

Integrated hip fracture care pathway (IHFCP): reducing complications and improving outcomes

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Abstract

Introduction: Hip fractures in elderly people are increasing. A five-year Integrated Hip Fracture Care Pathway (IHFCP) was implemented at our hospital for seamlessly integrating care for these patients from admission to post discharge. We aimed to evaluate how IHFCP improved process and outcome measures in these patients.

Methods: A study was conducted over a five-year period on patients with acute fragility hip fracture who were managed on IHFCP. The evaluation utilised a descriptive design, with outcomes analysed separately for each of the five years of the programme. First-year results were treated as baseline.

Results: The main improvements in process and outcome measures over five years, when compared to baseline, were: (a) increase in surgeries performed within 48 hours of admission from 32.5% to 80.1%; (b) reduced non-operated patients from 19.6% to 11.9%; (c) reduced average length of stay at acute hospital among surgically (from 14.0 ± 12.3 days to 9.9 ± 1.0 days) and conservatively managed patients (from 19.1 ± 22.9 to 11.0 ± 2.5 days); (d) reduced 30-day readmission rate from 3.2% to 1.6%; and (e) improved Modified Functional Assessment Classification of VI to VII at six months from 48.0% to 78.2%.

Conclusion: The IHFCP is a standardised care path that can reduce time to surgery, average length of stay and readmission rates. It is distinct from other orthogeriatric care models, with its ability to provide optimal care coordination, early transfer to community hospitals and post-discharge day rehabilitation services. Consequently, it helped to optimise patients' functional status and improved their overall outcome.

Keywords: Complications, hip fracture, orthogeriatric, outcomes

INTRODUCTION

Hip fractures in elderly people are increasing, with an associated rise in morbidity and mortality.^[1] Earlier studies have projected that the number of hip fractures worldwide are expected to reach 4.50–6.26 million by 2050 and a majority of this increase would occur in Asia.^[2,3] The number of hip fractures in Asia is expected to see a 2.28-fold increase, from 1.12 million in 2018 to 2.56 million in 2050.^[4] Hip fractures are associated with increased mortality, with mortality rates in the range 8.4%–36.0% within the first year.^[5] Patients with hip fractures also have poorer functional outcomes, such as decreased mobility, greater dependence on walking aids, increased likelihood of institutionalisation and increased residual pain.^[6,7] Surgery plays a key role in the

management of hip fractures. It allows early mobilisation, hence reducing bed rest-associated complications, such as thromboembolism, urinary tract infection, atelectasis and pressure ulcers.^[8] It also improves pain control and gives the patient a higher likelihood of returning to their pre-morbid functional status.^[9]

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Hip fracture pathways have been effective in reducing postoperative complications and mortality.^[10] Current evidence shows limited results for integration of care, with few studies reporting the presence of a care coordinator in the process.^[11] A systematic review of hip fracture care paths found that many studies did not find a difference between care path and non-care path patients in terms of discharge destination.^[11] There is limited data of hip fracture pathways in Singapore. Previously published data from the same institution have shown preliminary results that a standardised care path can help to reduce perioperative complications.^[12] We hypothesised that a combined geriatric care service, with a standardised care path aimed at optimal care coordination and integration of care, can optimise patients' clinical outcomes and functional status, hence improving their overall outcome.

The primary objective of this study was to evaluate how this Integrated Hip Fracture Care Pathway (IHFCP) had improved process and outcome measures for elderly patients with hip fracture.

METHODS

The study was conducted on patients, aged 60 years and over and admitted from October 2011 to September 2016, with acute fragility hip fracture and managed on the IHFCP. We studied patients admitted consecutively to the Department of Orthopaedic Surgery at Tan Tock Seng Hospital (TTSH), Singapore, with neck of femur, intertrochanteric or subtrochanteric fractures. Patients with pathological fractures and high-impact injuries were excluded.

Year 1 results (from October 2011 to September 2012) were treated as baseline and were compared with results for the Years 2–5 (October 2012 to September 2016) when the IHFCP was fully implemented.

The IHFCP consists of interdisciplinary team involvement, with a combined orthogeriatric service, standard bundles of care and integrated care managers. It is a Ministry of Health, Health Services Development Project-funded project in Singapore. It was a five-year programme lasting from October 2011 to September 2016 and was a collaborative programme between TTSH, community rehabilitation hospitals and day rehabilitation centres (DRCs).

