Early mobilisation following fragility hip fracture surgery: current trends and association with discharge outcomes in a local tertiary hospital

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Abstract

Introduction: Postoperative day 1 (POD 1) mobilisation is a key clinical indicator for the fragility hip fracture surgery population. This study aimed to evaluate the current trends of POD 1 mobilisation at our institution and to review the relationships between early mobilisation and outcomes of early functional recovery, length of stay (LOS) and discharge destination.

Methods: In this preliminary observational study, data pertaining to demographics, premorbid function, health status, injury and surgical factors, POD 1 mobilisation status and clinical outcomes of interest were retrieved from eligible patients. Patients who attained POD 1 ambulation formed the early ambulation (EA) group, while the remaining patients formed the delayed ambulation (DA) group. Data were analysed for any significant difference between the groups.

Results: One hundred and fifteen patients were included in the analysis. The rate of patients achieving at least sitting out of bed on POD 1 was 80.0% (n=92), which was comparable to the data available from international hip fracture audit databases. There were 55 (47.8%) patients in the EA group and 60 (52.5%) patients in the DA group. The EA group was approximately nine times more likely to achieve independence in ambulation at discharge compared to the DA group (adjusted odds ratio 9.20, 95% confidence interval 1.50–56.45; P = 0.016). There were observed trends of shorter LOS and more proportion of home discharge in the EA group compared to the DA group (P > 0.05).

Conclusion: This is the first local study to offer benchmark of the POD 1 mobilisation status for this population. Patients who attained POD 1 ambulation had better early functional recovery.

Keywords: Benchmarking, discharge outcomes, early ambulation, hip fractures, inpatients

INTRODUCTION

With a growing ageing population worldwide, the incidence and consequent burden of hip fracture care are expected to increase.1 In line with this, several international hip fracture audit databases have been set up to ensure that care delivered to this population is efficacious and aligned with evidence-based practice.2-7 For the ageing population, early mobilisation is a key clinical indicator recommended across all international clinical guidelines8-10 and is tracked in these audit databases.12-7 Locally, there is a lack of such published data on early mobilisation status. In addition, it is recognised that early mobilisation minimises the risk of complications that arise from prolonged immobility and is an integral step of recovery for this population.8-10 Limited overseas research had shown that early mobilisation is associated with better early functional recovery,12 shorter length of stay (LOS)12,13 and higher likelihood of being discharged home.12,14 On the other hand, some studies had reported a lack of significant findings on the effect of early mobilisation on these same measures.12,14-16

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The primary aim of this study was to evaluate the current rate of early mobilisation on postoperative day 1 (POD 1) in the fragility hip fracture patient population at Changi General Hospital (CGH). The secondary aim was to compare the outcomes of patients who achieved ambulation on POD 1 with those who did not, in the following domains: (a) early functional recovery (ambulatory status at discharge), (b) LOS in the acute setting; and (c) discharge destination from the acute setting.

METHODS

We conducted an observational study at CGH, a public tertiary hospital in Singapore with an annual admission of approximately 500 hip fracture patients. This preliminary study used a convenient sample of patients who were enrolled in another prospective study approved by the Singhealth centralised institutional review board (CIRB) (reference number 2016/2136).[17]

Our study reviewed patients who were admitted to CGH between April 2016 and September 2016 due to fragility hip fracture. All patients received standardised care in accordance with the hospital’s hip fracture clinical pathway. This care protocol comprised optimisation aimed at early surgery, adequate pain management, ortho-geriatric review, physiotherapy review on POD 1 and early discharge planning coordinated by the hip fracture specialty case managers. Waiver of ethical approval for the use of data in the current study was granted by the Singhealth CIRB (reference number 2018/3021).

Patients were screened for eligibility for this study using the following inclusion criteria: (a) age 65–100 years; (b) admitted for single fragility hip fracture (neck of femur or intertrochanteric fractures); (c) undergone hip fracture surgery; and (d) allowed weight-bearing as tolerated on POD 1. Exclusion criteria were: (a) subtrochanteric, pathological or periprosthetic hip fractures; (b) multiple fractures or other injuries (e.g. head, chest, abdomen and/or pelvis); (c) restricted weight-bearing status postoperatively (e.g. non-weight-bearing, toe-touch or partial weight-bearing); (d) non-ambulatory premorbid status; (e) premorbid or new onset of neurological and/or musculoskeletal deficits limiting the ambulatory status; and (f) premorbid status of institutionalised care (e.g. nursing home).

