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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 (POD1) mobilisation is a key clinical indicator for the fragility hip fracture surgery population. This study aimed to evaluate the current trends of POD1 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, pre-morbid function, health status, injury and surgical factors, POD1 mobilisation status and clinical outcomes of interest were retrieved from eligible patients. Patients who attained POD1 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: 115 patients were included in the analysis. The rate of patients achieving at least sitting out of bed on POD1 was 80.0% (92 patients) which was comparable with data available from international hip fracture audit databases. 55 patients (47.8%) formed the EA group and 60 patients (52.5%) formed the DA group. 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 DA group ($p > 0.05$).

Conclusion: This is the first local study to offer benchmark of the POD1 mobilisation status for this population. Patients who attained POD1 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, there are several international hip fracture audit databases to ensure that care delivered for this population is efficacious and aligned with evidence-based practice.[2-7] For this population, early mobilisation is a key clinical indicator recommended across all international clinical guidelines[8-10] and is tracked in these audit databases.[2-7] Locally, there is a lack of published data on the early mobilisation status in Singapore. Therefore, this study firstly aimed to evaluate the trends of early mobilisation in the local context and compare it against the international hip fracture audit standards. Additionally, it is recognised that early mobilisation minimises the risk of complications that arises from prolonged immobility and is an integral step of recovery for this population.[8-11] Limited overseas research had shown that early mobilisation is associated with better early functional recovery,[12] shorter length of stay[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] Thus, the other aims of this study are to investigate, in the local context, the relationships between early mobilisation and outcomes of early functional recovery, length of stay and discharge destination.

The primary aim of this study was to evaluate the current rate of early mobilisation on post-operative day one (POD 1) in the fragility hip fracture patient population at Changi General Hospital (CGH). The secondary aims of this study were to: (a) compare the early functional recovery of patients (ambulatory status at discharge) between patients who achieved POD 1 ambulation with those patients who did not ambulate on POD 1; (b) compare the length of stay in the acute setting between patients who achieved POD 1 ambulation with those patients who did not ambulate on POD 1; and (c) compare the discharge destination from the acute setting between patients who achieved POD 1 ambulation with those patients who did not ambulate on POD 1.

METHODS

This was a preliminary observational study conducted at CGH, which is a public tertiary hospital in Singapore. CGH admits approximately 500 hip fracture patients a year. As this was a preliminary study, a convenient sample of patients enrolled in a recent study was selected (CIRB Reference Number 2016/2136). This recent study was a local Singhealth Centralised Institutional Review Board (CIRB) approved prospective study which reviewed patients who were admitted to CGH between April to September 2016 due to fragility hip fracture. All patients received standardised care in accordance to the hospital's Hip Fracture Clinical Pathway. This care comprised of optimisation aimed towards 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 was granted by the local CIRB board for the use of the data for this study (CIRB Reference Number 2018/3021).

Patients from the previous study were rescreened for eligibility for this study. Inclusion criteria were (1) age 65-100 years old, (2) admitted for single fragility hip fracture (neck of femur or intertrochanteric fractures), (3) undergone hip fracture surgery and (4) allowed weight-bearing as tolerated on POD 1. Exclusion criteria were (1) sub-trochanteric, pathological or periprosthetic hip fractures, (2) multiple fractures or sustaining other injuries (e.g. head, chest, abdomen and / or pelvis), (3) restricted weight bearing status post operatively (e.g. non-weight bearing, toe-touch weight bearing, partial weight bearing), (4) non-ambulatory pre-morbid status, (5) pre-morbid or new onset of neurological and / or musculoskeletal deficits limiting ambulatory status and (6) pre-morbidly from institutionalised care (e.g. nursing home).

Under the previous study, data was collected prospectively from patient's medical records. Demographic data included age, gender and race. Age was collected both as a continuous variable and also as a dichotomous variable with a cut off of <85 years old.(17) Pre-morbid function (defined as function before the fracture was sustained) was measured using the New Mobility Score (NMS) (range 0-9)(18) and Modified Barthel Index (MBI) (range 0-100).(19) Cut offs were chosen as NMS 7-9(20,21) and MBI 91-100(19) respectively for good pre-morbid functional status. Health status was measured using the American Society of Anaesthesiologists (ASA) score (range 1-5)(22) and the Nottingham Hip Fracture Score (NFHS).(23) The NHFS is a composite score calculated based on the various variables collected. It is a recognised risk stratifying tool of the perioperative morbidity and both short term and long term post-operative mortality risks for the hip fracture population.(23,24) Cut offs for good health status was determined as ASA score 1-2(25,26) and NFHS of 0-4.(23,24) Cognitive status was determined by the Abbreviated Mental Test (AMT) score,(27,28) 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 $\geq$7 out of 10 was used to assess for cognition.(20,27) Injury and surgical information collected were types of fracture (neck of femur or intertrochanteric) and types of surgical fixation (arthroplasty versus dynamic hip screws, cancellous screws, proximal femoral nail anti-rotation (PFNA), others). Following surgery, length of pre-operative period ($\leq$1 day versus >1 day),(29) day of the week of POD 1 day (weekday vs weekend, public holidays (PH))(14) and post-operative recovery area (general ward versus high dependency, intensive care units) were recorded. In addition, post-operative haemoglobin values (on either operative day or POD 1) and post-operative transfusion were determined. Research had shown that a cut-off of ≤10g/DL in the post-operative period was associated with poorer functional recovery for the hip fracture population.[30]

