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WALKING ABILITY AND ACTIVITY LEVEL AFTER HIP FRACTURE IN THE ELDERLY – A FOLLOW-UP

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Objective: **The purpose of this study was to investigate which variables can predict walking ability and activity level 1 year after hip fracture and to describe changes over time regarding functional capacity.**

Subjects: **One hundred and fifty-seven patients (111 women, 46 men), mean age 80.9 (SD 9.5) years, operated on for hip fracture, and able to participate either fully or to some extent in performance tests approximately 1 week after operation were included. Due to high mortality and fragility, only 57 patients participated in the 1-year follow-up.**

Design and methods: **The patients were tested at discharge regarding physical performance, pain and bone mineral density. Status before fracture was evaluated by means of interview. At the 1-year follow-up, patients were also asked about their activities outside the home. A stepwise logistic regression was used for prediction.**

Results: **The patients had a significantly faster walking speed and better balance function after 1 year than before. The test "Timed up and go" was a strong predictor for both walking ability and activity level 1 year after hip fracture. Knowledge about the patient's walking habits outdoors before hip fracture and the degree of independent walking before hip fracture strengthened the prediction.**

Key words: physiotherapy, tests, hip fracture, prediction.

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INTRODUCTION

The proportion of elderly people is increasing in most countries. Sweden has one of the largest proportions of elderly people in the world. Eighteen percent are over the age of 65 years, and by the year 2010 this figure will have increased to about 26%. Osteoporosis and fragility fractures have become one of our most common disorders. Osteoporosis is characterized by reduced bone mass and a change in the micro architecture of the bone, which results in an increased risk of fracture. Hip fracture is one of the most prevalent fractures, and the risk of sustaining a hip fracture increases with age and is greater in women than in men. Hip fractures result in high costs for medical care, and they affect the functional ability of elderly people and their possibilities for independent living (1).

Hip fracture patients have a lower body mass index (BMI) and a lower bone mineral content (BMC) than controls (2). In the last decade, interest in bone mineral measurements has grown as a result of the general increase in the incidence of hip fractures, especially in the Western world. Bone mineral density (BMD) is now accepted as a predictor of fractures (3).

The predisposition for falls increases with age. About 80% of all 80-year-olds fall at least once a year (4). A hip fracture is often caused by a fall that occurs when rising from a sitting to a standing position, or vice versa. It is likely that poor postural control or reduced muscle strength in the lower extremities reduces stability when an elderly person changes his or her body position (5). Asymmetric vestibular function may also contribute to falls and hip fracture (6). The prevalence of lateral falls in older adults and the links to risk of hip fracture were demonstrated by Maki & McIlroy (7), who also stated that an impaired ability to execute compensatory stepping reactions sideways constitutes an explanation for the falls.

The ability to walk is an important and useful measure of functional capacity. Hip fracture patients have a lower mean speed 2 years after the fracture compared with a control group (8). In addition, postoperative walking ability has been shown to be of importance in recovery after a hip fracture (9).

According to Tornvall (10), grip strength is considered fairly representative of total body strength. Low grip strength is an important predictor for hip fracture after the age of 70 years.

Pain at loading on the operated hip is of importance regarding the ability to walk and perform transfers, and is a limiting factor in rehabilitation. No studies have been found on instruments that measure pain during movement and at loading among elderly people operated on for hip fracture.

A risk factor for falling is reduced balance capacity (11). Clinically useful tests are the "Get up and go" (GUG) (12) and the "Timed up and go" (TUG) (13). The TUG can be used for quantifying functional mobility as well as for evaluating clinical change over time. According to Okumiya et al. (14) a TUG result of over 16 seconds can also predict a fall.

Patients with hip fractures have more symptoms of diseases, are more afraid of falling and are less physically active than controls (5). The prognosis for rehabilitation is thus dependent

Table I. *Participant characteristics at discharge by gender and follow-up status. Mean (SD)/Median (Range) or* n *(%)*