Data was collected prospectively from patients’ medical records. Demographic data included age, gender and race. Age was collected both as a continuous variable and a dichotomous variable with a cut-off of <85 years.[18] Premorbid function (defined as function before the fracture was sustained) was measured using the new mobility score (NMS) (range 0–9)[19] and modified Barthel index (MBI) (range 0–100).[20] Cut-offs for good premorbid functional status were NMS 7–9[21,22] and MBI 91–100,[20] respectively. Health status was measured using the American Society of Anesthesiologists (ASA) score (range 1–5)[23] and the Nottingham hip fracture score (NFHS).[24] The NHFS is a composite score calculated based on the various variables collected. It is a recognised risk-stratifying tool for perioperative morbidity and short- and long-term postoperative mortality risks for the hip fracture population.[24,25] Cut-offs for good health status were determined as ASA score 1–2[26,27] and NHFS 0–4.[24,25] Cognitive status was determined by the abbreviated mental test (AMT) score,[28,29] which was assessed at admission and by presence of the diagnosis of dementia and/or cognitive impairment based on the anaesthesia surgical assessment chart. A cut-off AMT score of ≥7 out of 10 was used to assess for cognition.[21,28] Injury and surgical information collected included the type of fracture (neck of femur or intertrochanteric) and type of surgical fixation (arthroplasty vs. dynamic hip screws, cancellous screws, proximal femoral nail anti-rotation and others). Following surgery, length of preoperative period (≤1 vs. >1 day),[30] day of the week of POD 1 (weekday vs. weekend, public holidays)[31] and postoperative recovery area (general ward vs. high-dependency unit, intensive care unit) were recorded. In addition, postoperative haemoglobin values (on either operative day or POD 1) and postoperative transfusion were determined; a cut-off of ≤10 g/dL in the postoperative period has been shown to be associated with poorer functional recovery for the hip fracture population.[31]

The patients’ level of mobilisation was retrieved from the POD 1 therapy session. Patients who attained POD 1 ambulation were placed into the early ambulation (EA) group and those who did not attain POD 1 ambulation were placed into the delayed ambulation (DA) group.

Early functional recovery was determined by independence in ambulation with at least a walking frame. This is similar to studies that assessed independence in function as a measure of early functional recovery in this population.[12,22,32] The LOS in the acute setting was defined as the duration of stay with care managed by the orthopaedics team. For majority of the patients, this was the period from admission till discharge from the hospital. A minority of patients were transferred from orthopaedic care to another medical speciality (e.g. geriatrics, rehabilitation teams). For these patients, date of transfer was used in the calculation of LOS in the acute setting. Discharge destination was categorised into home, step-down community hospital, takeover by other medical specialties (e.g. geriatrics, rehabilitation teams) or others (e.g. nursing home).

Descriptive statistical analysis was performed for the baseline and selected in-hospital data for patients as an overall cohort and respectively based on their groups. Univariate analysis was performed to assess for any significant difference in these data between the groups. For each variable, chi-square test was performed based on the dichotomous classification as mentioned above. Age was
additionally analysed as a continuous data with a normal distribution (t-test). The mobilisation status on POD 1 was analysed descriptively and compared with available international standards. For the outcome measures of early functional recovery and discharge destination, chi-square test was performed to compare the differences between the two groups. The outcome measure of LOS did not have a normal distribution; accordingly, the Mann–Whitney U test was performed to compare the difference between the two groups. For the measure of early functional recovery, which had significant univariate findings, multivariate analysis was additionally performed to adjust for possible covariates. The selection of covariates included factors that had been reported as significant by other studies. All statistical analyses were conducted using IBM SPSS Statistics version 19.0 (IBM Corp, Armonk, NY, USA) and the significance level was determined at \( P < 0.05 \).

**RESULTS**

A total of 240 patients were assessed for eligibility [Figure 1]. Of the 123 eligible patients, all but two patients were referred for physiotherapy on POD 1. One hundred and fifteen patients were included in the final analysis [Figure 1], and their characteristics are presented in Table 1. On POD 1, 16 (13.9%) patients did not achieve mobilisation. Of the remaining 99 patients, seven (6.1%) achieved sitting over the edge of bed, five (4.3%) achieved sitting out of bed, 32 (27.8%) achieved standing and 55 (47.8%) achieved ambulation as their highest level of mobilisation on POD 1. Based on their ambulatory status, 55 (47.8%) patients formed the EA group and the remaining 60 (52.2%) patients formed the DA group.