From their POD 1 therapy session, patient's level of mobilisation was retrieved. Based on their POD 1 ambulation status, patients were grouped into "Early Ambulation" (EA) group i.e. those who attained POD 1 ambulation and "Delayed Ambulation" (DA) group i.e. those who did not attain POD 1 ambulation.

Early functional recovery was determined by independence in ambulation with at least a walking frame. This was similar to the other studies which had assessed independence in function as a measure of early functional recovery in this population.[12,21,31] The length of stay 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 specialty (e.g. geriatrics, rehabilitation teams). For these patients, date of transfer was used in the calculation of length of stay in the acute setting. Discharge destination was categorised into home, step-down community hospital, other medical specialty takeover (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 also 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 which had a normal distribution (T test). POD 1 mobilisation status 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 measures of length of stay 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 co-variates. The selection of co-variates included factors which had previously been reported as significant factors by past studies.[15,31] All statistical analysis was done using SPSS statistical software, version 19.0 (IBM Corp. Armonk, NY) and significance level was determined at $p < 0.05$.

RESULTS

240 patients were assessed for eligibility (Fig. 1). Of the eligible patients (n = 123), all except two patients were referred to Physiotherapy on POD 1. 115 patients were included for the analysis (Fig. 1) and their characteristic is presented in Table I. On POD 1, 16 patients (13.9%) did not manage to achieve mobilisation. Seven patients (6.1%) achieved sitting over edge of bed, five patients (4.3%) achieved sitting out of bed, 32 (27.8%) patients achieved standing and 55 patients (47.8%) achieved ambulation, as their highest level of mobilisation on POD 1. Therefore, 55 patients (47.8%) formed the EA group and the remaining 60 patients (52.2%) formed the DA group. The EA group had a significantly higher proportion of patient who had their POD 1 day occurring on weekday (unadjusted odds ratio: 3.00; 95% Confidence Interval (CI) 1.27-7.08, p=0.010). For the other demographic and selected in-hospital data, there was no significant difference between the two groups (Table I).

At discharge, 9.6% (n = 11) of the overall cohort could ambulate independently with a walking frame or better. EA group had significantly more patients who could achieve this compared to DA group (16.4% vs 3.3%; p = 0.018). After adjusting for possible co-variates (age, pre-morbid status, health status, type of surgery, day of the week of POD 1), POD 1 ambulation remained as a significant factor for this measure (adjusted odds ratio 9.20; 95% CI 1.50-56.45; p = 0.016).

The overall cohort had a mean total length of stay of 11.5 days (median 10.0, interquartile range (IRQ) 4.0). EA group had a mean total length of stay of 11.0 days (median 10.0, IRQ 4.0) and DA group had a mean total length of stay of 12.1 days (median 10.5, IRQ 5.0) (p = 0.768).

The overall cohort had 13 patients (11.3%) who were discharged home, 96 patients (83.5%) who were discharged to a community hospital and the remaining were transferred to a different medical specialty (5.2%). Comparing the patients who were discharged home, EA group had eight patients (14.5%) while DA group had five patients (8.3%) (p = 0.293).

DISCUSSION

Early mobilisation is an integral milestone in the post-operative recovery of the fragility hip fracture surgery patients which is recommended in all the international clinical guidelines for this population.(8-10) In the international hip fracture audit databases,(2-7) 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%,(7) 86%(2) and 91%(2) for United Kingdom (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%,(4) 68%(5) and 77%(3) for UK, Scotland and Ireland respectively. The Scottish and Irish audits did not provide a definition for POD 1 mobilisation. For the UK figure, it was defined as achieving at least sitting out of bed on POD 1. This study had a similar rate of 80.0%. Lastly, the rates of POD 1 attainment of standing and ambulation in this study were 75.7% and 47.8% respectively. These figures were not reported in the international audit databases. Comparing with overseas studies, this study had a higher rate for patients achieving stand on POD 1 (75.7% vs 51.9%)[21] but a lower rate of POD 1 ambulation (47.8% vs ~ 65%).[14,30]

All in all, 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. It is hoped that this will allow for continual benchmarking of this key milestone for this patient population with both local and overseas standards. 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.