	All patients ($n = 157$)				
	Women ($n = 111$)	Men ($n = 46$)	Patients followed up after 1 year ($n = 57$)	Dropouts ($n = 100$)	p-value[1]
Age (years)	82.6 (8.4) 83.8 (56–97)	76.6 (10.9) 80.4 (49–92)	77.9 (10.3) 81 (49–93)	82.6 (8.7) 83 (57–97)	0.009
Sex					
Women *n* (%)	111 (71%)		41 (72%)	70 (70%)	0.85 ns
Men *n* (%)		46 (29%)	16 (28%)	30 (30%)	
Dementia, n (%)	13 (12%)	7 (15%)	3 (5%)	17 (17%)	0.045
Days in hospital	24.2 (13.6) 24 (4–79) $n = 96$	19.6 (13.8) 14 (4–65) $n = 96$	21.5 (13.3) 21 (4–57) $n = 48$	23.6 (14.0) 21.5 (4–79) $n = 48$	0.32 ns
Weight (kg)	59.0 (10.2) 58.4 (39–91)	71.6 (11.7) 72 (46–98)	62.8 (11.0) 62.3 (45–98)	62.4 (13.1) 60.3 (39–91)	0.79 ns
Height (cm)	160.7 (7.5) 161 (46–185)	176.8 (6.1) 176 (168–190)	165.9 (10.0) 166 (146–190)	164.6 (10.4) 163 (149–186)	0.41 ns
BMI (kg/cm^2)	22.9 (3.3) 22.8 (14–30)	22.9 (4.1) 22.3 (16–38)	22.8 (3.6) 22.3 (16–34)	23.0 (4.1) 22.9 (14–38)	0.63 ns

[1] *p*-value represents a comparison at discharge between patients followed up 1 year after operation and dropouts (Mann Whitney U Test). Sex and dementia (Fisher's Exact Test).

on functional capacity before the fracture, and mobility before the fracture is a significant predictive factor for continuous independent living (15). Broos et al. (16) found that functional status before hip fracture and the possibility of walking at discharge were important when predicting the probability of returning home.

Few studies have been conducted concerning tests used by physiotherapists that can predict future functional status. A great number of tests are carried out to follow patient rehabilitation, but there is no homogeneity among different hospitals. It is therefore of interest to determine whether there are tests that can predict walking ability and activity level over time.

The purpose of this study was to investigate which variables can predict walking ability and activity level 1 year after operation and to describe changes over time.

MATERIAL AND METHODS

Patients

One hundred and ninety-nine consecutively chosen inpatients – 138 women (69%) and 61 men (31%) with a mean age of 81.4 years (SD 9.3, range 49–97 years) who were operated on for hip fracture (62% for cervical fracture and 38% for trochanteric fracture) were eligible for the study. The patients were treated in 2 different hospitals belonging to the same organization, at a specialized orthopaedic ward and a fracture geriatric rehabilitation ward, respectively.

Inclusion criteria. Patients who could participate either fully or to some extent in performance tests approximately 1 week after operation.

Exclusion criteria. Severe illness and severe dementia defined as inability to answer questions about patient's name, date of birth, age and the name of the hospital as well as patient's home address, month of the year and season.

Forty-two patients (27 women and 15 men) with a mean age of 83.5 years (SD 8.1, range 61–96 years) were then excluded due to severe illness ($n = 7$), death ($n = 6$), refusal to participate ($n = 1$), an inability to co-operate due to severe dementia ($n = 5$), a missing test protocol (1), or because they were sent back to their nursing homes early and could thus not be tested ($n = 22$).

One hundred and fifty-seven patients with a mean age of 80.9 years (SD 9.5, range 49–97 years) were included in the study (Table I).

At the follow-up 1 year after operation, 57 patients were able to take part in the study. Of the 100 dropouts, 29 died within a year and of the 42 patients excluded from the beginning, 22 died within a year.

The study was not judged by an Ethical Committee since there was no ethical dilemma. The patients were not exposed to anything that is not a part of normal clinical praxis.

Physical status before fracture

The classification was based on an interview carried out in accordance with a Swedish national investigation (17) where *independent walking* was classified according to the following alternatives: walking alone outdoors [code: 1]; walking outdoors only when accompanied [2]; walking alone indoors – not outdoors [3]; walking indoors only when accompanied, not able to walk but able to sit in a chair or bedridden [4]. *Walking habits outdoors* were classified as follows: every day [1]; every week [2]; a few times a month [3]; a few times a year [4]; only outside when going by car or was not outdoors before fracture [5]. *Use of walking aids* was registered as walking without aids, walking with cane(s) or crutch(es), with a walking frame, a walking frame with wheels, or a support walker, sitting in a wheelchair, bedridden.