A significantly higher proportion of patients in the EA group had their POD 1 on a weekday (unadjusted odds ratio \( OR \) 3.00, 95% confidence interval \( CI \) 1.27–7.08; \( P = 0.010 \)). For other demographic and selected in-hospital data, no significant differences were observed between the two groups [Table 1].

At discharge, 9.6% \( (n = 11) \) of the overall cohort could ambulate independently with a walking frame or better. The EA group had significantly more patients who could achieve this compared to patients in the DA group (16.4% vs. 3.3%, \( P = 0.018 \)). After adjusting for possible covariates (age, premorbid status, health status, type of surgery, day of the week of POD 1), POD 1 ambulation remained a significant factor for this measure (adjusted OR 9.20, 95% CI 1.50–56.45; \( P = 0.016 \)).

The overall cohort had a mean total LOS of 11.5 (median 10.0, interquartile range \( IQR \) 4.0) days. The EA group had a mean total LOS of 11.0 (median 10.0, IQR 4.0) days and the DA group had a mean total LOS of 12.1 (median 10.5, IQR 5.0) days \( (P = 0.768) \).

Overall, 13 (11.3%) patients were discharged home, 96 (83.5%) were discharged to a community hospital and the remaining six patients (5.2%) were transferred to a different medical specialty. Of the patients who were discharged home, eight (14.5%) patients were from the EA group and five (8.3%) were from the DA group \( (P = 0.293) \).

**DISCUSSION**

Early mobilisation is an integral milestone in the postoperative recovery of fragility hip fracture surgery patients, and it...
is recommended in all the international clinical guidelines for this population. In the international hip fracture audit databases, this milestone is tracked via POD 1 physiotherapy referral rate and/or actual POD 1 mobilisation status. For POD 1 physiotherapy referral rate, the reported average national rates were 97%, 86% and 91% for the UK, Australia and New Zealand, respectively. In this study, POD 1 physiotherapy referral rate was comparable at 98.4%. For POD 1 actual mobilisation rate, the reported national figures were 80%, 68% and 77% for the UK, Scotland and Ireland, respectively. However, on multivariate analysis of early functional recovery, the day on which POD 1 falls did not retain its significance (P > 0.05). The weekend effect has been investigated considerably in the medical literature on the basis that variability in medical, nursing and rehabilitation resources over a weekend could lead to a gap in weekend care. For the hip fracture cohort, the weekend effect can impact care depending on the different timeframes.

In this study, more patients achieved EA if their POD 1 was on a weekday as compared to those whose POD 1 fell on a weekend or public holiday. This finding is similar to those reported in other studies. However, on multivariate analysis of early functional recovery, the day on which POD 1 falls did not retain its significance (P > 0.05). The weekend effect has been investigated considerably in the medical literature on the basis that variability in medical, nursing and rehabilitation resources over a weekend could lead to a gap in weekend care. For the hip fracture cohort, the weekend effect can impact care depending on the different timeframes.

This is the first known local study that has provided a benchmark for POD 1 physiotherapy referral rate and early mobilisation rate for the fragility hip fracture surgery cohort in Singapore. We hope that our findings will allow for continual benchmarking of this key milestone with both local and overseas standards for this patient population. Similar to overseas hip fracture registries, this could allow for prospective assessment of key indicators to monitor performances and various outcomes in the local health system.

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Table 1. Baseline and selected in-hospital characteristics of the study sample.