Once the hip fracture was diagnosed in the emergency department (ED), the patient was placed on the IHFCP to allow early identification and optimisation of medical issues by the orthogeriatric team to facilitate early surgery. The consensus for early surgery was performing surgery within 48 hours of admission.^[13–15] The integrated care managers also initiated patient education, care coordination and discharge planning.

The objectives of the IHFCP were to: (a) seamlessly integrate care from TTSH to rehabilitation and post-discharge community services facilitated by care coordination; (b) optimise patients'

clinical and functional outcomes based on evidence-based protocols; and (c) reduce inpatient length of stay, unplanned readmissions and morbidity associated with hip fractures. The identified gaps in the process of care included time to surgery, timely transfer to rehabilitation, continued rehabilitation in the community, and coordination and transition of care.

The quality improvement measures for the IHFCP included:

1. Co-management between orthopaedic surgery and geriatric medicine (combined orthogeriatric service), with interdisciplinary team involvement, to optimise and manage medical issues to allow early surgery;
2. Standardised bundles of care through the IHFCP;
3. Improved patient and family education through the hip fracture booklet;
4. Recruitment of integrated care managers, who are experienced nurses, to assist with patient education, improve care path compliance, discharge planning by identifying and referring suitable patients to rehabilitation facilities, and care coordination.^[16] They would also follow up the patients through telephone calls for up to one year post discharge and address their functional, rehabilitation and care needs and track their progress;
5. Implementation of 'Fitness for Operation Criteria' developed jointly between geriatricians, orthopaedic surgeons and anaesthetists, which allowed patients with minor abnormalities to proceed with surgery while undergoing correction, hence minimising delays in surgery.^[17,18] These patients had mild abnormalities with their vital signs, chronic medical and metabolic illnesses, or blood investigations, but were stable to proceed with surgery if undergoing correction;
6. Reduce proportion of conservatively managed hip fractures through patient and family education;
7. Extend rehabilitation beyond discharge at DRCs through education, care coordination and patient financial subsidies; and
8. Improve osteoporosis management and falls prevention through implementation of the multidisciplinary hip fracture clinic.

Data was collected on demographics (e.g. age, gender and ethnicity). Timely admission from the ED to the orthopaedic ward (defined as within four hours of arrival at ED), timely assessment by integrated care managers (defined as within one working day) and timely surgery (defined as operation within 48 hours of admission) were recorded. The number of patients managed surgically or conservatively was documented. Early therapy intervention post operation was defined as therapy by Postoperative Day (POD) 1. Timely transfer to inpatient rehabilitation facilities was defined as transfer by POD 6. Bone health assessment, with bone mineral density scan, was tracked to determine if it was performed within three months of ED presentation. Patients were excluded from the bone mineral density scan if their prognosis was less than six months or creatinine clearance was less than 20 mL/minute. The number

and percentage of patients assessed by a dietician among those who failed nutrition screening were documented. Functional performance of the activities of daily living was assessed using the Modified Barthel Index (MBI), as reported by the patient or caregiver. Ambulatory function was assessed using the Modified Functional Ambulatory Classification (MFAC). The MFAC has also been shown to be a valid assessment tool to measure ambulatory function of patients with hip fracture in a rehabilitation setting that is easy to apply and incorporate.^[19] The number of patients who met the criteria for post-discharge community rehabilitation and were referred, as well as those who completed individualised programmes at partnered DRCs, was recorded. Patients who would benefit from DRC referrals included those who were able to or aimed to weight-bear, were not back to pre-morbid status and had potential for functional improvement. They also must have had a carer available to bring the patient to the void deck to await transport.

The average length of stay, both in the acute hospital as well as inpatient rehabilitation centre, was ascertained. Data on postoperative complications that occurred during inpatient stay, such as urinary tract infections, wound infections, pressure ulcers and venous thromboembolism, was also recorded. In addition, hospital readmission within 30 days of orthopaedic surgery for hip fracture-related issues at TTSH and mortality rates were noted.

Demographic data, pre-morbid mobility and MBI scores were compared between patients from Year 1 to Year 5. Categorical data were described as frequency and percentage values, while continuous data were presented as mean \pm standard deviation. For identifying factors for surgical delay, we performed univariate analyses using the two-sample *t*-test and Mann-Whitney *U* test for parametric and non-parametric

continuous variables, respectively, and Chi-square test for categorical variables.