Measurements after fracture

Bed transfers. Lying to sitting, lying down, transfer from bed to chair, and rising from a 47-cm high *armchair* using the arms for assistance were classified as being performed alone, with supervision, with the help of 1 or 2 persons or as being unable to be done. The Elderly Mobility Scale (EMS), which includes some of the transfer tests, has been found to be reliable and valid when used with frail hospitalized elderly people (18).

Walking 10 metres at a self-selected speed (metres/second) was tested in a corridor. Use of walking aids was recorded and degree of dependency was classified as walking alone, with supervision, with the help of 1 or 2 persons, or unable to walk that distance. The test is reliable, sensitive and has good validity (19).

Walking 30 metres at maximum speed (metres/second). Use of walking aids and degree of dependency were noted as above.

Balance while standing was classified as safe without support >1

Table II. *Distribution of results for tests at discharge for all patients and for discharge and after 1 year for patients measured at both occasions. Continous variables, Mean (SD)*

	Values at discharge			Patients measured both at discharge and after 1 year		
	Dropout group $n = 100$	Follow-up group $n = 57$	p value[1]	Discharge	1 year	p value[2]
Variable						
Walking 10 meters, metres/second (self-selected speed)	0.42 (0.22) $n = 80$	0.46 (0.17) $n = 48$	0.07 ns	0.47 (0.18) $n = 43$	0.68 (0.28) $n = 43$	<0.0001
Walking 30 metres, metres/second (maximum speed)	0.53 (0.30) $n = 55$	0.65 (0.25) $n = 36$	0.009	0.64 (0.25) $n = 34$	0.71 (0.31) $n = 34$	0.18 ns
TUG, seconds	45.7 (23.4) $n = 63$	37.7 (18.7) $n = 45$	0.058 ns	37.3 (18.1) $n = 43$	28.3 (17.8) $n = 43$	0.0002
Grip strength, kg/cm^2 (mean-left, right)	20.4 (9.4) $n = 83$	23.9 (8.7) $n = 48$	0.009	23.4 (8.5) $n = 46$	24.8 (11.5) $n = 46$	0.32 ns
PEF, 1/min	260 (142) $n = 61$	291 (95) $n = 37$	0.08 ns	291 (95) $n = 37$	284 (100) $n = 37$	0.50 ns

[1] p-value represents a comparison at discharge between dropouts and follow-up patients (Mann-Whitney U test).
[2] p-value represents changes over time, from discharge until 1-year follow-up (Wilcoxon Signed Rank test).

minute, need for supervision, or need for help. One of the items in the Berg Balance Scale is standing. The scale has good validity and reliability (20).

Get up and go (GUG.) The patient is asked to stand up from a sitting position in an armchair, walk 3 metres, turn around, walk back and sit down. The performance is classified as normal, very slightly abnormal, mildly abnormal, moderately abnormal or severely abnormal. When using a walking aid, such as crutches or a walking frame on wheels, balance was considered as very slightly abnormal, and when using a walker, balance was graded as severely abnormal. The GUG is considered to be reasonably reliable and consistent (12).

Timed up and go (TUG). This is the same test, but performance is timed in seconds. General directions and instructions to the patient were in accordance with Thompson & Medley (21). The TUG is a reliable and valid instrument for quantifying functional mobility (13).

Grip strength was tested with a dynamometer (Baseline Hydraulic Hand Dynamometer). Values for the left and the right hand as well as the mean value for both hands were recorded in kg/cm^2 when the patient was sitting with his/her elbow in 90° flexion. The best results of 3 trials were registered. Mathioweiz et al. evaluated the reliability of 4 tests of hand strength. The results showed very high inter-rater reliability and high test-retest reliability (22).

Lung function. Peak expiratory flow (PEF) (23) in litres/minute was measured with the patient in a sitting position. The best result of 3 attempts was recorded. A PEF-recorder was used.

Pain at loading. The experience of *pain* was evaluated while standing after having walked 10 metres – a 10-grade scale was used (24). The patient was acquainted with the scale before the assessment.

Measurements of osteoporosis. Bone mineral density (BMD) of the opposite hip was measured by Dual Energy X-ray absorptiometry (DXA) using Hologic QDR-2000plus in g/cm^2 and a *t*-score. An experienced nurse at a specialized osteoporosis unit performed these measurements.

Weight and height were measured in connection with the DXA-tests.

Body mass index (BMI in kg/cm^2) was calculated from weight and height.

Motivation was assessed by the physiotherapist at 1 of 3 levels – high, some, none.

