



Management of elderly hip fractures by an orthopaedic trauma surgeon reduces surgical delays but does not improve outcomes compared to non-trauma surgeons

Wei Yuan¹ · Ernest Beng Kee Kwek¹

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Abstract

Purpose Recent literature on hip fractures has focussed on the optimal environment for best outcomes. One factor that has not been studied is the managing surgeon's training background. Our study aims to examine if hip fracture patients managed by fellowship-trained orthopaedic trauma surgeons have better outcomes compared to non-trauma trained general orthopaedic surgeons.

Methods This is a retrospective study performed at a tertiary hospital with an established orthogeriatric co-managed hip fracture care pathway. All surgically treated elderly hip fracture patients over a period of 2 years were included and divided into 2 groups based on the managing surgeon: trauma and non-trauma. Patient characteristics, fracture and surgery information, post-operative complications, 1 year mortality and the Modified Barthel Index (MBI) scores were collected and compared.

Results 871 patients were included. 32.1% ($N=280$) were managed by trauma surgeons and 67.9% ($N=591$) by non-trauma surgeons. There was no significant difference in the MBI scores pre-operatively and at 6 and 12 months post-operatively between the 2 groups. There was no difference in the incidence of postoperative complications and mortality. However, patients managed by trauma surgeons had significantly shorter time to surgery ($p=0.028$) and higher proportion of surgeries performed within 48 h ($p=0.039$). Trauma surgeons also took a shorter time to fix intertrochanteric fractures ($p=0.000$).

Conclusions This study did not find any difference in the functional outcomes of hip fracture patients managed by trauma surgeons or non-trauma surgeons. However, trauma surgeons had faster times to surgery and shorter surgical times when fixing intertrochanteric fractures.

Keywords Hip fractures · Managing surgeon · Trauma surgeon · Non-trauma surgeon · Outcomes

Introduction

As the world population ages, hip fractures are expected to become more and more common. Projections indicate that the number of hip fractures occurring annually will rise from 1.66 million in 1990 to 3.94 million in 2025 and to 6.26 million in 2050, with 51.1% expected to occur in Asia [1]. Studies have shown that the 1-year mortality for hip fractures is 25% [2] and half of those who survive do not regain their pre-fracture mobility [3].

Current management for geriatric hip fracture patients varies from hospital to hospital. They may be taken care by trained orthopaedic trauma surgeons or general orthopaedic surgeons. Several studies have looked at the correlation between surgeon experience or centre volume and surgical outcomes. This study instead analyses the effect of the training background of surgeons managing geriatric hip fracture patients on their functional outcomes.

The objective of this study was to see if there is any difference in the outcomes between a patient managed by a fellowship-trained trauma surgeon and one by non-trauma fellowship trained general orthopaedic surgeon.

✉ Ernest Beng Kee Kwek
Ernest_Kwek@ttsh.com.sg

¹ Department of Orthopaedic Surgery, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433, Singapore

Materials and methods

This is a retrospective study at a trauma centre with an established orthogeriatric co-managed hip fracture care pathway. Over a period of 2 years from October 2011 to October 2013, all patients aged 60 and above admitted for low-energy geriatric hip fractures who underwent primary surgical fixation or joint replacement were included. Patients with other concomitant fractures, pathologic fractures, bilateral hip fractures, or revision surgeries were excluded. The patients were categorised into cohorts based on the type of orthopaedic surgeon they were managed by, either trauma or non-trauma.

Definitions

In this paper, trauma surgeons refer to fellowship trained orthopaedic surgeons who subspecialize in orthopaedic trauma surgery, while non-trauma general orthopaedic surgeons refer to orthopaedic surgeons of other subspecialties (e.g. adult reconstruction, foot and ankle, etc.). In our current system, the hip fracture patients are admitted through the emergency department and may come under the care of either trauma or non-trauma surgeons depending on the call roster. There were 4 trauma surgeons and 12 non-trauma general orthopaedic surgeons during the study period. Surgeries can be performed by either registrars or consultants.

