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RESEARCH PAPER

Discharge after hip fracture surgery by mobilisation timing: secondary analysis of the UK National Hip Fracture Database

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Abstract

Objective: To determine whether mobilisation timing was associated with the cumulative incidence of hospital discharge by 30 days after hip fracture surgery, accounting for potential confounders and the competing risk of in-hospital death.
Method: We examined data for 135,105 patients 60 years or older who underwent surgery for nonpathological first hip fracture between 1 January 2014 and 31 December 2016 in any hospital in England or Wales. We tested whether the cumulative incidences of discharge differed between those mobilised early (within 36 h of surgery) and those mobilised late, accounting for potential confounders and the competing risk of in-hospital death.
Results: A total of 106,722 (79%) of patients first mobilised early. The average rate of discharge was 39.2 (95% CI 38.9–39.5) per 1,000 patient days, varying from 43.1 (95% CI 42.8–43.5) among those who mobilised early to 27.0 (95% CI 26.6–27.5) among those who mobilised late, accounting for the competing risk of death. By 30-day postoperatively, the crude and adjusted odds ratios of discharge were 2.36 (95% CI 2.29–2.43) and 2.08 (95% CI 2.00–2.16), respectively, among those who first mobilised early compared with those who mobilised late, accounting for the competing risk of death.
Conclusion: Early mobilisation led to a 2-fold increase in the adjusted odds of discharge by 30-day postoperatively. We recommend inclusion of mobilisation within 36 h of surgery as a new UK Best Practice Tariff to help reduce delays to mobilisation currently experienced by one-fifth of patients surgically treated for hip fracture.

Keywords: hip fracture, early mobilisation, length of stay, competing event, audit, older people

Key Points

- In all, 79% of patients mobilised within the recommended 36 h of their hip fracture surgery.
- Mobilisation within 36 h of surgery was associated with a higher rate of discharge each day for 30-day postoperatively.
- Early mobilisation led to a 2-fold increase in the adjusted odds of discharge by 30-day postoperatively.
- Inclusion of mobilisation within 36 h of surgery as a new BPT could reduce delays to mobilisation.

Introduction

In 2018, UK hospitals surgically treated 98% of the 66,313 older adults admitted with hip fracture [1]. To maximise the benefits of surgery, the National Institute for Health and Care Excellence (NICE) Clinical Guideline 124 recommends patients are mobilised on the day after hip fracture surgery [2]. Indeed, advocates for early mobilisation argue longer waits may lead to complications such as pulmonary embolism or pneumonia [3] and loss of muscle strength induced by bed rest [4]. These complications may lead to delay to discharge and/or in-hospital death. Further, a recent UK qualitative study reported participants' perceived hip fracture as a temporary disruption in their lives, which could be overcome through early engagement with rehabilitation to achieve their goal of discharge from hospital [5]. Yet, a recent audit indicated only 68% of patients mobilised on the day after surgery, and in 7% of sites this was achieved for less than half of their patients [6].

The UK Best Practice Tariff (BPT) system may offer a mechanism to promote early mobilisation as best practice in line with the NICE guidelines and patient-reported goals [7]. The BPT system incentivises providers by payment when requirements of activities related to tariffs are met [7]. For hip fracture, there are six BPTs whose compliance is monitored from data submitted by providers to the National Hip Fracture Database (NHFD) audit programme [1,7]. The BPTs change as variation in tariffed activities becomes negligible and evidence emerges to support the introduction of new tariffs. The current evidence underlying the NICE guideline for early mobilisation is based on one trial of low to moderate quality and therefore the findings were 'interpreted with caution' [2]. There is a need to generate additional evidence to support the introduction of an early mobilisation BPT.

We examined available records from the NHFD linked to hospitalisation records to determine whether mobilisation timing was associated with the cumulative incidence of hospital discharge by 30 days after hip fracture surgery, accounting for potential confounders and the competing risk of in-hospital death.

