Most patients regain prefracture basic mobility after hip fracture surgery in a fast-track programme

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INTRODUCTION: Treatment of patients with hip fracture has improved over the past decade. Still, some patients do not regain independent mobility within their primary hospital stay even if they follow a multimodal fast-track surgical programme. The aim of the present article was to examine the validity of the preliminary prefracture New Mobility Score (NMS), age and fracture type as independent predictors of in-hospital outcome after hip fracture surgery.

MATERIAL AND METHODS: The study comprised a total of 213 consecutive patients with a median age of 82 years who were admitted from their own home to a special hip fracture unit. Outcome variables were the regain of independency in basic mobility as evaluated by the Cumulated Ambulation Score, and discharge destination in the community.

RESULTS: Multiple logistic regression analysis revealed that patients with a low prefracture NMS and/or an intertrochanteric fracture were 6.5 and four times more likely to not regain independency in basic mobility during admittance than patients with a high prefracture NMS level and a cervical fracture, respectively. In addition, the odds of not regaining independent mobility increased with age by 5% per year. The same three variables significantly increased the odds of patients not being discharged to their own home.

CONCLUSION: Prefracture NMS, age and fracture type were confirmed as independent predictors of in-hospital outcome in patients with hip fracture who followed a multimodal rehabilitation concept.

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TRIAL REGISTRATION: not relevant.

About 10,000 hip fractures occur annually in Denmark [1]. The reestablishment of independent mobility after surgery is a national and worldwide challenge, and it is considered the foremost goal of rehabilitation. The outcome of patients with hip fracture is associated with several factors [2] including age [3], gender [4, 5], prefracture functional level [6], mental status [7], health status [5] and fracture type [8, 9], in addition to surgical procedure [10] and postoperative mobility level [11, 12].

Multimodal strategies in optimised programmes targeting patients with hip fracture [13] have improved outcome and reduced length of stay without increasing the number of readmissions, morbidity or mortality. Still, some patients do not regain their prefracture basic mobility level in the acute orthopaedic ward; and some do not return directly to their previous residence (own home). Patients who lose basic mobility – i.e. the ability to walk, to get in and out of bed, and to sit down in and get up from a chair – also lose essential aspects of their quality of life and potentially need more health care support than those who do not lose their basic mobility. Thus, determining in advance which patients will likely face mobility problems seems essential to optimise their rehabilitation outcome.

A recent study showed that patients with a more advanced age, a low prefracture level and/or an inter/subtrochanteric fracture were more likely not to regain basic mobility independency, and to not be discharged to their previous residence (own home) when adjusted for gender, mental and health status in multiple logistic

Patient after hip fracture surgery. Photo by *Morten Tange Kristensen*.

ORIGINAL ARTICLE

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TABLE 1

The New Mobility Score (0-9 points).

Mobility	No difficulty and no aid	With a walking aid	With help from another person	Not at all
Able to get about the house (indoor walking)	3	2	1	0
Able to get out of the house (outdoor walking)	3	2	1	0
Able to go shopping (walking during shopping)	3	2	1	0

Kristensen MT, Hvidovre Hospital. Updated from Parker & Palmer [17] following personal communication with Dr. Martyn Parker, Peterborough, England, December 2009.

regression models [3]. The specific purpose of this study was to evaluate the New Mobility Score (NMS) as a predictor of in-hospital outcome when adjusted for other potential predictor variables. Thus, the model produced from this previous initial study [3] is based on a development sample, which in our opinion should be examined in a validation sample as presented in the present study. This procedure has also been used in a study that validated a new outcome measure [14].

Consequently, the aim of the present study was to examine if previously established preoperative factors of in-hospital basic mobility outcome and discharge destination could be confirmed in a new sample of patients with hip fracture.

MATERIAL AND METHODS

Evaluated for the study were all patients admitted from their own home to an acute hip fracture unit at Hvidovre University Hospital, Copenhagen, Denmark between August 2004 and February 2006. To be included, a patient had to be ambulatory pre-fracture (indoor walking or higher level), have no other fracture than the hip fracture, and be allowed full weight-bearing after surgery. Furthermore, included patients needed to follow the in-hospital multimodal rehabilitation programme [15]. The study is part of the hospital hip fracture project, which has been approved by the local ethical committee and the Danish Data Protection Agency.

