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Hip Fractures—Treatment and Early Complications

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ABSTRACT

A prospective follow-up study was performed on 282 patients with hip fractures with respect to early complications and their possible relation to patient or treatment variables.

A hip fracture patient needed at least 1 - 2 hours in the operating theatre (length of anaesthesia), while the operating time was half or less. The operative trauma, measured in operating time and blood loss, was greater in patients with trochanteric fractures than in those with fractures of the femoral neck. Reduction was difficult and only half the internal fixations were satisfactory, as judged from X-rays at the end of the operation. The immediate results of the operations were satisfactory in the trochanteric group, but some problems were encountered in the group with fractures of the femoral neck.

Complications were frequent and interrelated. At multiple discriminant analysis higher age, delay of operation, trochanteric fracture and long operating time were often found to be negative factors. Bladder catheterization increased the risk of urinary tract infection to some degree.

INTRODUCTION

An increasing incidence of hip fractures has been reported during recent years in Sweden. The present study was part of a methodological investigation on "production control" initiated by the Swedish Planning and Rationalization Institute of Health and Social Services (SPRI) in 1973 (20).

The aim of this part was to study the treatment and the early complications and to investigate the possible relation between complications and patient or treatment variables.

PATIENTS AND METHODS

The study was carried out on 282 consecutive patients with hip fractures (151 femoral neck and 131 trochanteric) who were treated during a one-year period from 1973 - 1974 at the departments of surgery and orthopaedics of the Regional Hospital in Örebro. This hospital has a primary catchment population of 163,000.

Conventional clinical routines were followed on admission to the hospital. Wire traction on a Böhler frame was applied in patients with displaced fractures.

The Rydell hook nail was used in 95 % of the femoral neck fractures and the AO 130 angled nail in 89 % of the trochanteric and subtrochanteric fractures. The patients were admitted to operation in turn after arrival and the operations were performed in office hours from Monday to Friday. Twenty-two surgeons took part in the operative treatment, which was performed with use of an image intensifier in 2 planes. An X-ray check was made at the end of the operation.

Antibiotics were not used routinely. Five hundred ml of 6 % Dextran were given for thromboembolic prophylaxis on the day of arrival, the day of operation and every other day thereafter for the first week. Mobilization started immediately and it was our intention that the patients should be weight-bearing within the first week unless the surgeon in question considered the internal fixation to be unstable. Mental hospital patients and patients from geriatric clinics were sent back for rehabilitation. Patients from their own homes and old people's homes were transferred to an aftercare unit connected to the acute department if they needed more training before returning home.

A special nurse interviewed the patients after arrival, usually on the following day. The nurse collected and recorded all data concerning the patient and treatment and made regular visits to the ward to follow the patient's progress. All data were entered on preconstructed data sheets and subsequently analysed (21).

Table 1. Basic pre- and peroperative explanatory variables and effect variables included in the multiple discriminant analysis (MDA).

PREOPERATIVE	PEROPERATIVE
Age (years)	Surgeon's experience
Sex(male/female)	(specialist/non-specialist)
State of general health	Duration of operation(min)
(healthy/non-healthy)	Fracture reduction quality(good/bad)
Number of previous fractures (n)	Nailing quality (good/bad)
Preoperative walking	
capacity (scale 1-4)	EFFECT VARIABLES
Time from accident to	Wound infection
admission (h)	Urinary tract infection
Time from admission to	Thromboembolism
operation (days)	Heart complications
Type of fracture	Confusion
(femoral neck/troch)	Pressure sores
	Any complication

Ordinary statistical methods (chi2 test) were used. To study specific complications multiple discriminant analysis (MDA) was performed in two steps (2). The effect variable (e.g. the occurence of confusion) was tested against the preoperative explanatory variables (Table 1) starting with age.

If any of these variables had a significant bearing (p =0.1) on the outcome they were kept constant in the discriminant equation when testing the peroperative variables. The basic variables were selected by the author among all previously recorded variables and were supplemented for specific complications.