Methods

Study cohort

We examined data for 170,970 patients 60 years or older who underwent surgery for nonpathological first hip fracture with a hospital stay of at least 1 day after surgery between 1 January 2014 and 31 December 2016 in any hospital in England or Wales. These data were identified from the NHFD audit maintained by the Royal College of Physicians on behalf of Healthcare Quality Improvement Partnership. The NHFD assembles data on the characteristics of all patients and the care they received following hospitalisation with hip fracture in the United Kingdom [1]. We linked the NHFD to the Hospital Episode Statistics database from National Health Service (NHS) Digital and the Patient Episode Database for Wales from NHS Wales Informatics Service for additional data on comorbidities, ethnicity, deprivation and mortality (Supplementary File 1). We selected patients with complete data for both exposure and outcome ($n = 135{,}105$). Differences between patients with and patients without complete data for exposure and outcome are presented in Supplementary File 2.

Exposure

The exposure was a binary indicator for the timing of first mobilisation, grouped as 'early' (within 36 h of surgery) and 'late' (beyond 36 h of surgery). The NHFD defines mobilisation by the ability to sit or stand out of bed [1]. Data for this indicator is identified through review of charts by the clinical team at each hospital and approved by the Consultant Geriatrician prior to submission to the NHFD.

Study outcome

The study outcome was hospital discharge. Discharge was identified by the NHFD discharge destination codes: own home/sheltered housing, residential care, nursing home or long-term care hospital. In-hospital death was treated as a competing event. Patients were followed up to 30 days on the premise that longer stays reflect nonacute hospitalisation [8].

Statistical analysis

We describe patient and care characteristics as proportions, overall and by mobilisation timing. We used the χ^2 test to compare distributions of patient and care characteristics by mobilisation timing. We estimated the daily rate of discharge by dividing the number of discharges by the total number of inpatient days, overall and by mobilisation timing. We estimated the cumulative incidence of discharge as a function of postoperative day, with in-hospital death as a competing event. We treated hospital stays that ended with loss to follow-up (NHFD discharge destination of rehabilitation unit, acute hospital or unit) and stays that exceeded 30 postoperative days as right-censored observations [9]. We used the Pepe–Mori two-sample test [10] and proportional odds regression models [11] to test whether the cumulative incidences of discharge differed between those mobilised early and those mobilised late. We summarised the differences by 30-day risk differences [12] and by odds ratios [13]. The analysis was conducted with R [14] packages CIFsmry [15], cmprsk [16], prodlim [17] and geepack [18].

We adjusted for potential confounders in the regression analysis [19]. We adjusted for patient characteristics age (<85 years, ≥ 85 years) [20], sex [20], ethnicity (White, Caribbean or African or any mixed Black background, Asian or Asian British or any mixed Asian background, any other mixed background) [21], fracture type (intracapsular, intertrochanteric/subtrochanteric) [20], deprivation (Index of Multiple Deprivation decile groups) [22], comorbidities (heart failure or pulmonary oedema) [23], chronic obstructive pulmonary disease [24], ischaemic heart disease (acute or chronic) [25], cardiac dysrhythmias [26], hypertension [27], hypotension [28], diabetes with complication [29], Alzheimer's or dementia [30], depression [31], delirium [31], American Society of Anaesthesiologists grade [32], prefracture residence (own home/sheltered housing, nursing care/residential care) [20] and prefracture mobility (no functional mobility, indoor mobility, outdoor mobility) [33]. We adjusted for processes timing of surgery (within 36 h target time, not within 36 h target time) [34] and procedure type (internal fixation, hemiarthroplasty/arthroplasty) [35]. We adjusted for structures hospital volume (low (less than first quartile), medium (second and third quartile) or high (fourth quartile) volume at admission based on the average annual number of surgeries at the admitting hospital) [36], day of admission (Monday–Friday, Saturday–Sunday) [36] and calendar year of admission (2014, 2015, 2016) as a proxy for changes in practice and funding.

Sensitivity analysis

We completed additional analysis to determine whether the results of the complete case analysis were sensitive to data missingness in the exposure and potential confounders using a multiple imputation by chained equation (MICE) technique [37, 38]. We identified missing values and replaced them with a random sample of plausible (imputed) values. We generated 25 imputed datasets to reduce the sampling variability from the imputation process and to limit the loss of power to no more than 1% for testing the association between exposure and outcome [37, 39]. We estimated the 30-day risk differences and odds ratios for each of the 25 datasets. We performed the MICE using MICE R package and analysis model [38] and the combination across imputed datasets using Rubin's rules [40]. We did not impute missing data for the outcome as the approach offers limited protection against outcome data not missing at random, with small performance differences between no outcome imputation and outcome imputation for data missing at random [41].