The observers have done repeated tests before the study in order to get a high interobserver reliability. Concordant analyses between 1 or several pairs of physiotherapists at different occasions have been carried out.

Predictor variables

All the above measurements along with age were used as initial predictor variables. At the 1-year follow-up an interview was conducted concerning activity level, which included activities outside the home, walking and pain.

As many components comprised the outcome variables, definitions of walking and activity level were constructed. The *dependent variables*, walking ability and activity level, were defined as follows based on clinical experience and the literature.

Walking ability 10 metres at a self-selected speed indoors

Good walking ability. (a) Walks alone, (b) with or without a cane, (c) in less than 15 seconds.

Moderate walking ability. (a) Walks with supervision, (b) with 2 canes, a walking frame on wheels or a support walker, (c) in less than 30 seconds.

Poor walking ability. Poorer ability to walk than the above.

Activity level

High activity level. (a) Walks alone outdoors, (b) walks every day, (c) takes part regularly in 3 or more activities outside the home (such as gardening, visiting (grand)children, walking, working, participating in a union/gymnastic club, shopping, travelling).

Moderate activity level. (a) Walks outdoors when accompanied, (b) walks outdoors every week or a few times every month, (c) takes part regularly in 2 activities outside the home.

Low activity level. Lower activity level than the above.

A minimum of 2 out of 3 items (a, b, c) in each ability/level had to be achieved.

Procedure

The patients were tested 7 days after operation, at discharge from hospital, and 1 year after operation regarding ambulation, transfers in/out of bed, balance, pain, muscle strength and breathing. The surgery was carried out at an orthopaedic clinic at Sahlgrenska University Hospital in Göteborg, Sweden. Most patients continued their rehabilitation at a geriatric clinic. The tests were carried out by 12 physiotherapists who also interviewed the patients or their relatives about the patient's walking abilities and habits before the operation. At the time of discharge bone densiotometry (DXA) of the whole body, the lumbar spine and the opposite hip was carried out on patients who were able to participate. Measurements of weight and height for these patients were done at the same time. The 1-year follow-up visit took place at an outpatient clinic. Interviews regarding activities, walking and pain were carried out at this visit.

For clinical reasons, we chose values for the different variables included in the test protocol that were obtained at the time of the patients' discharge from hospital as the predictor variables. Thus, results from 1 week after operation are not used in this model. The follow-up time of 1 year after operation was chosen as the dependent outcome variable in the final logistic model.

Within a period of 1 year and 9 months (September 1996–May 1998), all the patients had gone through all tests and interviews – from the start at the hospital until the 1-year follow-up at a geriatric outpatient clinic.

Regarding death, all patients were followed for a minimum of 18 months, and the end point was 6 months later – November 1998.

In the statistical calculations, the remaining 71 patients comprising the dropouts, who could not be tested due to their poor condition or new, serious conditions (e.g. stroke, heart attack, fracture of the other leg, confusion), were classified as having "poor walking ability" and a "low activity level" at the 1-year follow-up. These very frail patients were staying in nursing homes, sheltered accommodation, residential homes or in hospitals. The 29 patients who had died during the first year were classified in the same way. Thus all 100 dropouts were classified as having "poor walking ability" as well as a "low activity level".

Statistical methods

Distributions of variables are given as means, standard deviations (SD), medians and ranges or numbers with percentages. Survival curves were calculated with the product limit estimate, the Kaplan-Meier survival curve. The Spearman rank correlation coefficient was used for all correlation analyses. Within group changes over time for continuous variables were analysed with the Wilcoxon Signed rank test for matched pairs and for ordered variables with the Sign test.

For comparisons between 2 groups the Mann-Whitney-U test was used for continuous variables, Mantel-Haenszel's chi-square test (25) for ordered variables, and Fisher's exact test for dichotomous variables.

In order to study the relationship between the dependent variables "walking ability", "activity level" and the predictors, a primary correlation test between each predictor and each dependent variable was carried out. Selected significant clinical variables together with significant bone mineral density variables (only significant for activity level) from the primary analysis were then entered into stepwise logistic regression models (see Table IV), 1 for predicting "good" and 1 for predicting "good + moderate". The probabilities of moderate and good/high "walking ability" and "activity level" for a patient are then calculated by the formula $P = 1/(1 + e^{-LC})$. The linear combination (LC) in the logistic model can be determined by multiplying a given coefficient by the numeric value of the respective factor for the patient and then adding the products and the intercept. For model discrimination the c statistic was calculated, where the value c denotes the probability that a randomly chosen patient will be classified in the true group conditional on the predictor variables in the model. All significance tests were two-tailed and conducted at the 5 % significance level.