RESULTS

TRACTION, ANAESTHESIA AND OPERATION. Wire traction was used in 245 patients (87 %). Twenty-nine patients with fractures of the femoral neck and 8 patients with trochanteric fractures were not treated with traction.

The duration of traction was less than 24 hours in 36 % of the patients, 25 - 48 hours in 23 %, 49 - 72 hours in 19 % and more than 72 hours in the remaining patients. In 3 patients the time of commencement of traction was not noted. There was no difference in the duration of traction between men and women or between patients with femoral neck and trochanteric fractures.

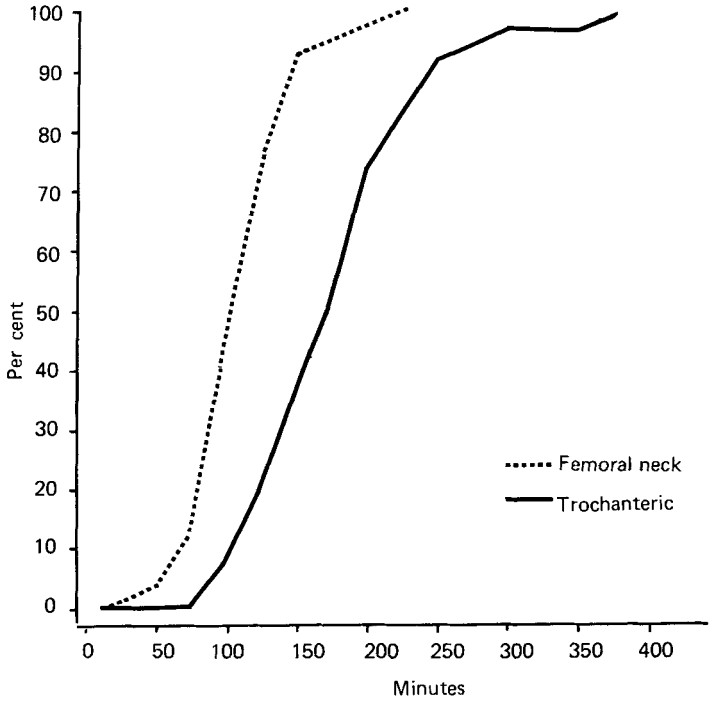

Fig.1.Duration of anaesthesia. The cumulative proportions of patients who were transferred to the postoperative ward at different times.

Epidural anaesthesia was most commonly used (42 %), followed by combination anaesthesia (28 %) and inhalation anaesthesia (25 %). No differences in anaesthesia with respect to sex or type of fracture were noted. The duration of anaesthesia was measured from the induction of anaesthesia to delivery of the patient to the postoperative ward. The median duration for femoral neck fractures was 103 minutes and for trochanteric fractures 171 min. It was slightly shorter for men (119 min) than for women (130 min). The cumulative proportions of patients leaving the operating theatres at different times can be seen in Fig. 1.

Anaesthetic complications occurred in 5 patients and surgery had to be abandoned in one of them. This patient later succumbed.

Operation was performed by 22 different surgeons. Most of them were under training and specialists operated on only 15 % of the patients, with no differences with respect to sex or fracture type. The number of patients who underwent surgery was 277 (98 % of the total series). The duration of operation was measured from the first incision to the last suture. It was apparently shorter for fractures of the femoral neck (mean 36 +/- 22 min, median 34 min) than for trochanteric fractures (102 +/- 51 min, median 92 min). It was slightly shorter for men than for women (median 49 and 58 min respectively). The cumulative proportions of patients whose operations were completed after different lengths of time can be seen in Fig. 2.