Approvals

This study received NHS Health Research Authority and Health and Care Research Wales approval (Integrated Research Application System Project ID: 230215). The study did not require NHS research ethics committee approval as it involves secondary analysis of pseudonymised data (i.e. a patient may only be identified if data were combined with other data not available to the research team).

Results

Patient characteristics

A total of 135,105 patients surgically treated for a nonpathological first hip fracture between 1 January 2014 and 31 December 2016 were included in the analysis (Table 1). The majority was women (73%), White (71%), admitted from home (80%), presented with at least one major comorbidity (72%) and an intracapsular hip fracture (59%). The largest proportions of patients were aged 85–94 years old (41.3%), freely mobile without aids prefracture (38%), admitted to high-volume hospitals (51%), between Monday and Friday (67%) and underwent surgery within the recommended target time (72%).

Discharge by mobilisation timing

Overall, 106,722 (79%) of patients first mobilised early. By 30-day postoperatively, 71,330 (53%) hospital stays ended with discharge, 5,709 (4%) ended with in-hospital death, 44,465 (33%) had right-censoring events and 13,601 (10%) stays were longer than 30 days (Figure 1, Table 2). Among those discharged, 51,320 (72%) went home and 20,010 (28%) went to nursing or residential care. The average rate of discharge was 39.2 (95% CI 38.9–39.5) per 1,000 patient days, varying from 43.1 (95% CI 42.8–43.5) among those who mobilised early to 27.0 (95% CI 26.6–27.5) among those who mobilised late, accounting for the competing risk of death. By 30-day postoperatively, there were an additional 187 (95% CI 179–195) discharges per 1,000 surgeries among patients who mobilised early when compared with those who mobilised late, accounting for the competing risk of death (Figure 2). Figure 3 shows the between-group difference persisted over the 30-day period, favouring those who first mobilised early. The size of difference increased with time, reaching a maximum at day 16, and then decreased steadily but moderately. By 30-day postoperatively, the crude and adjusted odds ratios of discharge were 2.36 (95% CI 2.29–2.43) and 2.08 (95% CI 2.00–2.16), respectively, among those who first mobilised early compared with those who mobilised late, accounting for the competing risk of death.

Sensitivity analyses

For imputed results, an additional 170 discharges per 1,000 surgeries was estimated among patients who mobilised early when compared with those who mobilised late, accounting for the competing risk of death. By postoperative day 30, the crude and adjusted odds ratios of discharge were 2.21 (95% CI 2.15–2.28) and 1.97 (95% CI 1.90–2.03), respectively, among those who mobilised early compared with those mobilised late, accounting for the competing risk of death. Full results of imputed analyses are available in Supplementary File 3.

Discussion

Main findings

Overall, 79% of patients mobilised within the recommended 36 h of their hip fracture surgery. Mobilisation within 36 h of surgery was associated with a higher rate of discharge each day for the first 30 postoperative days when compared with mobilisation after 36 h of surgery. This early mobilisation led to a 2-fold increase in the odds of discharge by 30-day postoperatively after adjustment for potential confounders and the competing risk of death.

Table 1. Characteristics of 135,105 patients surgically treated for nonpathological first hip fracture overall and by timing of mobilisation