Predictor variables

The reliable [16] and updated New Mobility Score (NMS 0-9, **Tabel 1**) [17] was used to evaluate the prefracture functional level within one week before the fracture occurred. NMS was classified as either low (NMS 2-6) or high (NMS 7-9) [3]. Fracture types were classified as cervical versus intertrochanteric (including subtrochanteric fractures (n = 6) as no significant difference was found in the baseline characteristics of patients with trochanteric fractures). Mental status was evaluated by Hindsoe's test (0-9) [18] and classified as low (score 0-6) or high (score 7-9); while health status was evaluated with the American Society of Anesthesiologists' rating (ASA 0-4) and classified as poor (ASA 3-4) or good (ASA 1-2). Additionally, gender was recorded as a categorical along with age as continuous variable.

Outcome variables

The main outcome variable was the reliable [19] Cumulated Ambulation Score (CAS) [12], which describes the patient's independency in terms of three basic mobility activities (1. getting in and out of bed, 2. sitting down and standing up from a chair, 3. walking ability with or without an appropriate walking aid), and which is being used in the National Indicator Project in Denmark. Each activity is assessed on a three-point scale (2 = independent of human assistance or guiding, 1 = requiring human assistance or guiding to perform activity, 0 = unable to perform activity despite human assistance) [19]. Use of walking aids is allowed. The score for each activity is cumulated to provide a daily range from 0 to 6, with a CAS = 6 indicating independent ambulation on that particular day. Regaining independency in basic mobility (scoring 6 on the CAS) or not was used in analyses.

The secondary outcome variable was residential status at discharge. This variable was classified as own home (previous residence) versus inpatient rehabilitation facilities or nursing home. To be discharged to their own home, patients should be independent with regard to getting in and out of a bed, sitting down and standing up from a chair and toilet, and walking with the aid to be used at home.

Statistical analysis

Simple linear regression analysis was used to examine the influence of age, gender, prefracture function, mental and health status, and fracture type on the two out-

TABLE 2

Demographic, preoperative variables, and outcome of participants. Data are presented as number of patients (percentage) and as median (25-75% quartiles) (n = 213).

Age at fracture, years	82 (75-88)
Female sex	157 (74)
Low prefracture function, NMS (2-6)	132 (47)
Low mental status, Hindsoe's test (0-6)	49 (23)
Poor health status (ASA score 3-4)	80 (38)
Cervical femoral fracture	104 (49)
Intertrochanteric fracture	103 (48)
Subtrochanteric fracture	6 (3)
Days from surgery to CAS = 6 (n = 163)	7 (4-11)
Days to discharge to own home (n = 162)	11 (8-15)
Days to discharge to in-patient rehabilitation (n = 51)	23 (16-32)

ASA = American Society of Anesthesiologists score (0-4).
CAS = Cumulated Ambulation Score (a score of six indicates independent mobility).
NMS = New Mobility Score (0-9).

come variables. These predictor variables were then entered into multiple logistic regression models to determine their relative contribution to the prediction of patients not regaining independency in basic mobility or not being discharged to their previous residence. Reference categories were: men, prefracture functional level (NMS 7-9, high), mental status (Hindsoe´s 7-9, high), health status (ASA rating 1-2, healthy), and cervical fracture, while age was entered as a continuous variable.

Kaplan-Meyer survival charts were then used to illustrate the percentage of patients regaining mobility and the numbers of days to independent mobility for those predictor variables that the multiple regression analysis showed were significant.

All analyses were done in SPSS 16.0 (SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606), and the level of significance was set at $p < 0.05$.

Trial registration: not relevant.

RESULTS

During the 1.5-year recruitment period, a total of 294 consecutive patients with an acute hip fracture were admitted from their own home to the Hip Fracture Unit. Among these, 65 patients were excluded from analysis due to non-ambulatory prefracture (n = 10), multiple fractures (n = 11), not allowed full weight-bearing (n = 7), early transfer to medical wards (n = 17), resurgery during admittance (n = 14) and logistics (n = 8). Additionally, 16 patients (5%) who died during their hospitalisation at the acute orthopaedic ward were not included, which left 213 patients for final analysis. Demographic and preoperative variables for these patients are presented in **Table 2**. The 65 patients not included were significantly ($p = 0.01$) younger (median age 78 versus 82 years); otherwise, no significant ($p > 0.3$) difference was found between the six predictor variables for these patients versus the 213 included patients. 77% of the patients regained their basic mobility independency during the period of their admittance, and 76% were discharged directly to their own home; while the time from surgery to independent mobility was a median of seven days (Table 2). Patients discharged to their own home stayed at the hospital for a significantly shorter period than patients discharged to further inpatient rehabilitation units in the community (Table 2). In the model analysing regain of basic mobility, all predictor variables – barring gender and health status – were significantly ($p \leq 0.001$) associated with the basic mobility outcome in simple regression analysis, as presented in **Table 3**. Multiple regression models shoved that only age, having a low prefracture NMS level and/or an intertrochanteric fracture remained significant ($p \leq 0.04$) predictors of patients not regaining independency in basic mobility and/or not being discharged to their own home (Table 3 and **Table 4**).

