Geriatrics & Gerontology INTERNATIONAL Medline Indexed

Geriatr Gerontol Int 2013; **13:** *334–341*

ORIGINAL ARTICLE: EPIDEMIOLOGY, CLINICAL PRACTICE AND HEALTH

More than half of hip fracture patients do not regain mobility in the first postoperative year

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Aim: To measure functional recovery and determine risk factors for failure to return to the prefracture level of mobility of hip fracture patients 1 year postoperatively.

Methods: A prospective cohort follow-up study of 390 hip fracture patients aged 65 years and older was carried out. Patients were stratified in categories based on prefracture mobility: mobile without aid, with aid in- and outdoors, or only mobile indoors. Immobile patients were excluded. Risk factors for not regaining prefracture mobility were identified.

Results: Nearly half of all patients regained their prefracture level of mobility after 1 year. Mobile patients without an aid were less likely to return to their prefracture mobility level compared with patients who were mobile with aid or mobile indoors. After 1 year, 18.7% of all patients had become immobile. Most important independent risk factors for failure to return to the prefracture level of mobility were a limited prefracture level of activities of daily living and a delirium during admission.

Conclusions: The risk not to regain prefracture mobility is highest in mobile patients without an aid. The risk of becoming immobile is higher in those having a lower prefracture mobility. Activities of daily living dependence and delirium were the main risk factors for not regaining mobility. **Geriatr Gerontol Int 2013; 13: 334–341**.

Keywords: functional recovery, hip fracture, mobility, risk factors.

Introduction

Hip fractures are an important cause of loss of function in the aging Western population.[1–4] Increasing life expectancy is accompanied by a higher number of fragility fractures.[5] The total number of hip fracture patients aged 50 years and older has been estimated to increase to over 500 000 in the USA by 2040.[5] The reported percentage of patients regaining their prefracture level of mobility varies largely between 11% and 82%, depending on the studied patient population.[1,3,4,6–9] As a result of the loss of mobility after a hip fracture, patients are often restricted in their daily activities, causing loss of confidence and independence.[1,4] Economically, the impact of deterioration of mobility is large as well; medical costs for hip fracture patients were about threefold greater than those of age- and residence-matched controls without a fracture.[10]

Older age, poor health status, a limited prefracture level of activities of daily living (ADL) and cognitive impairment have previously been identified as the main negative contributors to long-term functional outcome after a hip fracture.[11] Many other factors, such as sex, race, prefracture residence, hemoglobin level, type of fracture, delirium during admission and length of stay, show inconsistent results with respect to long-term outcome.[4,12–17]

The majority of previous studies describe functional outcome (i.e. the level of daily activities and dependency)[2–4,12,14,16–18] rather than walking ability solely.[7–9,13,15] Furthermore, just a few had a follow up of 1 year or longer.[3,6,8,12,16]

In this study, we present the mobility of hip fracture patients before admission, and at 3 and 12 months postoperatively. The main goals were to measure functional recovery and to identify risk factors for failing to return to the prefracture level of mobility in the first year after a hip fracture.

Accepted for publication 13 May 2012.

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Methods

Patient cohort

A prospective observational cohort study of 444 consecutive admissions for a hip fracture in 429 patients was carried out. All patients were aged 65 years and older, and were admitted to a 450-bed teaching hospital (Delft, the Netherlands) between January 2008 and December 2009. Patients with a fracture as a result of a high-energy trauma or with a pathological fracture were not included in this cohort. Patients with a contralateral hip fracture within the time window of the study ($n = 15$), those who were treated conservatively ($n = 12$) and patients who were immobile before admission ($n = 12$) were excluded from the current study. Thus, 390 patients were included for final analysis. The length of follow up for all patients was 12 months.

Data collection

Uniform collection and recording of all patient' data was achieved by standard evaluation at admission, and after 3 and 12 months according to the standardized care pathway for hip fracture patients. Age, sex, presence of a partner and prefracture place of residence (living in their own home or in institutionalized care; i.e. a residential home or a nursing home) were registered at admission.