		All (N = 135,105)	Mobilisation day of or day after surgery (N = 106,722)	Mobilisation at least 2 days after surgery (N = 28,383)
		n (%)	*n* (%)	*n* (%)
Age at admission (years)*	60–74	23,908 (17.7)	19,957 (83.5)	3,951 (16.5)
	75–84	47,557 (35.2)	38,067 (80.0)	9,490 (20.0)
	85–94	55,758 (41.3)	42,899 (76.9)	12,859 (23.1)
	≥95	7,640 (5.7)	5,612 (73.5)	2,028 (26.5)
	Missing	242 (0.2)	187 (77.3)	55 (22.7)
Sex*	Women	98,227 (72.7)	78,041 (79.4)	20,186 (20.6)
	Men	36,876 (27.3)	28,680 (77.8)	8,196 (22.2)
	Missing	2 (0.0)	1 (50.0)	1 (50.0)
Ethnicity*	White	95,471 (70.7)	75,890 (79.5)	19,581 (20.5)
	Caribbean or African or any mixed Black background	227 (0.2)	149 (65.6)	78 (34.4)
	Asian or Asian British or any mixed Asian background	1,193 (0.9)	914 (76.6)	279 (23.4)
	Any other mixed background	25 (0.0)	19 (76.0)	6 (24.0)
	Missing	38,189 (28.3)	29,750 (77.9)	8,439 (22.1)
Comorbidities*,[a]	Heart failure or pulmonary oedema	12,969 (9.6)	9,165 (70.7)	3,804 (29.3)
	Chronic obstructive pulmonary disease	17,360 (12.9)	13,105 (75.5)	4,255 (24.5)
	Ischaemic heart disease (acute)	11,547 (8.6)	8,638 (74.8)	2,909 (25.2)
	Cardiac dysrhythmias	26,692 (19.8)	19,935 (74.7)	6,757 (25.3)
	Ischaemic heart disease (chronic)	20,148 (14.9)	15,109 (75.0)	5,039 (25.0)
	Hypertension	65,505 (48.5)	51,771 (79.0)	13,734 (21.0)
	Hypotension	10,292 (7.6)	7,388 (71.8)	2,904 (28.2)
	Diabetes with complication	1,674 (1.2)	1,248 (74.6)	426 (25.4)
	Alzheimer's or dementia	35,077 (26.0)	25,283 (72.1)	9,794 (27.9)
	Depression	9,659 (7.2)	7,412 (76.7)	2,247 (23.3)
	Delirium	10,000 (7.4)	7,178 (71.8)	2,822 (28.2)
ASA grade[b]	I	3,105 (2.3)	2,820 (2.6)	285 (1.0)
	II	36,636 (27.1)	31,503 (29.5)	5,133 (18.1)
	III	74,803 (55.4)	58,179 (54.5)	16,624 (58.6)
	IV	16,993 (12.6)	11,412 (10.7)	5,581 (19.7)
	V	289 (0.2)	168 (0.2)	121 (0.4)
	Missing	3,279 (2.4)	2,640 (2.5)	639 (2.3)
Prefracture residence*	Own home/sheltered housing	107,972 (79.9)	87,887 (81.4)	20,085 (18.6)
	Nursing care/residential care	24,487 (18.1)	17,043 (69.6)	7,444 (30.4)
	Other[d]	2,625 (1.9)	1,775 (67.6)	850 (32.4)
	Missing	21 (0.0)	17 (81.0)	4 (19.0)
Prefracture mobility*	Freely mobile without aids	51,911 (38.4)	44,021 (84.8)	7,890 (15.2)
	Mobile outdoors with one aid	30,179 (22.3)	24,281 (80.5)	5,898 (19.5)
	Mobile outdoors with two aids or frame	18,893 (14.0)	14,617 (77.4)	4,276 (22.6)
	Some indoor mobility but never goes outside without help	30,834 (22.8)	21,663 (70.3)	9,171 (29.7)
	No functional mobility	1,786 (1.3)	1,071 (60.0)	715 (40.0)
	Missing	1,502 (1.1)	1,069 (71.2)	433 (28.8)
Deprivation*	Least deprived 10%	10,050 (7.4)	7,827 (77.9)	2,223 (22.1)
	Less deprived 10–20%	9,876 (7.3)	7,620 (77.2)	2,256 (22.8)
	Less deprived 20–30%	10,748 (8.0)	8,310 (77.3)	2,438 (22.7)
	Less deprived 30–40%	11,533 (8.5)	8,964 (77.7)	2,569 (22.3)
	Less deprived 40–50%	12,104 (9.0)	9,502 (78.5)	2,602 (21.5)
	More deprived 40–50%	12,783 (9.5)	10,047 (78.6)	2,736 (21.4)
	More deprived 30–40%	12,564 (9.3)	9,915 (78.9)	2,649 (21.1)
	More deprived 20–30%	12,194 (9.0)	9,710 (79.6)	2,484 (20.4)
	More deprived 10–20%	12,092 (9.0)	9,694 (80.2)	2,398 (19.8)
	Most deprived 10%	11,440 (8.5)	9,215 (80.6)	2,225 (19.4)
	Missing	19,721 (14.6)	15,918 (80.7)	3,803 (19.3)
Fracture type*	Intracapsular	79,797 (59.1)	63,596 (79.7)	16,201 (20.3)
	Intertrochanteric	47,238 (35.0)	37,170 (78.7)	10,068 (21.3)
	Subtrochanteric	8,010 (5.9)	5,907 (73.7)	2,103 (26.3)
	Missing	60 (0.0)	49 (81.7)	11 (18.3)
Surgery timing*	Within target time of 36 h	96,721 (71.6)	77,211 (79.8)	19,510 (20.2)
	Not within target time	29,977 (22.2)	22,849 (76.2)	7,128 (23.8)
	Missing	8,407 (6.2)	6,662 (79.2)	1,745 (20.8)
Procedure type*	Internal fixation	65,790 (48.7)	52,069 (79.1)	13,721 (20.9)
	Hemiarthroplasty	58,320 (43.2)	44,983 (77.1)	13,337 (22.9)
	Arthroplasty	10,407 (7.7)	9,246 (88.8)	1,161 (11.2)
	Missing/other	588 (0.4)	424 (72.1)	164 (27.9)