In this study, the proportion of patients who achieved early ambulation was higher in those with POD 1 occurring on a weekday than patients who had their POD 1 occurring on a weekend or PH. This finding is similar to that reported by past studies.[6,14] Under the multivariate analysis for early functional recovery, day of POD 1 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 the weekend care.[32] For the hip fracture cohort, there are different timeframes as to how the weekend effects can impact care i.e. weekend admission or weekend surgery (including of operation day or POD 1 occurring on weekend). Given the multiple time points that the weekend effects can occur, analysis of the weekend effect can be complex for the hip fracture population. The findings of the weekend effects investigated by some studies are summarised in Table II.[33-36] It is noteworthy that findings of these studies had been mixed and direct interpretation of these findings must be cautioned. The different studies had different outcome measures and different timeframes in which the weekend effect was assessed on. In this study, day of POD 1 was chosen as a variable as a previous study had reported it as a significant factor for attainment of POD 1 ambulation.[14] Another study had found that eve of weekends surgeries (not exclusive to hip fracture surgeries) was associated with higher 30-day mortality.[37] All in all, future research is needed to analyse more in depth the impact of the different timeframes of the weekend effects on early mobilisation for this population and identify the sub-components of care of weekend care that need to be addressed.

In this study, early mobilisation is associated with significantly better early functional recovery. Patients who achieved ambulation on POD 1 (EA group) were approximately nine times more likely to regain independence at discharge for ambulation using at least a walking frame. This finding is similar to that reported by Oldmeadow and colleagues.[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 length of stay 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 level of statistical significance (Table III). There are a few possible explanations why the observed trends in this study did not achieve statistical significance. Firstly, length of stay and discharge destinations are influenced by other factors. Specific to the hip fracture population, male gender, higher ASA score, pre-operative cardiac testing and admission day of the week between Thursday and Friday were found to be associated with longer length of stay for the acute hospitalisation.[38] 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.[39] Almost all of the fragility hip fracture cohort 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 for 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 the statistical significance. Based on the observed trend for length of stay, a sample size calculation (two-tailed t test with 80% power and a 5% level of significance)[40] revealed that a sample size of 375 per group was needed for an 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 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 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 as well. 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 for some factors but there remains other factors that were not analysed. For example, use of nerve blocks for pain management and cardiac enzyme (as a measure of post-operative cardiac status) have been shown to affect POD 1 mobilisation.[12,41] 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 mentioned 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 a future bigger scale study to further investigate this topic.

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Fig. 1 – Flow diagram shows patient selection process

Assessed for Eligibility (n=240)

Excluded Patients (n=117)

1. Age <65 (n=18)
2. NWB (n=35)/TTWB (n=1)/PWB (n=22)
3. Non-ambulatory pre-morbid (chair/bed bound) (n=5)
4. Pathological (n=2)/periprosthetic (n=7) / subtrochanteric fracture (n=2)
5. Multiple or other injuries (n=14)
6. Pre-morbid or new onset of neurological and/or musculoskeletal deficits limiting ambulatory status (n=5)
7. Pre-morbidly from institutionalised care (e.g. nursing homes) (n= 6)

Eligible Patients (n=123)

Drop Out (n=8)

1. Deviated care from clinical pathway (n=6)
   - Missed therapy referrals (n=2)
   - Surgeon's order for POD 1 non-mobilisation (n=3)
   - Long pre-operative period of 44 days (n=1)
2. Had abdominal surgery on POD 2 (n=1)
3. Had stroke on POD 2 (n=1)

Patients included for univariate analysis (n=115)

Abbreviations: NWB: Non-weight bearing; **TTWB:** Toe-touch weight bearing;

PWB: Partial weight bearing; **POD 1/2:** Post-operative day one / two

Table I – Baseline and selected in-hospital characteristics of study sample

		Overall Cohort (n=115)		Early Ambulation (EA) Group (n = 55)		Delayed Ambulation (DA) Group (n = 60)		p~
		n	**%**	**n**	**%**	**n**	**%**	
Age	Mean (SD) (years old)	80.9 (7.7)		81.4 (8.0)		80.1 (7.6)		0.366
	65-84 years old	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 (valid data 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 (valid data 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 (valid data n=102)	62	60.8	32	65.3	30	56.6	0.368
Injury Factors	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
Pre-operative Period	≤1 day	29	25.2	15	27.3	14	23.3	0.627
POD 1 day	Weekday	81	70.4	45	81.8	36	60.0	0.010*
Post-Operative 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 Value^ ≥10g/DL (valid data n=114)	69	60.5	35	63.6	34	57.6	0.512

Note : ^ indicates variables with missing data – number of valid data shown in brackets
: ~p value shown are between EA and DA group, * indicates p <0.05

