. In our series, 32 of 225 fractures (14%) were reoperated on within 3 months of fixation failure. 22 debilitated patients (10%) died during the same period.

The causes of early impaired healing expressed as a change in fracture position are only partially understood. In previous studies (Alberts and Jervaeus 1990, Alho et al. 1992), poor fracture reduction was associated with an increased risk of failure. In the present study, an anterior position of the screw was an adverse factor. Fracture displacement and comminution and high age of the patient are risk factors (Alho et al. 1991, 1992, Nilsson et al. 1993).

Our starting point for observations was the 3-month follow-up examination. At that time, 10% of debilitated patients had died and 14% of the fractures had failed because of causes related to the fracture and its treatment. Healing disturbances, as indicated by a change in fracture position or backing or perforation of the femoral head by the screws, were recorded and

their importance as signs of complications were analyzed.

As expected, impaired healing showed a high association with local complications. The age of the patient modified this association, making it stronger in older patients. This means that younger patients developed complications without signs of impaired healing at 3 months. The higher risk of failure within 3 months and of disturbed healing in older patients in general (Alho et al. 1992) is the most likely explanation. The gender of the patient modified this relationship as well, the association being stronger in men. The importance of this finding remains unclear.

Early signs of impaired healing and changes in fracture position found on the 3-month follow-up examination were highly predictive of nonunion and a need for a reoperation, whereas impaired healing did not predict late segmental collapse of the femoral head which, in fact, was more frequent in the fractures which showed no early radiographic signs of impaired healing. Since an overall prediction would be desirable at this time, scintimetry might be of value for the evaluation (Strömqvist et al. 1984, Alberts 1990).

In a busy clinical practice, the patients who have been discharged from the hospital and show improved function are not always examined regularly. The great predictive value of changes detectable on radiographs at 3 months should be considered. If signs of impaired

healing are present and the hip is painful, the decision for reintervention should not be postponed in an otherwise well-functioning patient. If the decision not to operate is made, regular follow-ups should be done. In case of satisfactory function, the patient and those closest to the patient should be instructed about a risk of deterioration and probable need for a follow-up examination later.

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