(Continued)

Table 1. Continued

		All (N = 135,105)	Mobilisation day of or day after surgery (N = 106,722)	Mobilisation at least 2 days after surgery (N = 28,383)
Calendar year of surgery*	2014	31,680 (23.5)	24,668 (77.9)	7,012 (22.1)
	2015	54,208 (40.1)	43,185 (79.7)	11,023 (20.3)
	2016	49,217 (36.4)	38,869 (79.0)	10,348 (21.0)
Day of admission*	Weekday	91,065 (67.4)	71,720 (78.8)	19,345 (21.2)
	Weekend	41,884 (31.0)	33,480 (79.9)	8,404 (20.1)
	Missing	2,156 (1.6)	1,522 (70.6)	634 (29.4)
Hospital volume*,[c]	Low	33,909 (25.1)	26,506 (78.2)	7,403 (21.8)
	Medium	32,013 (23.7)	25,748 (80.4)	6,265 (19.6)
	High	69,183 (51.2)	54,468 (78.7)	14,715 (21.3)

Data are presented according to the categories used in regression analysis. $^*P \leq 0.001$. [a]Does not include 18,831 without comorbidity data. [b]I, normal healthy individual; II, mild systemic disease that does not limit activity; III, severe systemic disease that limits activity but is not incapacitating; IV, incapacitating systemic disease, which is constantly life threatening; V-moribund, not expected to survive 24 h with or without surgery. [c]Low (less than first quartile), medium (second and third quartile) or high (fourth quartile) volume at admission based on the average annual number of surgeries at the admitting hospital. [d]Rehabilitation unit/acute hospital/already in hospital/this hospital site/other hospital site of this trust/other hospital trust, merged with 'missing' for regression analysis.

Table 2. Cumulative incidence of discharge by timing of mobilisation among 135,105 patients surgically treated for nonpathological first hip fracture

Mobilisation timing	Number of patients	Number of deaths[a]	Number of discharges[b]	Discharge rate (95% CI)[c]	30-day CIF, % (95% CI)	Pepe–Mori test (P value)[d]	Unadjusted OR of CIF (95% CI)	Adjusted OR of CIF (95% CI)[e]
Mobilised 2 days or more after surgery	28,383	2,549	12,032	27.0 (26.6–27.5)	567 (559–574)		1.00	1.00
Mobilised on the day of or day after surgery	106,722	3,160	59,298	43.1 (42.8–43.5)	753 (750–757)	<0.001	2.36 (2.29–2.43)	2.08[f] (2.00–2.16)

CIF, cumulative incidence function; CI, confidence interval; OR, odds ratio. [a]At 30 days from surgery. [b]At 30 days from surgery. [c]Per 1,000 patient–days. [d]Two-sample test compared with mobilised 2 days or more after surgery. [e]Adjusted for age, sex, ethnicity, fracture type, calendar period of admission, timing of surgery, comorbidity, ASA grade, prefracture residence, prefracture mobility, procedure type, day of admission and hospital volume. CIF regression at inpatient days 3, 4, 6, 8, 12, 16, 20, 24 and 30. [f]Excludes 50,959 patients with unknown information on adjustment variables. Analysis after imputation of adjustment variables is available in Supplementary File 3.