Clinical characteristics obtained during the hospital stay were American Society of Anesthesiologists (ASA) Physical Status classification, presence of dementia (based on the medical history and history-taking from patients, family and caretakers) or anemia at admission based on the criteria of the World Health Organization (hemoglobin level below 7.5 mmol/L [12 g/dL] in women and below 8.1 mmol/L [13 g/dL] in men), type of fracture and treatment, diagnosis of delirium based on Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV criteria, and length of stay (LOS).[19,20]

The in-hospital, 3- and 12-month mortality rate of the patients was scored meticulously by repeated consultation of the population registers of the counties in the region of both hospitals, as well as the hospital's patient registration systems for the full length of follow up.

Level of mobility and activities of daily living

Mobility was registered at admission, and at 3 and 12 months after hip fracture during routine follow up in the outpatient clinic, or by a questionnaire sent to patients or caretakers in case of dementia. Mobility was divided into four categories: mobile in- and outdoors without the use of an aid, mobile in- and outdoors with the use of an aid in- and/or outdoors, only mobile indoors regardless of the use of an aid, and those who were immobile both in- and outdoors. A cane, crutch(es) or walker were all considered an aid. Patients in a wheelchair or those who were bedridden were considered to be immobile. As aforementioned, immobile patients ($n = 12$) were excluded from the present study.

The Groningen Activity Restriction Score (GARS) was used to assess the functional ADL.[21] It includes competence in abilities in 11 personal basic ADL and seven instrumental ADL. A summed score for the ADL was calculated ranging from 18 (indicating ability to carry out all activities without assistance or undue effort) to 72 (indicating disability). A higher GARS score therefore represents a lower level of ADL.

Statistical analysis

Categorical data are presented as the numbers, along with the percentages. The χ^2-test and Fisher's exact test were used for comparing groups of categorical data.

Bivariate analysis was carried out for the whole cohort and for the three different prefracture mobility categories. Age, sex, presence of a partner, intraoperative risk (ASA classification I/II *vs* III/IV), dementia, anemia at admission, prefracture level of ADL (high *vs* low GARS), prefracture place of residence (own home *vs* institutionalized care), type of fracture (intra- *vs* extracapsular hip fracture) or treatment (osteosynthesis *vs* [hemi-] arthroplasty), delirium during admission and LOS (≤ or >10 days) were included in the analysis, being possible independent risk factors.

Age, ADL and LOS were used as a binary outcome, based on the median value. For the analysis of the three mobility categories, the median values of the age and GARS of the specific category were used, LOS was ≤ or >10 days in all analysis. Multivariable logistic regression analysis was carried out in the same groups using the same possible risk factors to identify independent risk factors for failure to return to the prefracture mobility level at 3 and 12 months postoperatively. The likelihood ratio backward test was carried out to find the model by selecting the variables one by one. The probability for entry was set at 0.05, and the probability for removal at 0.10. All data were analyzed in SPSS 17.0 (SPSS, Chicago, IL, USA).

Results

Clinical characteristics

Table 1 shows the characteristics of the whole cohort and stratified by mobility category. The mean (SD) age of all patients was 83.4 years (7.1), 72.8% were female and the 12-month mortality was 24.9%. Patients that were mobile without an aid were significantly younger and in better general condition. The type of fracture or treatment was not related to a specific mobility category.

Table 1 Clinical characteristics of the whole cohort and stratified by mobility category