Orthogeriatric co-managed hip fracture pathway

All the patients were managed according to a well-established hip fracture pathway. A multidisciplinary approach involving orthopaedic surgeons, geriatricians, nursing staff, physiotherapists, occupational therapists and case coordinators was adopted. Guidelines for bladder and bowel management, analgesia use, thromboprophylaxis, diabetic management, cognitive assessment, preoperative cardiac assessment, and fitness for surgery were developed as part of the pathway. After patients were admitted, their medical conditions and fitness for surgery were assessed by geriatricians, with further optimisation where necessary. Mechanical deep vein thrombosis (DVT) prophylaxis was initiated immediately after admission. Chemoprophylaxis with subcutaneous enoxaparin (Clexane) was considered in patients with a past history of DVT or pulmonary embolism, active cancer or cancer treatment, obesity (body mass index > 30), varicose veins with phlebitis, or anticipated delay in surgery for more than 48 h. Regular oral paracetamol was prescribed for all patients without contraindication. Oral tramadol was added for moderate pain and oral or subcutaneous morphine for severe pain. Pain specialists were referred if the pain was

still not well controlled with above medications and femoral nerve/fascia iliaca block would be considered. Nonsteroidal anti-inflammatory drugs were avoided. Gabapentin and selective serotonin reuptake inhibitors were not used for hip pain.

Standard preoperative workup included a full blood count, renal function test, coagulation profile, chest radiography and electrocardiogram. Other investigations such as echocardiograms were performed when necessary as per the geriatricians' suggestion.

Physiotherapy was initiated preoperatively unless surgery was performed without any delay. Surgery was preferably performed under spinal anaesthesia to reduce the risk of cardiopulmonary complications. General anaesthesia was administered according to patient's preference or for patients whose spinal anaesthesia had failed. Intertrochanteric (IT) fractures were preferably fixed with the proximal femoral nail antirotation (PFNA) or dynamic hip screw (DHS), and Neck of Femur (NOF) fractures were primarily treated with bipolar hemiarthroplasty. Total hip arthroplasty was considered in patients with pre-existing osteoarthritis or patients with high functional demand. Postoperatively patients were allowed full weight bearing as tolerated unless this was contraindicated due to intraoperative complications. Early postoperatively physiotherapy involved bed exercises, sitting up in bed, out of bed and progression to standing and walking. Chest physiotherapy and incentive spirometry were encouraged when necessary. Occupational therapists were to assess and improve patients' function for daily life, e.g. transferring, toileting, bathing, eating, and ambulation. Geriatricians co-managed the patients with orthopaedic surgeons until they were fit to be discharged.

Data collection

By reviewing medical records, data on patient demographics (age, gender, race), American Society of Anaesthesiologist (ASA) status, significant preoperative comorbidities (diabetes, end-stage renal failure, ischemic heart disease, stroke and dementia), type and laterality of fracture, type of surgical intervention, time to surgery, length of stay (LOS), inpatient complications, 1 year mortality, post-discharge complications within 1 year (infection, dislocation, periprosthetic fracture, implant failure, nonunion), and preoperative, 6 and 12 months postoperative Modified Barthel Index (MBI) scores [4] was collected and compared between the 2 groups. Based on the fracture location on plain radiographs, fractures were divided into either NOF or IT fractures. The patient's history of medical comorbidities were extracted from their medical records, in addition to screening by geriatricians after admission. LOS was defined as the time from admission to discharge to either home or a step down care facility. Surgical site infection was diagnosed

according to the Centers for Disease Control and Prevention (CDC) guidelines. A periprosthetic dislocation must be confirmed with radiographs with diagonal views. Nonunion was defined as a fractured bone that has not completely healed within 9 months of injury and that has not shown progression towards healing over 3 consecutive months on serial radiographs according to the US Food and Drug Administration (FDA) definition. Surgical time was also compared among surgeons of different training levels (trauma surgeon, non-trauma surgeon, or registrar).

Outcome measurements

The primary outcomes of our study were the MBI score, complication and mortality rates. Time to surgery, surgical time and LOS were the secondary outcomes.

Statistics

Statistical analysis was performed with SPSS version 19.0 (IBM Corp. Armonk, NY). Categorical variables were presented as numbers and percentages. Values of continuous variables were presented as mean \pm standard deviation (SD) or as median with inter-quartile range (IQR). Shapiro–Wilk *W* test was used to determine data normality. Chi-square test or Fisher’s exact test was used as appropriate to compare categorical variables. Student’s *t* test or Wilcoxon test was used as appropriate to compare continuous variables in two groups. One way ANOVA or Kruskal–Wallis test was used to compare continuous variables in more than two groups. A 2-tailed *p* value of less than 0.05 was considered significant for all tests.

Results

Demographics

871 patients were included. 72.9% ($n = 635$) were female and 27.1% ($n = 236$) were male. 54.1% ($n = 471$) had a NOF fracture and 45.9% ($n = 400$) had an IT fracture. The mean age was 80.9 years. 280 patients were managed by trauma surgeons and 591 by non-trauma surgeons. There was no significant difference in the demographics, ASA status, significant comorbidities and laterality of fractures between patients managed by trauma surgeons and non-trauma surgeons ($p > 0.05$) (Table 1).