Abbreviations: SD: standard deviation; **NMS:** New Mobility Score; **MBI:** Modified Barthel Index; **ASA:** American Society of Anaesthesiologists; **NFHS:** Nottingham Hip Fracture Score; **AMT:** Abbreviated Mental Test; **POD:** Post-Operative Day; **Hb:** Haemoglobin

Table II – Comparison of findings of weekend effects

Authors **(Study Period)**	**Country (Sample Size)**	**Patient Cohort**	**Findings**
Nijland et. al. (2017)[33] (2000-2015)	The Netherlands (n=1803)	Hip Fracture	Weekend admissions and weekend surgeries: N.S for 30d and 1 year mortality rates
UK NHFD – England and Wales[34] (2011-2014)	United Kingdom (n= 241,446)	Hip Fracture	Weekend admissions: N.S for 30d mortality rate Sunday Surgeries: higher 30d mortality rate *(OR: 1.094, 95% CI 1.043–1.148, p<0.0001)*
Shiekh et. al. (2018)[35] (September 2008-March 2011)	United Kingdom (n=1326)	Hip Fracture	Weekend admissions and surgeries: N.S for 30d, 90d and 1 year mortality rates
Thomas et. al. (2014)[36] (July 2009- February 2013)	United Kingdom (n=2989)	Hip Fracture	Weekend admissions: higher 30d mortality rate *(OR: 1.4, 95% CI 1.02-1.9, p=0.039)* Weekend surgeries: N.S for 30d mortality rate
Zare et. al. (2017)[37] (2000-2004)	United States (n= 89,786)	Nonemergent surgeries admitted to general wards post operatively (inclusive of 3092 hip fracture cases)	Eve of weekend surgeries: higher 30d mortality rate *(OR: 1.36, 95% CI 1.24–1.49, p<0.001)*
Hip Sprint Audit (as part of NHFD)[6] (2017)	United Kingdom (n=5989)	Hip Fracture	POD 1 on weekend: lower rates of achieving sitting out of bed (weekend 63% vs weekday 75%)
Barone et. al. (2008)[14] (November 2005-January 2007)	Italy (n=469)	Hip Fracture	POD 1 on weekend: less likely to attain POD 1 ambulation *(OR: 2.49, 95% CI 1.56-3.99, p<0.001*)

Note : Weekend are defined as Saturday, Sunday and also inclusive of Public Holidays

Abbreviations: N.S: not significant; **30d:** 30-day; **90d:** 90-day;**OR:** Odds Ratio; **95% CI:** 95% Confidence Interval; **UK:** United Kingdom; **NHFD:** National Hip Fracture Database; **POD:** Post-Operative Day

Table III – Comparison of discharge measures of this study with other studies

(a) length of stay measure

Authors (Study Period)	**Country** (Sample Size)		**Overall Cohort**	**EA Group**	**DA Group**	**P~**
Current Study (April-September 2016)	Singapore (n=115)	Median (IRQ)	10.0 (4.0)	10.0 (4.0)	10.5 (5.0)	0.768
		Mean (SD)	11.5 (5.4)	11.0 (4.1)	12.1 (6.4)	0.768
Oldmeadow et. al. (2006)^(12) (March to December 2004)	Australia (n=29)	Mean (Range)	16.6 (4–136)	9.27 (4–33)	17.90 (5–33)	0.003
Barone et. al. (2009)(14) (November 2005-January 2007)	Italy (n=469)	Mean (SD)	15.5 (9.9)	15.0 (8.1)	17.2 (14.6)	0.23
Baer et. al. (2019)(15) (2011-2017)	Switzerland (n=219)	Mean (SD)	9.6 (5.3)	9.5 (5.4)	10.0 (5.2)	N.S.

(b) home discharge measure

Authors (Study Period)	**Country** (Sample Size)	**Overall Cohort**	**EA Group**	**DA Group**	**p~**
Current Study (April-September 2016)	Singapore (n=115)	11.3%	14.5%	8.3%	0.293
Oldmeadow et. al. (2006)^(12) (March to December 2004)	Australia (n=29)	17.2%	26.3%	0%	0.44
Barone et. al. (2009)(14) (November 2005-January 2007)	Italy (n=469)	24.1%	27.3%	17.5%	0.04
United Kingdom (UK) NHFD(16) (2013-2015)	United Kingdom (n=34142)	No figure provided but findings reported that early mobilisation group had better outcomes for discharge destinations than delayed mobilisation group, which maintained after propensity weighting.			

Note : Figures for length of stay measure shown are in days
: ~ p value shown are between EA and DA group
: ^ For this study, sub-cohort of the study i.e. "true early mobilisation" vs "failed early mobilisation" groups are presented.

Abbreviations: EA: early ambulation; **DA:** delayed ambulation; **IRQ:** Interquartile range; **SD:** standard deviation; **N.S.:** not significant (exact value not provided), **NHFD:** National Hip Fracture Database