	Cohort	Mobility categories			*P*-value
		Without an aid	With an aid	Only indoors	
	n = 390	*n* = 140	*n* = 181	*n* = 69	
Median age, years (IQR)	83.7 (9.8)	79.4 (8.2)	86.0 (7.0)	88.1 (11.7)	<0.001
Female sex	284 (72.8)	85 (60.7)	142 (78.5)	57 (82.6)	<0.001
Absence of a partner at admission†	247 (67.3)	73 (54.5)	130 (73.9)	44 (77.2)	<0.001
ASA classification III/IV	129 (33.1)	28 (20.0)	66 (36.5)	35 (50.7)	<0.001
Dementia‡	91 (24.1)	19 (13.7)	41 (23.7)	31 (47.7)	<0.001
Anemia at admission§	164 (42.2)	44 (31.4)	83 (46.1)	37 (53.6)	0.003
Median GARS (IQR)¶	43.0 (31.0)	21.5 (13.0)	45.0 (19.0)	64.0 (12.0)	<0.001
Institutionalized prior to admission	129 (33.1)	18 (12.9)	58 (32.0)	53 (76.8)	<0.001
Intracapsular hip fracture	220 (56.4)	85 (60.7)	99 (54.7)	36 (52.2)	0.412
Osteosynthesis	224 (57.4)	82 (58.6)	99 (54.7)	43 (62.3)	0.521
Delirium§	88 (22.6)	23 (16.4)	48 (26.7)	17 (24.6)	0.086
LOS >10 days	182 (46.7)	47 (33.6)	98 (54.1)	37 (53.6)	0.001
Regained prefracture mobility at 3 months	150 (45.5)	34 (27.4)	90 (58.1)	26 (51.0)	<0.001
Regained prefracture mobility at 12 months	138 (47.8)	47 (39.5)	77 (57.9)	14 (37.8)	0.006
Immobile at 12 month follow up	54 (18.7)	6 (5.0)	26 (19.5)	22 (59.5)	<0.001
Mortality					
In-hospital	13 (3.3)	2 (1.4)	6 (3.3)	5 (7.2)	0.093
3-month	52 (13.3)	12 (8.6)	21 (11.6)	19 (27.5)	<0.001
12-month	97 (24.9)	18 (12.9)	47 (26.0)	32 (46.4)	<0.001

Values are given as *n* (%) if not defined otherwise. Data not available in: †23, ‡13, §1 and ¶3 patient(s). ASA, American Society of Anesthesiologists Physical Status classification; IQR, interquartile range; LOS, length of stay; GARS, Groningen Activity Restriction Score.

Mobility at follow up

At 3-month follow up, no data about the level of mobility and ADL was available in eight patients (2.3%). At 12-month follow up, this information was missing in four patients (1.3%). All percentages at 3- and 12-month follow up that are mentioned were corrected for mortality.

Figure 1 shows the percentage of patients who were able to regain their prefracture mobility for the whole cohort and stratified by mobility category. Overall, approximately half of the patients regained their prefracture mobility level. Mobile patients without an aid showed the lowest level of regaining mobility, and were the only subgroup with a significant improvement of mobility between 3 and 12 months.

Furthermore, Figure 1 shows the percentage of patients being immobile at 3- and 12-months follow up for the whole cohort and stratified by mobility category as well. In total, 18.7% of all patients became immobile.

The more limited the level of prefracture mobility, the higher the number of patients that became immobile. Solely patients who were only mobile indoors showed a significant increase in percentage in becoming immobile between 3 and 12 months postoperatively.

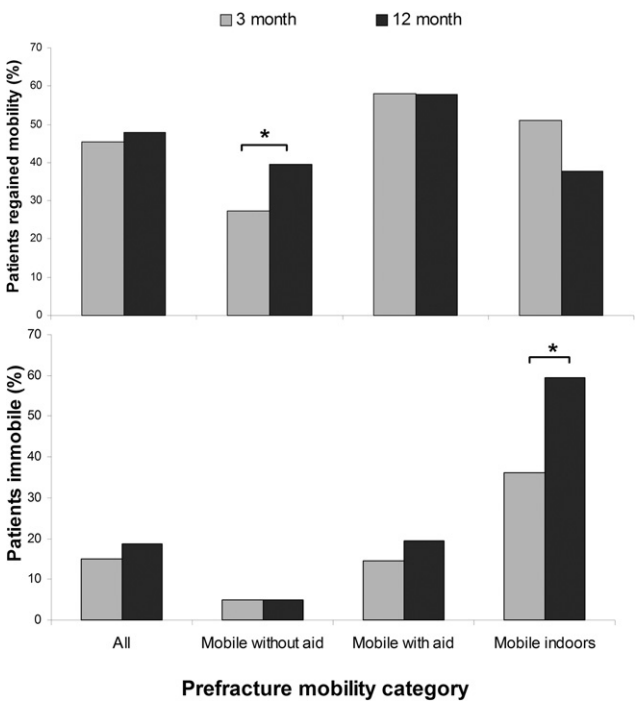

Figure 1 Percentages of patients who were able to regain their prefracture mobility and became immobile for the whole cohort and stratified by mobility category. *$P < 0.05$.