TABLE 3

Simple and multiple logistic regressions predicting patients not regaining independency in basic mobility (n = 213).

Predictor variables	Crude OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age (continuous)	1.08 (1.04-1.12)	< 0.001	1.05 (1.0-1.09)	0.044
Women	2.2 (0.96-5.0)	0.063	1.8 (0.65-4.7)	0.152
Low prefracture functional level (NMS 2-6)	9.5 (4.0-22.4)	< 0.001	6.5 (2.6-16.3)	< 0.001
Low mental status	3.1 (1.5-6.2)	0.001	2.3 (0.99-5.3)	0.051
Poor health status (ASA 3-4)	1.8 (0.93-3.4)	0.083	1.1 (0.53-2.4)	0.749
Intertrochanteric fracture	3.2 (1.6-6.3)	0.001	4.1 (1.8-9.2)	0.001

ASA = American Society of Anesthesiologists score (0-4).
CI = confidence interval.
NMS = New Mobility Score (0-9).
OR = odds ratio.

TABLE 4

Simple and multiple logistic regressions predicting patients not being discharged directly to previous residence (n = 213).

Predictor variables	Crude OR (95% CI)	p value	Adjusted OR (95% CI)	p value
Age (continuous)	1.11 (1.07-1.16)	< 0.001	1.09 (1.04-1.15)	0.001
Women	1.2 (0.58-2.5)	0.608	0.66 (0.26-1.6)	0.373
Low prefracture functional Level (NMS 2-6)	6.0 (2.8-12.7)	< 0.001	3.6 (1.6-8.4)	0.003
Low mental status	2.6 (1.3-5.2)	< 0.007	1.7 (0.74-3.9)	0.216
Poor health status (ASA 3-4)	2.6 (1.4-4.9)	0.004	1.9 (0.92-4.0)	0.081
Intertrochanteric fracture	2.9 (1.5-5.8)	0.002	3.4 (1.5-7.5)	0.002

ASA = American Society of Anesthesiologists score (0-4).
CI = confidence interval.
NMS = New Mobility Score (0-9).
OR = odds ratio.

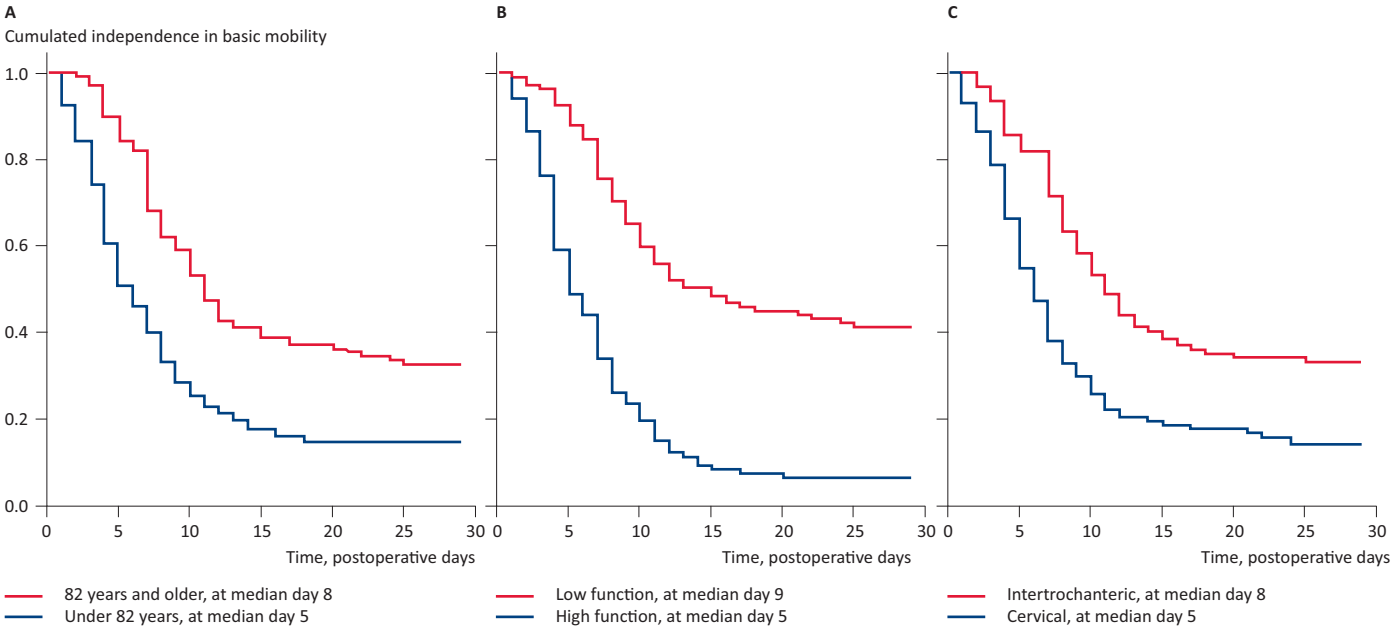
The two logistic regression models were statistically stable and correctly classified 79% (Table 3, basic mobility independency) and 80% (Table 4, discharge destination) of the cases, respectively. **Figure 1** presents the distribution of patients who regained independent mobility and the days until independent mobility was achieved by age, prefracture function and fracture type groups.