We compared the outcomes between patients who had surgery within 48 hours of ED admission versus their counterparts with surgery after 48 hours. Univariate analysis was performed using PASW Statistics version 18 (SPSS Inc, Chicago, IL, USA) to assess the effect of IHFCP by comparing Year 1 results with that of the subsequent years. Statistical tests were two-tailed, with $P \leq 0.05$ considered to be statistically significant. Ethics committee approval for this study was obtained from National Healthcare Group Domain Specific Review Board.

RESULTS

A total of 3,057 elderly patients were admitted with hip fractures during the study period. They were predominantly women (70.5%) and of Chinese ethnicity (88.2%) [Table 1].

Timely assessment by integrated care managers within one working day of arrival at the ward improved significantly from 90.1% to 96.8% ($P < 0.01$). There was a significant reduction in the number of non-operated patients from 19.6% to 11.9% ($P < 0.01$). Complications rate, which included wound infection, pressure ulcer, urinary tract infection and venous thromboembolism, remained low throughout the five years. There was a significant reduction in the 30-day readmission rate from 3.2% to 1.6% ($P < 0.01$). The percentage of patients who died during the one-year follow-up period was between 10.2% and 10.7%, although not statistically significant [Table 2].

The number of timely surgeries performed on patients who were fit for operation (i.e. patients operated upon within 48

Table 1. Study population demographics.

Variable	No. (%)					Difference (Year 1 vs. Years 2-5)
	Year 1 (n=557)	Year 2 (n=582)	Year 3 (n=599)	Year 4 (n=643)	Year 5 (n=676)	
Age (yr)*	80.4 \pm 8.9	81.8 \pm 8.9	81.5 \pm 8.6	80.1 \pm 8.6	79.3 \pm 8.6	0.21 (-0.53 to 0.96) [†]
Female gender	421 (75.6)	408 (70.1)	425 (71.0)	442 (68.7)	459 (67.9)	<0.01 [‡]
Chinese ethnicity	485 (87.1)	519 (89.2)	536 (89.5)	557 (86.6)	600 (88.8)	0.13

*Data presented as mean \pm standard deviation. [†]Odds ratio (95% confidence interval). [‡] $P < 0.05$ was statistically significant

Table 2. Overall outcome of patients.

Variable	No. (%)		<i>P</i> [*] (Year 1 vs. Years 2-5)
	Year 1 (n=557)	Years 2-5 (n=2,500)	
Timely assessment by integrated care managers within 1 working day	502 (90.1)	2,419 (96.8)	<0.01 [†]
Non-operated patients	109 (19.6)	298 (11.9)	<0.01 [†]
Patients who developed any of 4 complications	39 (7.0)	190 (7.6)	0.32
Patients readmitted to our orthopaedics department for current hip fracture within 30 days of surgery	18 (3.2)	41 (1.6)	<0.01 [†]
Mortality during the 1-yr follow-up period	57 (10.2)	268 (10.7)	0.19

*Assessed using Chi-square test. [†] $P < 0.05$ was statistically significant

hours of admission) increased significantly from 32.5% to 80.1% ($P < 0.01$) [Table 3].

The number of patients who had early therapy intervention by POD 1 increased significantly from 89.4% to 93.8% ($P < 0.01$) [Appendix].

The ambulatory function of patients improved significantly, with the number of patients discharged from inpatient rehabilitation with MFAC VI to VII improvement at six months increasing significantly from 48.0% (36 of 75 patients) to 78.2% (495 of 633 patients) ($P < 0.01$) and MFAC VI to VII improvement at 12 months significantly increasing from 21.3% (16 of 75 patients) to 79.2% (468 of 591 patients) ($P < 0.01$) [Table 4].

The ambulatory function of patients based on Timed Up and Go test scores did improve, although not statistically significant (data not presented).

Patients who were transferred to inpatient rehabilitation facilities by POD 6 also increased significantly from 51.5% to 72.9% ($P < 0.01$) [Appendix]. Only 200 patients in Year 1 and 1,332 patients in Years 2–5 were eligible for transfer to an inpatient rehabilitation facility based on the criteria for post-discharge community hospital referral. The percentage

of patients who met the criteria for community rehabilitation post discharge remained similar throughout the study period from 43.8% (71 of 162 patients) in Year 1 to 43.0% (485 of 1,128 patients) in Years 2–5. However, the difference was not statistically significant.