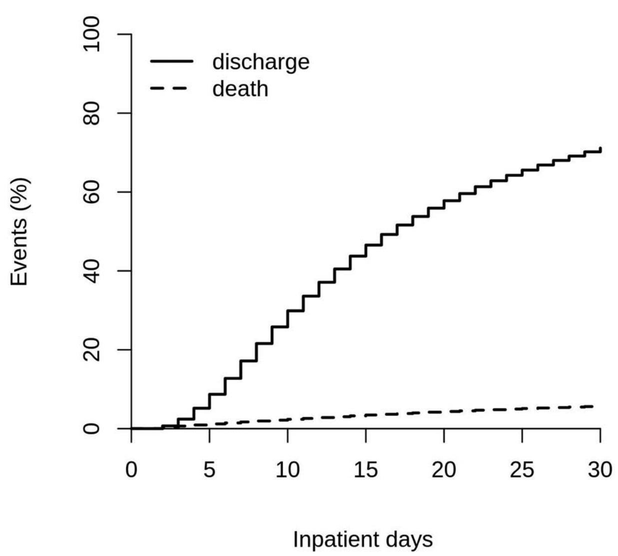

Figure 1. Cumulative incidence of postoperative discharge and death by days after surgery among patients surgically treated for nonpathological first hip fracture.

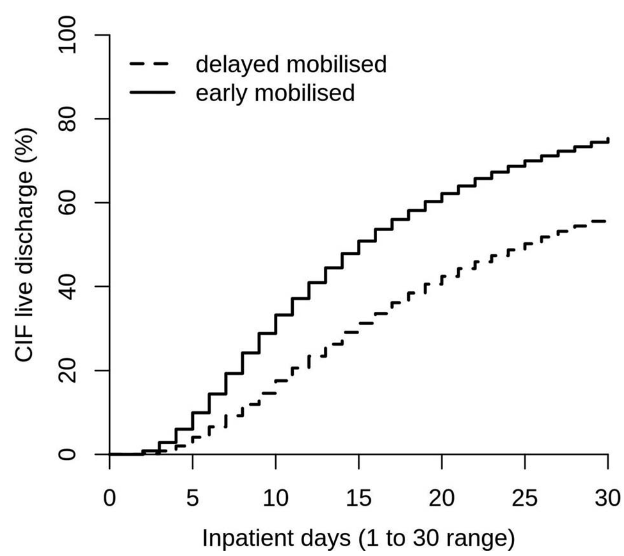

Figure 2. Cumulative incidence function (CIF) of postoperative discharge by days after surgery among patients surgically treated for nonpathological first hip fracture by timing of mobilisation.

Comparison with other literature

The NICE Clinical Guideline's recommendation for early mobilisation is based on a randomised controlled trial of 60 patients, which evaluated the effect of mobilisation within 48 h of surgery on 1-week postoperative walking distance, length of stay and discharge destination [2,42]. The authors reported a positive effect of early mobilisation on walking distance and discharge directly home and a negative effect

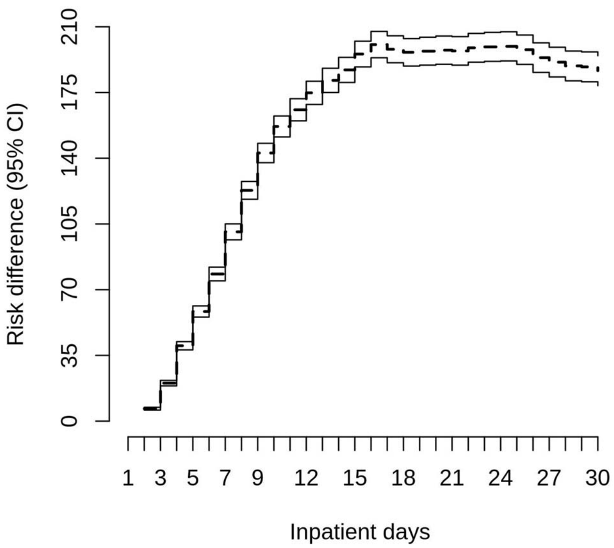

Figure 3. Additional discharges per 1,000 surgeries (95% CI) in patients who mobilised early when compared with number of discharges in patients who mobilised late.

of early mobilisation on length of stay compared with late mobilisation [42]. However, 10 participants (35%) of the early mobilised group failed to mobilise within 48 h of surgery and one participant died in hospital [42]. Exclusion of these cases from their analysis of length of stay demonstrated a positive association between early mobilisation ($n = 18$) and length of stay when compared with late mobilisation ($n = 31$). The current study builds on these findings, demonstrating a positive association between early mobilisation and an increased cumulative incidence of discharge by 30-day postoperatively when compared with late mobilisation, accounting for potential confounders and the competing risk of death.