RESULTS

Patients were significantly older and suffered to a greater extent from dementia in the dropout group than in the follow-up group (Table I). In the initial group of 157 patients, women had a higher mean age than men did ($p = 0.001$), but in the follow-up group ($n = 57$) no difference in age ($p = 0.16$) could be found. Among the dropouts ($n = 100$), women were older (mean 84.5, SD 7.6) than men (mean 78, SD 9.5) ($p = 0.0009$).

Differences at discharge and changes over time from discharge to the 1-year follow-up

The follow-up group showed significantly better results in maximum walking speed and grip strength than the dropout group as early as at discharge (Table II). A significant difference could also be found for all transfers from bed, for balance measured with the GUG test, independence in walking 10 metres, 30 metres, and for motivation (Table III).

After 1 year, walking 10 metres at a self-selected speed (+0.21 metres/second) and time for the balance test (−9 seconds) had improved significantly (Table II). The patients also had significantly better balance, were using less support when walking with aids indoors and experienced less hip pain (Table III).

Prediction of walking ability and activity level at the 1-year follow-up

Good walking ability was achieved by 25 (16%) patients, moderate by 24 (15%) and low by 108 (69%). High activity level was achieved by 27 (17%) patients, moderate by 12 (8%) and low by 118 (75%).

The following variables were significantly correlated with walking ability at the 1-year follow-up: age, prefracture outdoor walking habits and independent walking, transfer from bed to chair, walking aids indoors and outdoors, independence and speed in walking 10 metres, time to accomplish TUG, standing balance, lung function, motivation and grip strength (Table IV). The same variables and, in addition, height and BMD (grams and *t*-score) were found to be significantly correlated to activity level at the 1-year follow-up. The following variables were then entered into the final stepwise logistic regression model: age, prefracture outdoor walking, prefracture independent walking, transfer from bed to chair, independence and speed in walking 10 metres, time to accomplish TUG, standing balance, grip strength and bone mineral density (only regarding activity level).

The results from the logistic regression analysis in Table V predicting good walking ability showed that frequent walking outdoors before fracture (odds ratio OR, 0.25; 95% CI 0.08–0.81) and a short performance time on the TUG balance test (OR 0.95; 95% CI 0.91–0.99) were the strongest determinants for whether elderly patients operated on for hip fracture would have good walking ability after 1 year. Even when predicting good or moderate walking ability after 1 year, these 2 variables were the strongest predictors, although the TUG was not significant. The probability of classifying the patients correctly in terms of future walking turned out to be high in both models ($c = 0.82$ and $c = 0.68$, respectively).

Regarding activity level, a short performance time on the same balance test as above was the strongest predictor for high activity level (OR 0.95; 95% CI, 0.91–0.99). In the second model for predicting high or moderate activity level, the degree of independence when walking before the fracture was the strongest predictor (OR 0.13; 95% CI 0.03–0.52), as well as a short performance time on the TUG-test (OR 0.97; 95% CI 0.95–1.003), although the latter was not significant. The probability of classifying the patients into the correct future activity level turned out to be high in both models ($c = 0.70$ and $c = 0.75$, respectively) (Table V).

The findings indicate that future walking ability can be predicted by the frequency of walking outdoors before the fracture and by performance time on the TUG balance test at discharge from hospital. Activity level after 1 year can be predicted by the degree of independence in walking before the fracture and by performance time for the TUG balance test at discharge.

Mortality

Fifty-one (25.6%) of the total of 199 patients died during the first year after operation, and 63 (31.7%) died within 1.5 years. The survival distribution function and associated 95% confidence interval based on all patients are given in Fig. 1. One-year survival was estimated at 73.9%, CI: 67.8–80.0%, and the 2-year survival at 61.9%, CI: 54.9–68.8%.