Risk factors for not regaining prefracture mobility

Table 2 shows the relative risks of the different variables for not regaining prefracture mobility at 3 months for the whole cohort and stratified by mobility category. For the whole cohort, dementia, living in institutionalized care before admission and a delirium during admission were significant risk factors for not regaining the prefracture level of mobility. In addition to these items, a longer LOS and a lower ADL level were significant in the two groups of patients that were mobile in- and outdoors (regardless the use of an aid). ASA and fracture type were significant factors only in the group that was mobile with an aid.

Table 3 shows the relative risks of the different variables for not regaining prefracture mobility at 12 months, which were the same as at 3-month follow up. The additional risk factors in the group that was mobile with an aid in the analysis at 3 months lost their significance at 12 months.

The outcome of the multivariable regression analysis of the risk factors for not regaining prefracture mobility for the whole cohort and stratified by mobility category is shown in Table 4. A lower level of ADL was, together with the occurrence of a delirium, the most important independent risk factor for not regaining the prefracture level of mobility in the whole cohort and the subgroups, without a difference between 3- and 12 month follow up. In the bi- and multivariable regression analysis of the group of patients who were only mobile indoors, none of the risk factors reached significance.

Discussion

In the present study, approximately half of the patients had regained their prefracture mobility 3 months after a hip fracture. The majority of mobile patients without an aid did not regain their mobility, but improved their level of mobility between 3 and 12 months postoperatively. The level of mobility of patients in the other mobility categories did not significantly improve after 3-month follow up. Furthermore, the more limited the prefracture level of mobility, the higher the number that became immobile after 12 months. The most important independent risk factors for failure to return to the prefracture level of mobility were a lower prefracture level of ADL and a delirium during admission.

Previous series from Western societies reporting specifically on walking ability showed either a comparable[3,6,9] or a much lower (11–16%)[7] percentage of patients returning to their prefracture level. The prefracture level of mobility in these series was higher[7,9] or defined differently.[3,6]

A Japanese cohort was younger and less mobile before fracture than our cohort, but had a comparable level of mobility after 12 months.[8] The number of patients that became immobile at follow up was within the previous reported range of 5–21%.[6,7,9] The huge impact of a hip fracture can be shown by the percentage of patients becoming immobile. The present study showed that 60% of the patients who were mobile only indoors before the fracture occurred became immobile during the postoperative course of 1 year. Furthermore, the mobility of those patients deteriorated even more during the 1-year postoperative course, the latter has not been shown before.

Previous studies showed that functional recovery after hip fracture occurs within the first 4–6 months post-fracture.[1,4,8,18] In the current study, functional recovery was stratified by prefracture mobility. We found an improvement of mobility in patients who were mobile without an aid between 3 and 12 months, and no significant difference in the other subgroups. These results were confounded by age and mortality, as the less mobile groups were older and had a higher mortality rate.

Comparison between studies is limited because of different definitions of walking ability and functional outcome. A recent review showed that higher age, worse health condition and cognitive status, and lower prefracture functional level were the strongest risk factors for worse functional outcome after a hip fracture.[11] In the present study, dementia, lower level of ADL, living in an institutionalized care environment, delirium and a LOS >10 days were the main risk factors in the bivariate analysis. Dementia lost significance in the multivariable logistic regression analysis. In patients who were mobile without an aid, age was an additional risk factor in both bivariate and multivariable analysis at 3 months.