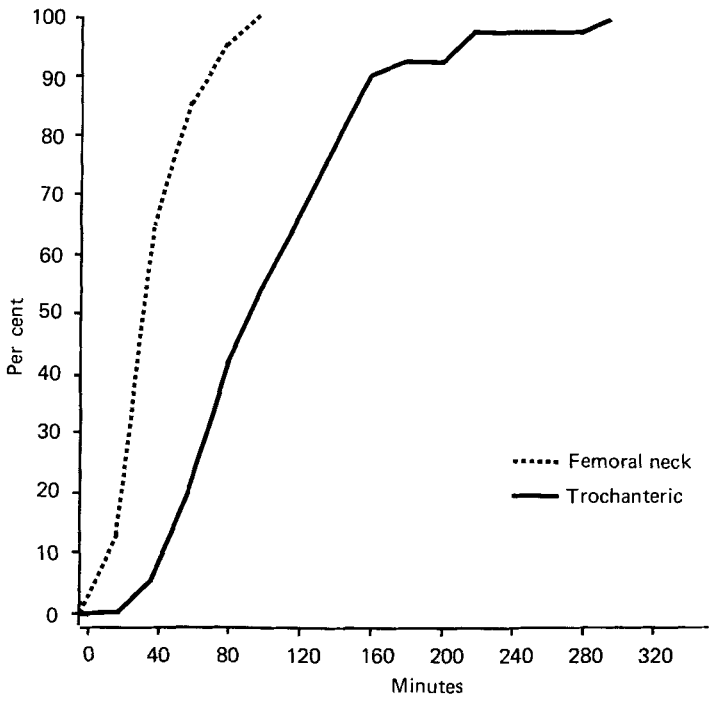

Fig.2. Duration of operation. The cumulative proportions of patients whose operations were completed after different lengths of time.

There was a striking difference in peroperative blood loss between patients with fractures of the femoral neck (147 +/- 94 ml) and those with trochanteric fractures (988 +/- 1461

ml). No sex difference was found. There was also a difference in the two groups regarding blood transfusion during operation. Only 6 % of the patients with femoral neck fractures required blood during operation, in contrast to the trochanteric fracture group, in which 74 % of the patients were transfused during operation and 29 % received more than 3 units.

The surgeon's opinion of the internal fixation performed was recorded. Eighteen trochanteric fractures and 2 fractures of the femoral neck were considered too unstable to permit early weight-bearing (a total of 15 %).

REDUCTION, NAILING AND EARLY FRACTURE COMPLICATIONS. The radiographs obtained at the end of the operation were analysed by the author as recommended by Garden for fractures of the femoral neck (10). For trochanteric fractures the conventional criteria were used. The reduction was unsatisfactory in 51 patients with fractures of the neck of the femur (36 %), and the usual fault was rotation posteriorly (18 %), laterally (11 %) or medially (8 %). Unsatisfactory reduction was noted in 47 patients (36 %) with trochanteric fractures. The most common problems were poor reduction of the antero-medial cortex (24 %), diastasis of the fracture (9 %) and varus displacement (7 %).

The position of the internal fixation material was also carefully analysed. The usual problem in fractures of the femoral neck (23 %) was that the tip of the nail was located anteriorly as a result of residual rotation (13 %) or that the nail penetrated the cartilage (10 %). In trochanteric fractures (18 %) the usual problem was penetration through the bone-cartilage border (9 %).

The total quality of the internal fixation (reduction and nailing) was also assessed. Fifty-five % of the internal fixations for femoral neck fractures and 53 % of those for trochanteric fractures were considered to be of good quality.

Early fracture complications were recorded in 31 patients during the hospital stay (11 %), and were equally distributed between the fracture groups. However, they had no substantial effect on the result. Within two months postoperatively 2 patients in the trochanteric group underwent reoperation (change of plates).

Twelve patients in the femoral neck group were reoperated upon within the corresponding period: 6 Moore prostheses were inserted, one was removed, one total hip prosthesis was inserted and 4 nails were extracted.