Table III. *Distribution of results for tests at discharge for all patients and for discharge and after 1 year for patients measured at both occasions. Discrete variables,* n *(%)*

	Values at discharge			Pat measured both at discharge and after 1 year		
Variable	Dropout group $n = 100$ n (%)	Follow-up group $n = 57$* n (%)	p value[1]	At discharge $n = 55$* n (%)	After 1 year $n = 55$ n (%)	p value[2]
Lying to sitting			<0.0001			1.0 ns
On his/her own	63 (64)	52 (94)		52 (94)	52 (94)	
With supervision	7 (7)	1 (2)		1 (2)	0 (0)	
With help	28 (29)	2 (4)		2 (4)	3 (6)	
Unable to do	0 (0)	0 (0)		0 (0)	0 (0)	
Lying down			0.002			1.0 ns
On his/her own	69 (70)	51 (93)		51 (93)	51 (93)	
With supervision	5 (5)	0 (0)		0 (0)	1 (2)	
With help	23 (24)	4 (7)		4 (7)	3 (5)	
Unable to do	1 (1)	0 (0)		0 (0)	0 (0)	
From bed to chair			0.0002			0.29 ns
On his/her own	55 (57)	47 (85)		47 (85)	51 (93)	
With supervision	15 (16)	5 (9)		5 (9)	1 (2)	
With help	25 (26)	3 (6)		3 (6)	3 (5)	
Unable to do	1 (1)	0 (0)		0 (0)	0 (0)	
Rising from chair			0.0002			1.0 ns
On his/her own	62 (63)	50 (91)		50 (91)	51 (93)	
With supervision	9 (9)	2 (4)		2 (4)	1 (2)	
With help	26 (27)	3 (5)		3 (5)	3 (5)	
Unable to do	1 (1)	0 (0)		0 (0)	0 (0)	
Standing balance			0.09 ns			0.27 ns
On his/her own	45 (47)	32 (59)		31 (60)	36 (69)	
With supervision	16 (17)	10 (19)		10 (19)	6 (12)	
With help	34 (36)	12 (22)		11 (21)	10 (19)	
Balance Get up and go			0.0002			<0.0001
Normal	0 (0)	2 (4)		2 (4)	21 (40)	
Very slightly abnormal	48 (49)	41 (76)		40 (77)	28 (54)	
Mildly abnormal	18 (19)	6 (11)		5 (9)	0 (0)	
Moderately abnormal	27 (28)	4 (7)		4 (8)	0 (0)	
Severely abnormal	4 (4)	1 (2)		1 (2)	3 (6)	
Walking 10 metres			0.0002			1.0 ns
On his/her own	53 (56)	48 (87)		48 (87)	49 (89)	
With supervision	14 (15)	4 (7)		4 (7)	3 (5)	
With help	16 (17)	1 (2)		1 (2)	0 (0)	
Unable to do	11 (12)	2 (4)		2 (4)	3 (5)	
Walking aids 10 metres			0.053 ns			<0.0001
Without	2 (2)	0 (0)		0 (0)	22 (44)	
Canes/crutches	13 (15)	14 (26)		14 (28)	3 (6)	
Walking frame/ with wheel	57 (66)	37 (70)		34 (68)	25 (50)	
Support walker/pers assist	15 (17)	2 (4)		2 (4)	0 (0)	
Walking 30 m			0.0007			0.23 ns
On his/her own	45 (51)	43 (81)		43 (81)	47 (89)	
With supervision	12 (14)	4 (8)		4 (8)	3 (6)	
With help	6 (7)	1 (2)		1 (2)	0 (0)	
Unable to do	25 (28)	5 (9)		5 (9)	3 (6)	
Motivation			0.006			1.0 ns
High	12 (16)	12 (28)		11 (28)	12 (31)	
Some	42 (58)	28 (67)		26 (67)	23 (59)	
None	19 (26)	2 (5)		2 (5)	4 (10)	
Pain at load			0.47 ns			<0.0001
0 no	11 (18)	2 (4)		2 (5)	25 (64)	
0.5–3 little	38 (61)	33 (74)		31 (80)	10 (26)	
4–10 much	13 (21)	10 (22)		6 (16)	4 (10)	

* 57 patients came to follow-up and of these only 55 performed the discharge test.
[1] p value represents a comparison at discharge between dropouts and follow-up patients (Mantel Haenszels Test).
[2] p value for changes over time (Sign test).