As previously reported, a limited level of ADL is one of the most important contributors to poor outcome.[6,7,11,12] Delirium as a risk factor was either confirmed or denied to be a risk factor in previous studies; in the present study, it was a risk factor in the whole cohort, as well as in the group that was mobile with an aid.[12,16] Most probably, patients who suffer from a delirium are generally in worse general condition, contributing to the loss of mobility.[22]

A longer LOS was reported by Magaziner *et al*. to be a risk factor for a poorer post-fracture functional level.[4] This might be because of the fact that a longer LOS often means more complications and therefore worse functional outcome on the long term.

Finally, living in institutionalized care was a risk factor for not regaining mobility in the whole cohort, but not in the subgroups. Others found worse functional outcomes in institutionalized patients compared with patients living independently.[15,17]

This is one of the few prospective studies reporting on the level of mobility from admission to 1 year after a hip fracture. The sample size, its prospective character, the accurate information on clinical characteristics, and the

Table 2 Relative risks of different variables for not-regaining mobility at 3-month follow up (bivariate analysis)

	All patients† Mobility regained?			Mobile without aid Mobility regained?			Mobile with aid Mobility regained?			Patients only mobile indoors Mobility regained?		
	Yes $n = 150$	No $n = 180$	RR (CI)	Yes $n = 34$	No $n = 90$	RR (CI)	Yes $n = 90$	No $n = 65$	RR (CI)	Yes $n = 26$	No $n = 25$	RR (CI)
Older age‡	47.3	42.2	0.91 (0.74–1.11)	26.5	57.8	1.41 (1.13–1.77)*	50.0	40.0	0.79 (0.54–1.16)	61.5	44.0	0.70 (0.40–1.23)
Female sex	74.7	70.0	0.90 (0.73–1.11)	50.0	63.3	1.17 (0.92–1.48)	81.1	76.9	0.87 (0.57–1.33)	84.6	76.0	0.77 (0.42–1.41)
Absence of a partner	67.6	64.2	0.93 (0.76–1.15)	41.2	56.8	1.19 (0.95–1.50)	75.3	69.4	0.84 (0.56–1.26)	77.3	78.3	1.03 (0.51–2.07)
ASA III/IV	28.7	31.1	1.05 (0.85–1.30)	8.8	17.8	1.19 (0.95–1.50)	28.9	44.6	1.46 (1.02–2.10)*	53.8	44.0	0.82 (0.46–1.44)
Dementia	14.1	28.4	1.41 (1.16–1.70)*	0.0	16.3	1.44 (1.27–1.63)*	12.9	40.3	2.08 (1.48–2.93)*	37.5	41.7	1.09 (0.62–1.93)
Anemia at admission	42.3	34.4	0.86 (0.69–1.06)	29.4	27.8	0.98 (0.77–1.25)	44.9	38.5	0.86 (0.58–1.26)	50.0	48.0	0.96 (0.55–1.68)
lower level of ADL†	45.9	47.8	1.03 (0.85–1.26)	17.6	55.6	1.52 (1.22–1.89)*	31.8	70.8	2.58 (1.68–3.97)*	34.6	52.0	1.43 (0.82–2.49)
Institutionalized	24.0	34.4	1.24 (1.02–1.51)*	0.0	14.4	1.44 (1.27–1.63)*	21.1	43.1	1.74 (1.22–2.47)*	65.4	84.0	1.80 (0.76–4.26)
Intracapsular fracture	54.7	61.1	1.13 (0.92–1.39)	64.7	60.0	0.95 (0.76–1.18)	48.9	66.2	1.53 (1.02–2.29)*	61.5	52.0	0.82 (0.47–1.43)
Osteosynthesis	56.7	56.1	0.99 (0.81–1.21)	61.8	60.0	0.98 (0.79–1.22)	56.7	47.7	0.81 (0.56–1.18)	50.0	64.0	1.35 (0.74–2.46)
Delirium	10.1	26.7	1.54 (1.28–1.84)*	0.0	17.8	1.46 (1.28–1.66)*	13.5	38.5	1.98 (1.41–2.77)*	11.5	28.0	1.59 (0.94–2.72)
LOS > 10 days	38.7	48.3	1.19 (0.98–1.45)	11.8	36.7	1.36 (1.13–1.64)*	44.4	60.0	1.44 (0.98–2.12)	53.8	60.0	1.14 (0.64–2.03)