NURSING AND MOBILIZATION. A nursing scale (for explanation of scores see Table 2) was used to follow up the patients during treatment. After one week the mean score on this scale was 3.5; the extreme values were 2.9 for men with a femoral neck fracture, and 3.5 for women with a trochanteric fracture. On discharge from hospital the corresponding scores were 3.0, 2.4 and 3.5 respectively. Patients who stayed longer in the ward had a higher score from the beginning (Table 2).

Table 2. Mean nursing scores after different lengths of time in hospital. The scores range from 1 (easy nursing) to 5 (heavy nursing) and are based on body weight, confusion, inactivity, incontinence and nutritional problems.

Patients still in hospital	Score at 1 week	2 weeks	4 weeks	8 weeks
At 8 weeks (n = 15)	4.4	4.4	4.3	3.9
At 4 weeks (n = 60)	3.9	3.5	3.2	--
At 2 weeks (n = 92)	3.3	2.8	--	--

Most patients got up within the first week, but it took nearly 2 weeks before protected weight-bearing with a quadruped was possible. Men with femoral neck fractures became mobilized twice as quickly (mean 8 days) as women with trochanteric fractures (mean 18 days). The range was wide.

WOUND INFECTION. Early wound infection (purulent discharge + positive culture) was diagnosed in 28 of the 277 operatively treated patients, or every tenth patient (in the femoral neck group 6 % and in the trochanteric group 15 %). Operative treatment was performed in 19 cases (debridement of the wound or extraction of internal fixation material). The most common organism cultured was staphylococcus aureus. Infections in the femoral neck fracture group were more easily managed and not serious, but in the group with trochanteric fractures infection led to a fatal outcome in 5 patients. In 12 patients (10 women) bleeding and haematoma were noted postoperatively.

Wound infection was studied in the patients from their own homes and old people's homes (230 patients) by means of MDA. The basic preoperative explanatory variables (Table 1) were supplemented with indwelling catheter on admission or before operation and overweight (defined as weight in kg/(height in cm - 100) > 1.1). Peroperatively, only the basic variables were used (Table 1). Preoperative negative variables of interest were found to be trochanteric fracture, preoperative catheter treatment, overweight and male sex, in that order. Peroperatively the duration of operation was a negative factor and took the first place in the total order of sequence. When these factors were known, 88 % of the patients could be correctly classified. No postoperative factors were analysed.

URINARY TRACT INFECTION. Urinary tract infection (positive culture) was present in 45 patients (16 %) on arrival at the hospital. This figure also included 20 patients with an indwelling catheter on admission. At operation there were 9 more positive cultures and within the first week 76 more. One hundred and thirty patients (46 %) showed a positive culture within the first week of treatment. Urinary tract infection was more common in women than in men (chi2, $p = 0.02$). An indwelling catheter was used for retention in 75 patients and incontinence in 51. Intermittent catheterization was performed in 15 patients. Table 3 shows the relation between the start of the catheter treatment and positive urinary culture; surprisingly the pattern was the same irrespective of whether the patient did or did not receive a catheter.

Table 3. Number of patients with positive urinary culture in relation to time of start of catheter treatment during the first week in hospital (n = 117). Patients with indwelling catheter on admission are excluded.

Positive urinary culture	Catheter preop	Catheter perop	Catheter postop within 1 week	No catheter	Total
On admission	12	6	3	17	38
At operation	4	1	1	2	8
Within 1 week postop	19	10	25	17	71
Total	35	17	29	36	117

MDA was used to analyse acquired urinary tract infection in patients from their own homes or old people's homes with negative urinary cultures and without a catheter from the beginning. The basic variables (Table 1) were supplemented with overweight and catheter inserted before operation or at operation.

Preoperative negative variables were found to be age, trochanteric fracture and catheter treatment pre- or peroperatively. The number of previous fractures also appeared as a negative factor. No postoperative factors were analysed. Half of the patients (53 %) had an indwelling catheter on discharge from the hospital.