The percentage of patients who completed individualised programmes at partnered DRCs increased from 60% (6 of 10 patients) to 72.9% (218 of 299 patients). This result was also not statistically significant (data not presented).

The average length of stay at the acute hospital was reduced significantly from 14.0 ± 12.3 days to 9.9 ± 1.0 days for surgically managed patients (difference = -4.1 , $P < 0.01$) and from 19.1 ± 22.9 to 11.0 ± 2.5 days for conservatively managed patients (difference = -8.2 , $P < 0.01$) [Table 5].

Patients who had bone health assessment within three months of ED presentation increased significantly from 25.5% in Year 1 to 95.2% in Years 2–5 ($P < 0.01$). 542 patients were deemed not suitable for bone mineral density and the initiation of osteoporosis treatment [Appendix].

In Year 1, 12 (48.0%) patients failed nutritional screening when assessed by a dietician. By Years 2–5, this had increased significantly to 218 (88.3%, $P < 0.01$) [Appendix].

The quality of life, when assessed using EuroQol-5 Dimension, showed improvement from pre-morbid status to six month post discharge (data not presented). However, the difference was not statistically significant.

DISCUSSION

The IHFCP is a standardised care path that involves a combined orthogeriatric service to optimise patients' care. It enables optimal care coordination by integrated care managers, early transfer to community hospitals and post-discharge rehabilitation.

Table 3. Patients who underwent timely surgery.*

Variable	No. (%)		P* (Year 1 vs. Years 2-5)
	Year 1 (n=446)	Years 2-5 (n=1,670)	
Surgery within 48 hr of admission	145 (32.5)	1,337 (80.1)	<0.01†
Surgery after over 48 hr of admission	301 (67.5)	333 (19.9)	

*Patients operated within 48 hours of admission. †Assessed using Chi-square test. ‡ $P < 0.05$ was statistically significant

Table 4. Ambulatory function (MFAC) of patients.

Variable	Year 1		Years 2-5		P* (Year 1 vs. years 2-5)
	Total	No. (%)	Total	No. (%)	
Patients in the ambulatory programme discharged from inpatient rehabilitation with MFAC VI to VII improvement					
At 6 mth	75	36 (48.0)	633	495 (78.2)	<0.01†
At 12 mth	75	16 (21.3)	591	468 (79.2)	<0.01†

*Assessed using Chi-square test. † $P < 0.05$ was statistically significant. MFAC=Modified Functional Ambulatory Classification.

Table 5. Length of stay of patients.

Variable	Mean ± SD		P* (Year 1 vs. Years 2-5)
	Year 1 (n=557)	Years 2-5 (n=2,500)	
Length of stay (day)			
Patients undergoing surgery	14.0 ± 12.3	9.9 ± 1.0	$-4.1 (<0.01^*)$
Patients undergoing conservative treatment	19.1 ± 22.9	11.0 ± 2.5	$-8.2 (<0.01^*)$

*Assessed using Chi-squared test. † $P < 0.05$ was statistically significant. SD=standard deviation.

Through collaborating with anaesthetists to develop a criterion for fitness for operation, we were able to reduce the time to surgery. This criteria is based on the McLaughlin criteria, which showed that, while major clinical abnormalities should be corrected prior to surgery, patients with minor abnormalities may proceed with surgery while undergoing correction.^[18] Previous research have shown that higher Charlson Comorbidity Index and American Society of Anesthesiologists scores were significantly associated with delay in surgery.^[17] There was also a dedicated trauma operation theatre for hip fractures, where hip fractures were prioritised, in comparison with the traditional model of surgery in an emergency operation theatre. A hip fracture booklet was also created for the integrated care managers to educate patients and families on hip fracture care and subsequent need for rehabilitation, and this was helpful to get early consent for surgeries. As a result, the number of patients who did not undergo surgery was reduced. This was also because there was greater awareness about poorer outcomes (e.g. poor pain control, immobility and its associated complications) among patients who are managed conservatively.

The number of patients who had therapy by POD 1 increased, as physiotherapists were assigned to see patients daily from POD 1 to POD 4 to encourage early mobilisation. The patient would also be seen by the physiotherapist over the weekend if it fell within the first four postoperative days. Early mobilisation has been shown to improve postoperative recovery and minimise complications associated with immobility, such as loss of muscle function, venous thromboembolism and pulmonary complications.^[20] By POD 6, more patients were transferred to an inpatient rehabilitation facility. This involved the integrated care managers working together with the community hospitals to facilitate early discharge planning and transfer patients via a pull system. This reduced complications, such as hospital-acquired infections, that patients may face due to prolonged stay in acute hospitals.