Values are given as percentage. *Significant at that moment in time; $P < 0.05$, bivariate analysis. †A total of 52 patients died and eight patients were lost to follow up of the baseline population. ‡Based on the median of the different groups. ADL, activities of daily living; ASA, American Society of Anesthesiologists Physical Status classification; LOS, length of stay.

Table 3 Relative risks of different variables for not regaining mobility at 12-month follow up (bivariate analysis)

	All patients† Mobility regained?			Mobile without aid Mobility regained?			Mobile with aid Mobility regained?			Patients only mobile indoors Mobility regained?		
	Yes $n = 138$	No $n = 151$	RR (CI)	Yes $n = 47$	No $n = 72$	RR (CI)	Yes $n = 77$	No $n = 56$	RR (CI)	Yes $n = 14$	No $n = 23$	RR (CI)
Older age‡	39.1	46.4	1.15 (0.92–1.43)	34.0	59.7	1.51 (1.11–2.04)*	51.9	39.3	0.74 (0.49–1.12)	64.3	43.5	0.73 (0.44–1.22)
Female sex	73.2	72.8	0.99 (0.77–1.27)	55.3	65.3	1.18 (0.86–1.62)	83.1	80.4	0.90 (0.55–1.47)	78.6	78.3	0.99 (0.54–1.82)
Absence of a partner	61.8	62.5	1.02 (0.80–1.29)	44.7	55.7	1.20 (0.88–1.62)	72.7	66.7	0.85 (0.55–1.30)	58.3	75.0	1.36 (0.69–2.70)
ASA III/IV	25.4	29.1	1.09 (0.86–1.39)	10.6	15.3	1.16 (0.80–1.68)	29.9	39.3	1.27 (0.85–1.88)	50.0	47.8	0.97 (0.58–1.60)
Dementia	12.3	27.2	1.48 (1.19–1.83)*	4.3	16.7	1.49 (1.13–1.95)*	12.7	35.2	1.88 (1.30–2.72)*	38.5	42.9	1.07 (0.63–1.82)
Anemia at admission	34.1	40.4	1.14 (0.91–1.42)	21.3	31.9	1.22 (0.91–1.64)	36.4	46.4	1.27 (0.85–1.88)	64.3	52.2	0.83 (0.51–1.37)
lower level of ADL†	33.3	49.7	1.37 (1.10–1.70)*	17.0	59.7	1.98 (1.46–2.67)*	28.6	62.5	2.22 (1.46–3.38)*	35.7	47.8	1.20 (0.73–1.98)
Institutionalized	16.7	33.8	1.48 (1.20–1.83)*	0.0	16.7	1.78 (1.51–2.11)*	18.2	37.5	1.68 (1.15–2.45)*	64.3	78.3	1.33 (0.68–2.62)
Intracapsular fracture	58.7	57.0	0.97 (0.77–1.21)	68.1	56.9	0.83 (0.63–1.11)	51.9	55.4	1.08 (0.72–1.62)	64.3	60.9	0.95 (0.57–1.58)
Osteosynthesis	60.1	55.6	0.92 (0.73–1.14)	66.0	58.3	0.88 (0.66–1.18)	59.7	51.8	0.83 (0.56–1.23)	42.9	56.5	1.23 (0.74–2.06)
Delirium	10.2	26.5	1.56 (1.27–1.92)*	4.3	18.1	1.53 (1.18–1.98)*	14.5	37.5	1.88 (1.30–2.70)*	7.1	26.1	1.51 (0.98–2.34)
LOS > 10 days	30.4	53.6	1.56 (1.25–1.94)*	10.6	40.3	1.69 (1.31–2.17)*	40.3	64.3	1.77 (1.16–2.72)*	42.9	69.6	1.56 (0.86–2.84)

Values are given as percentage, *Significant at that moment in time; $P < 0.05$, bivariate analysis, †A total of 97 patients died and four patients were lost to follow up of the baseline population, ‡Based on the median of the different groups. ADL, activities of daily living; ASA, American Society of Anesthesiologists Physical Status classification; LOS, length of stay.