For hip fracture, there is currently six UK BPTs: time to surgery within 36 h of arrival/inpatient fracture, assessment by a geriatrician in the perioperative period, abbreviated mental test preoperatively, fracture prevention, nutritional, delirium assessments during the admission and assessment by a physiotherapist the day of or day following surgery [7]. We propose mobilisation within 36 h of surgery as a new BPT following hip fracture. This activity is already submitted to the NHFD (enabling early implementation) and the evidence presented here indicates a positive association between early mobilisation and hospital discharge, a patient reported goal of acute rehabilitation [5]. Inclusion of mobilisation within 36 h of surgery as a new BPT would help to reduce delays to mobilisation currently experienced by one-fifth of patients admitted with hip fracture.

Future research

We demonstrated an association between mobilisation timing and hospital discharge. We did not explore potential mechanisms for this association. Some suggest early mobilisation reduces the risk of postoperative complications, which enables earlier discharge from hospital [3]. However, there is inconsistent evidence for an association between mobilisation timing and occurrence of complications. One study noted an association between delayed mobilisation and the occurrence of pneumonia and delirium after hip fracture surgery [3]. Jans *et al*. reported a higher risk of new-onset orthostatic intolerance with early mobilisation after hip arthroplasty [28]. Further research is needed to determine whether complications mediate the association between mobilisation timing and outcomes after hip fracture surgery.

In the current study, almost one-fifth of patients experienced delayed mobilisation. A recent UK Physiotherapy Hip Fracture Sprint Audit collated information related to reasons for delayed mobilisation [6]. Patient factors included prefracture function, hypotension, agitation/refusal, process factors included pain control and structural factors included physiotherapy staffing and equipment [6]. 'Other complications' was the most frequently reported reasons for delayed mobilisation [6]. There is a need to determine which factors delay mobilisation and whether these factors moderate the association between mobilisation timing and discharge.

The association between mobilisation timing and discharge may vary across patient subgroups. For example, some suggest those with greater immobility prefracture benefit most from early mobilisation [43]. Patients with delays to surgery may benefit more from early mobilisation than those not delayed to surgery to reduce overall immobilisation time [44]. Comparing the potential benefit of early mobilisation across subgroups defined by patient, structure and process characteristics may help to inform more effective resource allocation.

We focussed on discharge as an outcome of hospitalisation after hip fracture. A US prospective cohort study of 532 patients reported associations between mobilisation timing and 2-month mobility and 6-month mortality after hip fracture [43]. More recently, an Irish study of 15,603 patients reported an association between mobilisation timing and hospital mortality [45], whereas a UK study of 62,844 patients reported an association between mobilisation timing and function at 30-day postdischarge, irrespective of which healthcare professional supported early mobilisation [46]. It would be beneficial to further build on these studies through adjustment for additional potential confounders and considering the influence of missing data on outcomes reported for complete case analysis.

Limitations

We completed a secondary analysis of the NHFD linked to hospitalisation records. We adjusted our estimates for known potential confounders. However, we cannot be certain that the results were not influenced by unobserved confounding. In particular, discharge may be influenced by the availability of formal and informal support services [47] and patients' social capital [48, 49]. There is potential for bias due to exclusion of patients with missing exposure or covariate data from the complete case analysis presented. To determine the impact of these exclusions we completed sensitivity analyses whereby missing data were imputed. We estimated similar rates and odds ratios for both complete case and imputed analyses.

Conclusion

Early mobilisation led to a 2-fold increase in the adjusted odds of discharge by 30-day postoperatively, accounting for the competing risk of death and potential confounders. We recommend inclusion of mobilisation within 36 h of surgery as a new BPT to help reduce delays to mobilisation currently experienced by one-fifth of patients surgically treated for hip fracture.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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Additional references may be found in Supplementary File 4.

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