Continued rehabilitation in the community was also encouraged beyond the rehabilitation hospitals and community hospitals. The number of patients who were referred for community rehabilitation at DRCs after discharge from hospital increased due to subsidies provided from the IHFCP, which was means tested. The community rehabilitation programme was carried out over 16 sessions at one of eight partner DRCs. Free transportation, which was provided through programme funding, also helped to encourage patients to complete the individualised programme at the partnered DRC.

The number of patients who had their bone health screened within three months of ED presentation increased as the bone mineral density scan was embedded in the IHFCP. Screening for osteoporosis is important, as the initial hip fracture already defines a group of patients at a very high risk for additional

fractures. For these patients, the risk of a hip fracture within the next year is 5% and this goes up to 20% in the following 20 years.^[21,22]

Nutritional assessment rates improved in the inpatient rehabilitation facility by working with dieticians at community hospitals. There is evidence to show that nutritional supplementation in the form of oral protein and energy feeds reduces unfavourable outcomes after surgery for hip fracture.^[23]

A combined orthogeriatric care service helps to optimise patients' functional status.^[24] The improvements in MFAC at six months and 12 months showed that more patients were able to ambulate independently outdoors after community hospital rehabilitation and continued community rehabilitation following discharge. This highlights the importance of continued rehabilitation beyond discharge for mobility and functional improvements.^[25]

The IHFCP reduced the average length of stay in the acute-care hospital by enabling early surgery and effective discharge planning for elderly patients with hip fractures. It has been shown that using a comprehensive orthogeriatric model of care instead of a standard of care model uses 23% less resources per patient.^[12] Complications, such as wound infection, pressure ulcer, urinary tract infection and venous thromboembolism, remained low due to improved nutrition and reduced immobility.

The strengths of this study included the fairly large study population size and sufficient follow-up period of one year for functional and clinical outcomes.

There were several limitations to the study as well. There was no comparison group during the same time frame and Year 1 results were used as baseline instead. However, several quality improvement measures were initiated in stages throughout the five-year programme, which resulted in improved outcomes after the first year. As there was no real control period, it was difficult to adjust for secular changes over time that may have been associated with improved outcomes. Greater awareness of the benefits of early surgery may have affected the outcomes as well. It is possible that other logistical and system-related factors may have contributed to delayed admission and surgical care due to high workloads at our tertiary hospital. Such effects could be expected to have been minimised with the institution of the IHFCP. Further studies should be conducted to explore how outcomes of the IHFCP compare with other orthogeriatric care models.

In conclusion, the IHFCP is a standardised care path that is distinct from other orthogeriatric care models, with its ability to provide optimal care coordination, early transfer to community hospitals and post-discharge day rehabilitation services. It reduces time to surgery, number of patients treated conservatively and the average length of stay. With the facilitation of early and beyond discharge rehabilitation, it

also helps to optimise patients' functional status, thus reducing complications and improving the overall outcome of patients. The effects and advantages associated with IHFCP, when compared with other orthogeriatric care models, could be a focus for future research.

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Conflicts of interest

There are no conflicts of interest.

Supplementary Material

The Supplementary Table 1 is available online.

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Supplementary Table I. Rehabilitation and post discharge assessment of patients.

Variable	No. (%)		p-value* (Year 1 vs. Years 2-5)
	Year 1	Years 2-5	
Therapy by POD 1	398/445 (89.4)	2,023/2,156 (93.8)	< 0.01 [†]
Inpatient rehabilitation by POD 6	103/200 (51.5)	971/1,332 (72.9)	< 0.01 [†]
Patients referred for day rehabilitation	71/162 (43.8)	485/1,128 (43.0)	0.42
Bone health assessment within 3 mth of ED presentation	142/557 (25.5)	1,864/1,958 (95.2)	< 0.01 [†]
Patients who failed nutrition screening when assessed by a dietician	12/25 (48.0)	218/247 (88.3)	< 0.01 [†]

*Assessed using chi-square test. [†] $p < 0.05$ was statistically significant. ED: emergency department; POD: postoperative day