Table 4 Results of multivariable regression analysis of risk factors for not regaining prefracture level of mobility

	Risk factor	3-month follow up			12-month follow up		
		OR	95% CI	*P*-value	OR	95% CI	*P*-value
All patients[§]	Lower level of ADL[†]	3.01	1.40 to 6.45	0.005	3.79	1.69 to 8.50	0.001
	Delirium	3.94	1.92 to 8.07	<0.001	3.04	1.42 to 6.49	0.004
	LOS >10 days	1.71	1.00 to 2.92	0.050	2.81	1.58 to 4.98	<0.001
	Institutionalized before admission	2.72	1.40 to 5.28	<0.001	2.42	1.18 to 4.99	0.016
	Prefracture mobility[‡]						
	Mobile with an aid	0.08	0.04 to 0.17	<0.001	0.12	0.06 to 0.27	<0.001
	Only mobile indoors	0.05	0.025 to 0.24	<0.001	0.12	0.04 to 0.37	<0.001
Mobile without an aid[¶]	Lower level of ADL[†]	4.86	1.79 to 13.17	0.002	6.19	2.46 to 15.57	<0.001
	LOS >10 days	2.74	0.83 to 9.07	0.099	4.09	1.35 to 12.38	0.013
	Older age[†]	2.71	1.07 to 6.85	0.035	1.85	0.78 to 4.42	0.164
Mobile with an aid[††]	Lower level of ADL[†]	6.06	2.81 to 13.09	<0.001	4.04	1.89 to 8.63	<0.001
	Delirium	3.40	1.42 to 8.11	0.006	3.14	1.30 to 7.60	0.011

[†]Based on the median of the different groups. [‡]Mobile without an aid is the reference category. Analysis was carried out on: [§]330 patients at 3-month follow up and 289 patients at 12-month follow up; [¶]124 patients at 3-month follow up and 119 at 12-month follow up; and [††]155 patients at 3-month follow up and 133 at 12-month follow up. ADL, activities of daily living; LOS, length of stay.

length and high rate of follow up make this study valuable. Its main limitation was the absence of more detailed data on cognitive function. Furthermore, we did not use an objective measuring instrument, such as the Confusion Assessment Method, to establish a delirium; the diagnosis was based on clinical examination, as stated in the DSM-IV.[20,23] Another limitation is the fact that we did not have more objective data on the level of mobility (such as gait speed), besides the use of a walking aid or not. Finally, the number of patients that was categorized in the group only mobile indoors was rather small ($n = 69$).

In the present study, less than half of the patients regained their prefracture mobility 12 months after hip fracture. Just one-quarter of the mobile patients without an aid regained their level of mobility at 3-month follow up, this improved to approximately one-third at 12 months. The groups with a lower level of mobility regained their prefracture level of mobility in over half of the cases, but did not improve after 3 months. The most important independent risk factors for failure to return to the prefracture level of mobility were the prefracture level of ADL and a delirium during admission.

Acknowledgments

RN is a consultant (Data Safety Monitoring) for Smith&Nephew, and received research grants from Reumafonds, FP6&7-EU and ZonMw, and royalties from Springer. All fees were paid to the department and not to RN personally. RB is a consultant for Smith&Nephew. AV and PP are consultants for Biomet.

The work was supported by the Netherlands Organization for scientific research (NGI/NWO; 05040202 and 050-060-810 Netherlands Consortium for Healthy Aging [NCHA]), and the seventh framework program MYOAGE (HEALTH-2007-2.4.5-10) and Reumafonds LRR 13. None of the sponsors have influenced the design, methods, subject recruitment, data collections, analysis or preparation of this paper.

Disclosure statement

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article by any of the authors.

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