Table IV. *Significant predictor variables at discharge for walking ability after 1 year, 10 metres, and activity level after 1 year. Spearman correlation coefficients and p-values*

	Walking ability 10 metres, 1 year		Activity level after 1 year	
	Spearman (r_s)	*p* value[1]	Spearman (r_s)	*p* value[1]
Predictors at discharge				
Age	0.28	<0.0004	0.33	<0.0001
Height	−0.16	0.10 ns	−0.26	0.01
Prefracture outdoor walking	0.37	<0.0001	0.42	<0.0001
Prefracture independent walking	0.31	0.0001	0.40	<0.0001
Prefracture walking aids indoors	0.23	0.004	0.24	0.003
Prefracture walking aids outdoors	0.33	0.0001	0.37	<0.0001
Bed to chair	0.34	<0.0001	0.33	<0.0001
Walking 10 metres (independence)	0.27	0.002	0.30	0.0003
Walking 10 metres (self-selected speed)	0.23	0.008	0.29	0.0009
Standing balance	0.24	0.004	0.29	0.0004
Balance Timed up and go	0.25	0.009	0.29	0.003
Grip strength	−0.30	0.0007	−0.37	<0.0001
Peak expiratory flow	−0.25	0.01	−0.33	0.001
Bone mineral density Hip grams	−0.21	0.056 ns	−0.33	0.003
Bone mineral density Hip t-score	−0.20	0.06 ns	−0.30	0.005
Motivation	0.28	0.003	0.37	<0.0001

[1] *p* values are calculated using the continous variables, not the catgorized variables.

DISCUSSION

The present study demonstrates that at discharge there was already a large difference between the dropouts and the follow-up group regarding functional status. Out of 15 test variables, only 4 showed no significant differences between the 2 groups.

The frequency of walking outdoors before a fracture and the amount of time needed to perform a functional balance test constitute the most important knowledge needed for predicting future walking ability after 1 year in patients operated on for hip fracture. The degree of independence while walking before a fracture and performance in the balance test were important factors for predicting future activity level. Similar tests, used elsewhere, showed that age and physical performance measures (grip strength and maximum walking speed) were the most important factors for predicting future functional status of community-dwelling older adults (26).

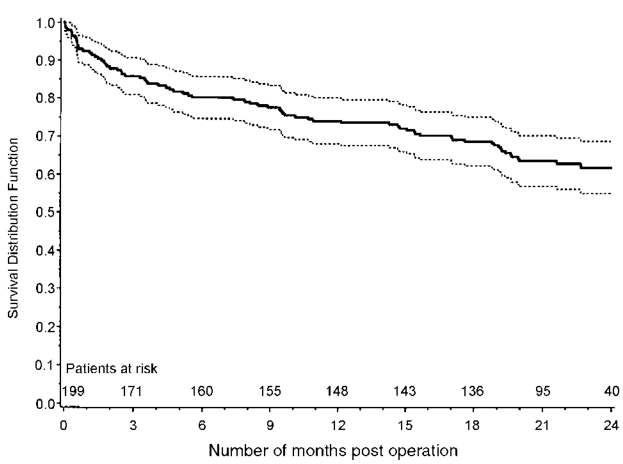

Fig. 1. Kaplan-Meier estimate of the survival distribution function and associated 95% confidence interval.

This study was performed in a real clinical situation where all hip fracture patients operated on during a certain period were included. Many patients were very frail, resulting in many dropouts in the different tests. The large number of physiotherapists involved is another reason for the many internal dropouts. During the time of the study several epidemics of intestinal disorders were flourishing, which caused the patients to be even frailer and prolonged their hospitalization.

Approximately 26% of the initial 199 patients died within 1 year of operation. These figures are similar to findings reported in the literature (1, 9). According to Schurch et al. (27) the mortality was significantly higher than for the general population.

The TUG test is a well-known and frequently used test for frail elderly people. The test measures a combination of functional mobility and balance. In our study the TUG turned out to be the most important instrument in all the final results regarding prediction of future walking ability and activity level. It can therefore be strongly recommended for this type of analysis. The mean time for performing this test for the follow-up patients in the present study (mean age 77.9 years) was 28.3 seconds 1 year after fracture. Healthy elderly persons with a mean age of 75 years have been shown to perform the TUG in 10 seconds or less (13), whereas subjects (mean age 81 years) with different functional and cognitive status living in residential care facilities performed the TUG from 16.1 to 28.6 seconds on average (28). Performance time becomes longer when a cane is introduced (21). This could possibly explain the low speed

Table V. *Results of stepwise logistic regression for the outcome variables "Walking ability, 10 metres", and "Activity level" regarding predictors at discharge*