THROMBOEMBOLISM. This complication was diagnosed during the hospital stay in 30 patients (11 %). The clinical diagnosis was verified by phlebography in 3 patients and at autopsy in one. A clinical diagnosis of thromboembolism was more common in the trochanteric fracture group (15 %) than in the group with fractures of the femoral neck (7 %). No sex difference was found. Seven patients (2.5 %) died of pulmonary embolism within the first 4 months.

MDA was used to study the occurrence of thromboembolism in patients from their own homes or old people's homes. The basic explanatory variables (Table 1) were supplemented with overweight and type of anaesthesia. Preoperative variables of importance were trochanteric fracture and the number of previous fractures (both negative). In the peroperative step duration of operation was a negative factor. No postoperative factors were analysed.

HEART COMPLICATIONS. Myocardial infarction and cardiac insufficiency were diagnosed in 13 % of the patients, with no sex difference.

In the MDA of this group with heart complications, the basic variables (Table 1) were supplemented with accidental/internal cause of fracture, overweight, hypertension (diastolic blood pressure > 110 mm Hg), low B-haemoglobin on admission (< 110 g/l), previous history of heart disease, history of cardio-pulmonary restriction (NHA 1-4), normal/abnormal Ecg preoperatively, normal/abnormal chest X-ray preoperatively and type of anaesthesia.

In the preoperative step Ecg aberrations, cardio-pulmonary restriction (NHA scale) and day of operation (delay of operation) were negative factors and accidental fall a positive factor. In the peroperative step the type of anaesthesia was found to be of importance, epidural anaesthesia surprisingly being least favourable.

CONFUSION. Postoperative confusion was found in 11 % of the patients, more frequently in men (16 %) than in women (9 %). There were no differences with respect to fracture group.

In the MDA applied to people from their own homes or old people's homes, the following variables were included in addition to the basic variables: accidental/internal cause of fracture, hypertension (diastolic blood pressure > 110 mmHg), normal/abnormal Ecg, history of earlier neurological disease and pain on admission. Age, accidental fall, day of operation (delayed operation) and previous neurological disease were negative factors for the outcome, whereas sex (women) and great pain on admission were positive factors. No peroperative factors were found to influence the result and postoperative factors were not analysed.

PRESSURE SORES. Pressure sores were the most common complication and were noted in 18 % of the patients, without any evident relation to sex.

Of 52 patients recorded as having pressure sores, 5 already had ulcers on admission. In 2 of them these grew worse and in 3 patients more ulcers developed during treatment. Ten patients had calcaneal sores, 10 sacral/gluteal sores and 4 multiple sores. In 23 cases the location of the pressure sore was not recorded.

Two patients underwent plastic surgery (sacral sores). Sixteen of these patients with pressure sores could not be mobilized and died at an early stage during treatment.

MDA in the group of patients from their own homes or old people's homes included, in addition to the basic variables, overweight, underweight (defined as weight in kg/(height in cm - 100) < 0.8), low B-haemoglobin on admission, a history of neurological or psychiatric disease and type of anaesthesia.

Trochanteric fracture and age were negative preoperative factors and duration of operation a negative peroperative factor. The reduction of the fracture was also of importance.

RISK OF ANY COMPLICATION. The risk of development of any of the above-mentioned complications (heart complication, urinary infection, wound infection, thromboembolism, confusion and pressure sores) postoperatively was tested by MDA in the group of patients from their own homes or from old people's homes. The basic variables were supplemented with overweight, underweight, low B-haemoglobin on admission, history of previous neurological or psychiatric disease and poor hygiene/sores on admission. Preoperative negative factors were age, trochanteric fracture and day of operation (delay of operation). Peroperatively the duration of operation was a negative factor. The above

complications often occurred in combination (Table 4) and were also interrelated, for example urinary infection/pressure sores, urinary infection/confusion and wound infection/thrombosis (Table 5).