Amongst the patients, 31.5% ($n = 274$) underwent cementless hemiarthroplasty, 16.2% ($n = 141$) cemented hemiarthroplasty, 3.8% ($n = 33$) total hip arthroplasty, 31.6% ($n = 275$) intramedullary nailing, 15.2% ($n = 132$) extramedullary fixation and 2.0% ($n = 17$) cancellous screw fixation. The type of surgical intervention for each type of fracture

Table 1 Comparison of characteristics and type of surgery between patients managed by trauma and non-trauma surgeons

	Trauma surgeon ($n = 280$)	Non-trauma surgeon ($n = 591$)	<i>p</i> value
Age	Mean \pm SD 81.6 \pm 8.5	Mean \pm SD 80.6 \pm 8.7	0.108
Gender	<i>N</i> %	<i>N</i> %	0.500
Male	80 (28.6%)	156 (26.4%)	
Female	200 (71.4%)	435 (73.6%)	
Ethnicity	<i>N</i> %	<i>N</i> %	0.454
Chinese	256 (91.4%)	515 (87.1%)	
Malay	9 (3.2%)	27 (4.6%)	
Indian	10 (3.6%)	33 (5.6%)	
Caucasian	1 (0.4%)	5 (0.8%)	
Others	4 (1.4%)	11 (1.9%)	
Laterality	<i>N</i> %	<i>N</i> %	0.069
Right	118 (42.1%)	288 (48.7%)	
Left	162 (57.9%)	303 (51.3%)	
ASA ^a	<i>N</i> %	<i>N</i> %	0.373
1	2 (0.7%)	12 (2.0%)	
2	117 (41.8%)	236 (39.9%)	
3	158 (56.4%)	340 (57.5%)	
4	3 (1.1%)	3 (0.5%)	
5	0 (0.0%)	0 (0.0%)	
Comorbidities	<i>N</i> %	<i>N</i> %	
Diabetes	98 (35%)	200 (33.8%)	0.736
End-stage renal failure	9 (3.2%)	8 (1.4%)	0.064
Stroke	45 (16.1%)	90 (15.2%)	0.748
Ischemic heart disease	41 (14.6%)	89 (15.1%)	0.872
Dementia	50 (17.9%)	85 (14.4%)	0.186
Neck of femur fractures	<i>N</i> %	<i>N</i> %	0.057
Cemented hemiarthroplasty	44 (35.2%)	97 (28.0%)	
Uncemented hemiarthroplasty	63 (50.4%)	210 (60.7%)	
Fixation	11 (8.8%)	14 (4.0%)	
Total hip arthroplasty	7 (5.6%)	25 (7.2%)	
Intertrochanteric fractures	<i>N</i> %	<i>N</i> %	0.725
Nail	106 (68.4%)	168 (68.6%)	
Extramedullary Fixation	49 (31.6%)	76 (31.0%)	
Total hip arthroplasty	0 (0.0%)	1 (0.4%)	

^aAmerican Society of Anaesthesiologist classification

(NOF or IT fracture) did not differ significantly between the 2 groups ($p > 0.05$).

Primary outcomes

Patients managed by both trauma surgeons and non-trauma surgeons had similar preoperative, 6 and 12 months postoperative MBI scores ($p > 0.05$) (Table 2).

Table 2 Comparison of outcomes between patients managed by trauma and non-trauma surgeons

	Trauma surgeon		Non-trauma surgeon		p value
	No	Mean \pm SD	No	Mean \pm SD	
MBI ^a					
Preoperative	248	91.1 \pm 13.2	512	91.4 \pm 13.1	0.780
6 months postoperative		79.8 \pm 17.0		81.1 \pm 17.0	0.300
12 months postoperative		83.0 \pm 18.3		83.0 \pm 20.0	0.994
Change in MBI ^a at 6 months		-11.4 \pm 17.7		-10.3 \pm 16.5	0.408
Change in MBI ^a at 12 months		-8.2 \pm 19.0		-8.4 \pm 18.4	0.850
Time to surgery (hour)	No	Median (IQR)	No	Median (IQR)	0.028*
	280	62.7 (38.1, 107.5)	591	73.1 (43.4, 112.1)	
Time to surgery	<i>N</i> %		<i>N</i> %		
< 48 h	105 (37.5%)		180 (30.5%)		0.039*
< 24 h	26 (9.3%)		47 (8.0%)		0.507
Length of stay	No	Median (IQR)	No	Median (IQR)	0.566
	280	9.9 (7.1, 14.4)	591	9.9 (7.2, 13.3)	
Inpatient complications	<i>N</i> %		<i>N</i> %		
Pneumonia	24 (8.6%)		45 (7.6%)		0.625
Urinary tract infection	78 (27.9%)		135 (22.8%)		0.108
Inpatient death	1 (0.4%)		7 (1.2%)		0.232
Other complications	30 (10.7%)		51 (8.6%)		0.322
Post-discharge complications within 1 year	<i>N</i> %		<i>N</i> %		0.151
	17 (6.1%)		23 (3.9%)		
1 year mortality	<i>N</i> %		<i>N</i> %		0.654
	23 (8.2%)		54 (9.1%)		