Model	Variables	Regression	SE	OR (95% CI)	*p*	Coefficient
Walking ability, 10 metres						
Good $n = 19$						
	Intercept	2.41	1.08			
	Prefracture outdoor walking	−1.38	0.60	0.25 (0.08–0.81)	0.020	
	Balance (Timed up and go)	−0.053	0.023	0.95 (0.91–0.99)	0.019	c = 0.82
Walking ability, 10 metres						
Good or Moderate $n = 38$						
	Intercept	1.09	0.56			
	Prefracture outdoor walking	−0.39	0.19	0.68 (0.47–0.98)	0.037	
	Balance (Timed up and go)	−0.022	0.011	0.98 (0.96–1.000)	0.054 ns	c = 0.68
Activity level						
High $n = 20$						
	Intercept	0.49	0.72			
	Balance (Timed up and go)	−0.054	0.020	0.95 (0.91–0.99)	0.009	c = 0.70
Activity level						
High or Moderate $n = 31$						
	Intercept	2.67	0.92			
	Prefracture independent walking	−2.07	0.72	0.13 (0.03–0.52)	0.004	
	Balance (Timed up and go)	−0.023	0.013	0.97 (0.95–1.003)	0.087 ns	c = 0.75

achieved by the patients in the present study, where 56% used walking aids after 1 year. The TUG can also predict a person's ability to walk outside independently. Those who perform the test in less than 20 seconds are generally independent in transfers and are able to walk outdoors on their own, whereas those who need more than 30 seconds tend to be more dependent on help in transferring to a chair or the toilet (13).

Significant improvements in results were found between discharge and the 1-year follow-up regarding walking 10 metres at a self-selected speed (metres/second), balance tested with the GUG and the TUG, use of walking aids, and pain at loading. It can therefore be advisable for physiotherapists to concentrate on these items when evaluating a patient after hip fracture.

The choice of variables for the last step in the logistic regression analysis was based on clinical reasoning. Patient motivation plays an important role in physiotherapy treatment, but that variable could not be used in the model since the scale has not been tested for validity or reliability. Nor could walking aids, height or PEF influence the prediction results.

Weak grip strength is associated with an increased risk of falling (29). In the present study patients in the follow-up group were already stronger than the dropout group at discharge, but there was no improvement in strength after 1 year. Although grip strength turned out to be a significant predictor variable in the first step in the logistic regression, it was not predictive in the last step of the analysis.

In the present study, the walking test did not predict future walking ability or activity level. It has however been demonstrated that maximum walking speed at age 70 years could predict dependence in ADL 6 years later (30). A different study has shown that self-selected speed was most sensitive in predicting the onset of functional dependence for people over 75 years and maximum walking speed was most sensitive for people aged 65–74 years (31). In fact walking speed is an important component in TUG, the test that turned out to be the strongest predictor in the present study.

Self-selected speed for walking 10 metres had improved after 1 year but no significant improvement had taken place regarding maximum speed. Possibly feelings of anxiety and fear of falling influenced the test of maximum speed. The fact that there was no improvement regarding standing balance – 19% still needed help and 50% still used some kind of walking frame – indicates that extended physiotherapy and other rehabilitation efforts are needed after discharge. The fact that no improvement was demonstrated regarding transfers is probably due to good capability at the time of discharge.

The diagnosis osteoporosis is given when the *t*-score is below −2.5 SD, meaning that 81% of the patients in our study suffered from this disease and should therefore have been recommended adequate treatment. A problem with measuring bone density is that some of the frailest patients cannot be positioned in the bone densiotometry equipment and therefore cannot be tested.

It is obvious that the patients who were most healthy at discharge were those who came back for follow-up after 1 year. This finding leads to a question concerning the setting of priorities with respect to rehabilitation.

It is essential that physiotherapists choose adequate tests in the early examination of the patient, both for the patient's benefit and with respect to cost-effectiveness. There will be savings in both time and energy if only a few tests are needed. The results suggest that the balance test TUG is a usable measure not only for quantifying functional mobility but also for predicting walking ability and activity level for elderly patients 1 year after hip fracture. Frequent walking outdoors before fracture is also important for predicting walking ability. When predicting activity level 1 year after fracture, independence in walking before the fracture is an additional factor of importance.

Further research is needed that elucidates the importance of greater rehabilitation efforts, specially for the group of patients predicted to have moderate walking ability and activity level 1 year after hip fracture.

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