DISCUSSION

This study confirmed previous initial findings that when adjusted for gender, mental and health status, the variables prefracture NMS, age and fracture type were independent predictors of in-hospital outcome in patients with hip fracture who followed a multimodal rehabilitation programme [3]. Specifically, patients who had an intertrochanteric fracture and/or a low prefracture NMS level, respectively, had a four and 6.5 fold increased risk of not regaining their basic mobility independency and/or of not being discharged directly to their own home (three and four times higher, respectively) compared

FIGURE 1

Age (**A**), prefracture function (**B**), and fracture type (**C**) in relation to regain of independent mobility.



with patients who had a cervical fracture and/or a high prefracture NMS level. Further, the odds of not regaining this independency and/or not being discharged directly to own home rose by 5% and 9%, respectively, per additional year the patient's age advanced. Correspondingly, patients with a low prefracture NMS and/or an intertrochanteric fracture who did regain their previous ambulatory status required on average 2.3 and 2.6 days more to achieve this level in addition to 1.3 days more per decade the patient's age advanced.

The fact that findings from an initial development sample [3] were confirmed in the present validation sample strengthens the importance of awareness of these findings among clinicians. Furthermore, we present an updated version of the NMS, which was confirmed by Mr. Parker and used in the initial, the present and a large number of previous studies from the same research group.

In addition, the fact that the Cumulated Ambulation Score, used as the primary outcome in the present study, is now part of the National Indicator Project in Denmark strengthens the relevance of our findings. We recommend that the next step for the predictive model, which was confirmed operational in the present study, should be an external validation. Still, the logistic models comprising the six preoperative variables only correctly classified up to 80% of the cases. This supports previous findings that postoperative events influence the postoperative outcome in patients with hip fracture. Such events include pain in the fractured region in the first postoperative days [20], lower limb oedema in the fractured limb [9], and/or the early ambulation level [12, 21], in addition to the preoperative factors found in this and in previous studies [3, 4, 8]. Also, it highlights that, although patients in this study followed an optimised multimodal rehabilitation programme, including surgery within 24 hours from admission, a liberal transfusion policy, epidural anaesthesia and analgesia, enforced oral nutrition and early mobilisation and physiotherapy [15], such a programme does not seem to be "sufficient" to ensure that all patients regain their ambulatory level in the primary hospital setting.

Critics might say that we can change neither age or prefracture functional status, nor the fracture type; but knowing in advance which patients will most likely face mobility problems allows clinicians to optimise their rehabilitation programme. Accordingly, further research studies and/or rehabilitation programmes ought to examine if special attention may change the short-term outcome of high-risk patients with older age, a low prefracture functional level, and/or an intertrochanteric fracture. In this view, it seems obvious to investigate the feasibility and effect of progressive strength training, particularly in patients with intertrochanteric fractures. Such training should be commenced shortly after surgery, as these patients lose more than 60% of their maximal knee-extension strength in the fractured limb within one week from

surgery, and associated with delayed ambulatory independence, compared with a patient who had a cervical fracture [9].

CONCLUSION

This study confirms previous initial findings that age, prefracture NMS function, and fracture type are independent predictors of short-term mobility outcome and discharge destination in patients with hip fracture following a multimodal programme. These findings provide clinicians with three valuable and easily available preoperative factors that will facilitate attempts at reducing the number of patients not regaining their prefracture basic mobility level and who are not discharged directly to their own home.

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