Table 4. Number of male and female patients with different postoperative complications (wound infection, thromboembolism, urinary tract infection, heart complications, confusion and decubitus) in the groups with trochanteric and femoral neck fractures.

	Women		Men		Total
No. of complications	Troch	Fem neck	Troch	Fem neck	
0	34	58	12	24	128
1	34	25	11	12	82
2	17	18	6	6	47
3	8	4	5	1	8
4	4	0	0	3	8

OTHER COMPLICATIONS. Other complications noted were pneumonia in 4 % of the patients (men 8 %, women 3 %), delirium in 3 patients and gastrointestinal bleeding in 5 patients. These complications were not specifically analysed. Peroneal paresis with drop foot was noted in 4 patients with trochanteric fractures, but the time of onset of the paresis could not be established.

Table 5. P values in a 2x2 table analysis (chi2 test) of the relations between some postoperative complications.

	Wound infect	Thrombo-embolism	Urinary tract infect.	Heart compl.	Confusion
Wound inf	-	-	-	-	-
Thromboemb	.007	-	-	-	-
Urin.tract	.159	.0694	-	-	-
Heart.compl	.631	.694	.305	-	-
Confusion	.246	1.000	.001	.884	-
Decubitus	.353	.072	.001	.400	.154

DISCUSSION

Wound infection in the trochanteric group was a serious complication. Antibiotic prophylaxis was not used generally in the patients of the present study, but Tengve & Kjellander (23) found in a study of trochanteric fractures at our hospital that the infection rate could be diminished from 16.9 to 1.9 % with Cephalothin/Cephalexin prophylaxis. Other authors have made similar observations (6). The method of operation used also has an impact on the infection rate - the larger the operative exposure, the higher the risk of infection (7, 16, 17). MDA confirmed that trochanteric fractures, especially in men with

overweight according to our definition, entailed a greater risk of wound infection. The duration of operation was also of importance. In our opinion Ender nailing or sliding nail plates with antibiotics are the best modern alternatives.

In this material we regarded a positive urinary culture as being equivalent to a urinary tract infection (5). The frequency of positive urinary cultures increases in the population with advancing age (4) and in the present material these were found in 45 patients without catheters on admission. The frequency of positive urinary cultures increased with increasing length of stay in hospital. Burnett (6) found 21 positive cultures in 307 patients on arrival at hospital, a figure about half of ours. Høivik found urinary tract infection in 8 % of his patients (18). In our material cultures were taken routinely on three occasions. This could partially explain our high figure for positive cultures. There is a very strong connection between indwelling catheters and urinary tract infection.

Half of our patients were treated with an indwelling catheter during their hospital stay, and modern anaesthetic routines (with increased used of spinal and epidural anaesthesia) might increase the use of bladder catheters in the future. We found that the frequency of positive cultures was not greatly influenced by the time of commencement of catheter treatment during the first week and consider that short-term treatment with an indwelling catheter treatment can be justifiable. The catheter should be removed as early as possible and it is remarkable that half of our patients left hospital with a catheter which they received during their treatment.

At MDA age was found to be an important factor for urinary tract infection, as were also a trochanteric fracture site and a history of previous fractures. It was calculated from the MDA equation that for a 75-year-old patient with a trochanteric fracture and a history of two previous fractures the risk of urinary tract infection would increase from 60 to 81 % if the catheter was used preoperatively. The corresponding increase for an essentially healthy 60-year-old patient with a fracture of the femoral neck would be 7 to 18 %. No specific difference in urinary tract infection was found between patients receiving pre- and peroperative catheter treatment.