| Variable                  | Overall (n=115) | EA group (n=55) | DA group (n=60) | P*  |
|---------------------------|-----------------|-----------------|-----------------|-----|
| Agea (yr)                 | 80.9±7.7        | 81.4±8.0        | 80.1±7.6        | 0.366 |
| 65–84                     | 32 (27.8)       | 34 (61.8)       | 45 (75.0)       | 0.128 |
| Gender                    |                 |                 |                 |     |
| Male                      | 79 (68.7)       | 15 (27.2)       | 17 (28.3)       | 0.899 |
| Race                      |                 |                 |                 |     |
| Chinese                   | 90 (78.2)       | 45 (81.8)       | 45 (75.0)       | 0.376 |
| Premorbid status          |                 |                 |                 |     |
| NMS 7–9                   | 56 (48.7)       | 26 (47.3)       | 30 (50.0)       | 0.770 |
| MBI 91–100 (n=91)         | 54 (59.3)       | 28 (60.9)       | 26 (57.8)       | 0.764 |
| Health status             |                 |                 |                 |     |
| ASA score 1–2             | 26 (22.6)       | 14 (25.5)       | 12 (20.0)       | 0.485 |
| NHFS 0–4 (n=102)          | 34 (33.3)       | 16 (32.7)       | 18 (34.0)       | 0.889 |
| Cognition                 |                 |                 |                 |     |
| Absence of dementia       | 82 (71.3)       | 42 (76.4)       | 40 (66.7)       | 0.251 |
| AMT score 7–10 (n=102)    | 62 (60.8)       | 32 (65.3)       | 30 (56.6)       | 0.368 |
| Injury factor             |                 |                 |                 |     |
| Neck of femur fracture    | 74 (64.3)       | 36 (65.5)       | 38 (63.3)       | 0.812 |
| Arthroplasty surgery      | 69 (60.0)       | 32 (58.2)       | 37 (61.7)       | 0.703 |
| Preoperative period       |                 |                 |                 |     |
| ≤1 day                    | 29 (25.2)       | 15 (27.3)       | 14 (23.3)       | 0.627 |
| POD 1                     |                 |                 |                 |     |
| Weekday                   | 81 (70.4)       | 45 (81.8)       | 36 (60.0)       | 0.010 |
| Postoperative ward        |                 |                 |                 |     |
| General ward              | 73 (63.5)       | 36 (65.5)       | 37 (61.7)       | 0.673 |
| Blood loss                |                 |                 |                 |     |
| No blood transfusion needed | 97 (84.3)       | 49 (89.1)       | 48 (80.0)       | 0.180 |
| POD 1 Hb ≥10 g/dL (n=114) | 69 (60.5)       | 35 (63.6)       | 34 (57.6)       | 0.512 |

a Data presented as mean±standard deviation. *Comparison between EA and DA groups. †Statistically significant at P < 0.05. AMT: abbreviated mental test, ASA: American Society of Anesthesiologists, DA: delayed ambulation, EA: early ambulation, Hb: haemoglobin, MBI: modified Barthel index, NFHS: Nottingham hip fracture score, NMS: new mobility score, POD: postoperative day.
over a weekend, i.e. weekend admission or weekend surgery (including operation day or POD 1 occurring on a weekend). Given the multiple time points at which the weekend effect could occur, it can be complex to analyse its effect on the hip fracture population. Table 2 summarises the findings of several studies on the weekend effect.\(^{[14-37]}\) It is noteworthy that these studies had mixed findings, as well as different outcome measures and timeframes at which the weekend effect was assessed; thus, direct interpretation of these findings must be done with caution. In this study, day of POD 1 was chosen as a variable; this is because a previous study had reported it as a significant factor for attainment of POD 1 ambulation.\(^{[12]}\)

Another study had found that eve of weekend surgeries (not exclusive to hip fracture surgeries) was associated with higher 30-day mortality.\(^{[38]}\) Further research is needed to analyse in greater depth the impact of the different timeframes of the weekend effect on early mobilisation for this population and to identify the subcomponents of weekend care that need to be addressed.

In this study, early mobilisation was associated with significantly better early functional recovery. Patients who achieved ambulation on POD 1 (EA group) were approximately nine times more likely at discharge to regain independence for ambulation using at least a walking frame. This finding is similar to that reported by Oldmeadow et al.\(^{[12]}\) Based on these findings, clinicians can provide evidence-based education to patients and families on the association between early mobilisation and early functional recovery.

For measures of LOS and discharge destination, there were similar trends in favour of patients who achieved ambulation on POD 1. However, these observed trends did not reach statistical significance. Limited overseas studies\(^{[12,14-16]}\) have also observed similar trends supporting the early mobilisation group, with varying levels of statistical significance \(\text{[Table 3]}\). There are a few possible explanations for why the observed trends in this study did not achieve statistical significance. Firstly, LOS and discharge destinations are influenced by other factors. Specific to the hip fracture population, male gender, higher ASA score, preoperative cardiac testing and admission day of the week between Thursday and Friday were found to be associated with longer LOS for acute hospitalisation.\(^{[39]}\) Another study reported that social issues relating to caregiving was one of the key factors that influenced discharge planning for the geriatric population in our local setting.\(^{[40]}\) Almost all of the fragility hip fracture cohort patients do not return to their baseline at the point of discharge from acute care. Thus, the influence of caregiving issues on discharge planning is likely present in the fragility hip fracture cohort at this timeframe.

Secondly, it is possible that there was a real difference, but due to the small sample size, this preliminary study was underpowered to detect statistical significance. Based on the observed trend for LOS, a sample size calculation (two-tailed t-test with 80% power and a 5% level of significance)\(^{[41]}\) revealed that a sample size of 375 per group was needed for optimal statistical analysis.

This study was not without limitations. Firstly, evaluation of the POD 1 mobilisation status offered by this study was based on patients who were included for the analysis. The rate reported was comparable to the internal data (2016) available for POD 1 mobilisation rate of sitting over the edge of bed (86.1% vs. 86.2%). The internal data was obtained from the ValuedCare Hip Fracture Programme, which has been tracking key performance indicators for this population (internal data provided by ValuedCare Programme Office, CGH). No internal

| Table 2. Comparison of findings of weekend effect. |
|---------------------------------------------------|
| **Study (study period)** | **Country (sample size)** | **Patient cohort** | **Findings** |
| Nijland et al.\(^{[34]}\) (2000–2015) | Netherlands \(n=1,803\) | Hip fracture | Weekend admissions and weekend surgeries: NS for 30-day and 1-year mortality rates |
| UK NHFD—England and Wales\(^{[35]}\) (2011–2014) | UK \(n=241,446\) | Hip fracture | Weekend admissions: NS for 30-day mortality rate Sunday surgeries: higher 30-day mortality rate \(\text{OR 1.094, 95% CI 1.043–1.148; } P<0.0001\) |
| Sheikh et al.\(^{[36]}\) (Sep 2008–Mar 2011) | UK \(n=1,326\) | Hip fracture | Weekend admissions and surgeries: NS for 30-day, 90-day and 1-year mortality rates |
| Thomas et al.\(^{[37]}\) (Jul 2009–Feb 2013) | UK \(n=2,989\) | Hip fracture | Weekend admissions: higher 30-day mortality rate \(\text{OR 1.4, 95% CI 1.02–1.9; } P=0.039\) Weekend surgeries: NS for 30-day mortality rate |
| Zare et al.\(^{[38]}\) (2000–2004) | USA \(n=89,786\) | Non-emergent surgery cases admitted to general wards postoperatively (inclusive of 3,092 hip fracture cases) | Eve of weekend surgeries: higher 30-day mortality rate \(\text{OR 1.36, 95% CI 1.24–1.49; } P<0.001\) |
| Hip Sprint Audit (as part of NHFD)\(^{[40]}\) (2017) | UK \(n=5,989\) | Hip fracture | POD 1 on weekend: lower rates of achieving sitting out of bed \(\text{weekend 63% vs. weekday 75%}\) |
| Barone et al.\(^{[16]}\) (Nov 2005–Jan 2007) | Italy \(n=469\) | Hip fracture | POD 1 on weekend: less likely to attain POD 1 ambulation \(\text{OR 2.49, 95% CI 1.56–3.99; } P<0.001\) |

Weekends include Saturdays, Sundays and public holidays. CI: confidence interval, NHFD: national hip fracture database, NS: not significant, OR: odds ratio, POD: postoperative day
data is available for the other levels of mobilisation. For a more thorough analysis to truly reflect the benchmark for the institution, future study should review the rates to include patients who were excluded from this study. Secondly, as mentioned earlier, this study had a small sample size. This could have undermined the detection of statistical significance of any observed association. Thirdly, there are several other factors that can influence the attainment of POD 1 ambulation. This study had attempted to analyse some factors, but there remain other factors that were not analysed. For example, use of nerve blocks for pain management and cardiac enzyme (as a measure of postoperative cardiac status) have been shown to affect POD 1 mobilisation. As this study referenced a previously collected dataset, it was not possible to retrieve information on these additional aspects. Future studies reviewing this topic should collect these other clinical factors for a comprehensive analysis of early mobilisation for this population.

In conclusion, this is the first local study to offer a benchmark of POD 1 mobilisation status for the fragility hip fracture population. It highlights that patients who attained POD 1 ambulation had better early functional recovery. The limitations of this study should be considered in the design of future larger-scale studies to further investigate this topic.

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Conflicts of interest
There are no conflicts of interest.

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