Thromboembolism is a common and usually underestimated complication of hip fractures. The diagnosis is often made on a clinical basis and is often uncertain. The frequency of thrombosis in hip fracture materials has been reported to be 40-50 % if the diagnosis is made with iodine-fibrinogen or phlebography, and the frequency of lethal pulmonary embolism is about 7 % without prophylaxis (3). The frequency of pulmonary embolism in our material was relatively low, but cases of embolism could have been concealed in the pneumonia group. If lung scintigraphy is performed routinely in elective hip surgery, pulmonary embolism may be found in 20 % (3). Scintigraphy was not used in our material. In this study Dextran was used as prophylaxis against thromboembolism and it has been found previously to be of value (3).

One problem in our series of patients was the high frequency of cardiac decompensation, which was probably due to the schematic Dextran prophylaxis that was given for one week. This phenomenon was also observed by Honkonen (14). The optimal length of Dextran

prophylaxis is uncertain and only two 500-ml infusions may be insufficient (10). In patients with a history of cardiac disease, heparin is an alternative.

MDA showed that a trochanteric fracture site and a history of previous fractures were negative factors for the risk of thromboembolism and that a long operating time also increased this risk.

Heart complications were fairly frequent in our material and this was probably due to the above-mentioned one-week treatment with Dextran for prophylactic treatment of thrombosis. Blood transfusions were also extensively used and could have influenced the haemodynamics. The MDA analysis showed that a history of cardiopulmonary restriction and Ecg aberrations are of importance in finding the patients at risk. The day of operation (delay of operation) and the type of anaesthesia also had an impact on the outcome.

Confusion was a frequent complication in the postoperative period and could seriously impair the rehabilitation of the patient. The causes can include a low PaO_2 (13, 22) or the ageing person's reaction to the acute situation, resulting from so called cerebral insufficiency (1). Nutritional problems can also be symptoms of cerebral insufficiency. In the MDA old age, a previous history of a neurological disorder and delay of operation were found to be negative variables with respect to confusion. Pain was thought to predispose to confusion, but was found to be a positive variable (possibility of expressing oneself?). Patients with accidental falls ran a greater risk of developing confusion.

Decubitus is an important complication, especially in the heel area, and can delay rehabilitation (15, 24). At MDA age and a trochanteric fracture site were negative factors for decubitus, as was a long operating time.

The risk of any complication was studied with MDA. Old age, trochanteric fracture and day of operation (delay of operation) were negative variables for this risk, as was a long operating time.

It is concluded from the above findings that the older the patient and the larger the fracture, the earlier, the shorter, and the less traumatic should be the operation.

The length of stay in the acute department varied according to the preoperative habitation. The relative number of complications per day of hospital stay did not differ, however, between patients from the mental hospital or geriatric clinics, on the one hand, and those from their own homes and old people's homes, on the other (chi2 test, $p = 0.13$). However, there was a tendency towards fewer diagnosed complications in the former group, and they were therefore not included in the MDA.

MDA was used to try to find out which factors are important in the often multifactorial situations that prevail during clinical practice. The analysis has been used by Havig for thromboembolic patients (12) and by other authors for hip fracture patients. (8, 19).

Our analysis was performed in two steps with a hope of better identifying factors that could influence the outcome of treatment. When the patient arrives at the hospital many factors are available a priori, e.g. age, and we analysed age as the first variable preoperatively, which was not done, for example, by Ceder & Thorngren (9). We used age primarily even though some other interesting and age-related factors disappeared. The

stepwise procedure whereby selected preoperative variables were kept constant in the next step possibly overestimated preoperative variables in spite of the relatively low level of significance (0.1) that we chose. The MDA showed expected variables (selected before being tested by the author), and totally unselected testing would be of interest, but this would increase the risk of random errors. The result is also dependent on the mathematics used in the test method. In very closely correlated variables, one of the variables could spuriously become positive for mathematical reasons, and the other negative. This was found, for example, when we analysed length of time in traction and day of operation at the same time. Traction time was omitted in the final analysis.

The MDA indicated that an early operation and a short duration of the operation would be beneficial for the patient. The use of MDA or an equivalent analysis should be encouraged and efforts should be made to choose independent variables in future studies.

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