*Statistically significant

^aModified Barthel Index score

Patients of trauma surgeons had a mean reduction of their MBI scores of 11.4 points and 8.2 points at 6 and 12 months postoperatively, respectively. Patients of non-trauma surgeons had a mean reduction of their MBI scores of 10.3 points and 8.4 points at 6 and 12 months postoperatively, respectively. The changes in their MBI scores at 6 and 12 months postoperatively (compared to the preoperative scores) were also not found to be significantly different ($p > 0.05$).

There was no significant difference between the 2 groups in terms of inpatient complications and post-discharge complications within 1 year ($p > 0.05$). The 1 year mortality of patients managed by trauma surgeons (8.2%) and non-trauma surgeons (9.1%) was not significantly different ($p = 0.654$).

Secondary outcomes

The median LOS of patients managed by trauma surgeons (9.9 days) is similar to patients managed by non-trauma surgeons (9.9 days) ($p = 0.566$). However, time to surgery was significantly shorter for patients managed by trauma surgeons (62.7 h, IQR 38.1–107.5) than those managed by non-trauma surgeons (73.1 h, IQR 43.4–112.1) ($p = 0.028$). Trauma surgeons also sent 37.5% ($n = 105$) of their patients for surgery in under 48 h, which was significantly more than non-trauma surgeons did ($p = 0.039$).

Further analysis of surgical time based on the training level of the surgeon performing the surgery revealed that for IT fractures, trauma surgeons had significantly shorter surgical time (60 min) than non-trauma surgeons (80 min) and registrars (77.5 min) ($p = 0.000$) (Table 3). For NOF

Table 3 Comparison of surgical time among surgeons of different training levels

Surgical time (min)	Trauma surgeon	Non-trauma surgeon	Registrar	<i>p</i> value
	Median (IQR)	Median (IQR)	Median (IQR)	
Intertrochanteric fractures	60 (30)	80 (42.5)	77.5 (35)	0.000*
Neck of femur fractures	90 (30)	90 (50)	100 (35)	0.000*

*Statistically significant

fractures, however, trauma and non-trauma surgeons performed surgeries faster (90 min) than registrars (100 min) ($p = 0.000$).

Discussion

This is the first study to specifically investigate the differences between trauma and non-trauma surgeons' management of hip fractures. The main finding of this study is that hip fracture patients managed by either surgeons had similar outcomes. However, those managed by trauma surgeons received their surgeries earlier.

Previous studies have shown correlation between surgeon and hospital volumes for hip fracture surgeries and better outcomes. Browne et al. [5] reported that higher surgeon volume in the treatment of hip fractures was associated with decreased mortality, non-fatal morbidity and length of stay, while hospital volume was associated with the latter two. Surgeons who performed less than 7 hip fracture surgeries per year had a significantly increased post-operative mortality compared to surgeons who performed more than 15 such surgeries per year. Our results do not reflect poorer outcomes for the general orthopaedic surgeons as they are also exposed to high numbers of hip fracture patients by virtue of the increased institutional hip fracture load.

There have been numerous other studies examining the correlation between greater surgical volume and better outcomes for hip fracture patients [6–9]. Shah et al. [6] analyzed 173,508 cases who underwent hip hemiarthroplasty for NOF fractures from the Nationwide Inpatient Sample (NIS) and demonstrated that hospitals with low caseload volumes were associated with increased risk of prolonged LOS, pulmonary embolism, urinary tract infection, and pneumonia. The study also found that surgeons with low caseload volumes were associated with increased risk of mortality and prolonged LOS. Ames et al. [8] found the surgeon's experience in primary total hip arthroplasty also significantly affected mortality, prosthetic dislocation and superficial infection for patients who underwent hip hemiarthroplasty for NOF fractures. Forte et al. [9] reported similar results for IT fractures. Among the 192,365 patients with IT fractures treated with internal fixation, those managed at lower volume hospitals had significantly higher adjusted risk of inpatient mortality than those managed at the highest volume hospitals. However, these previous studies did not evaluate the impact of the training background of the managing orthopaedic surgeons on the outcomes.

Our study shows that the current practice where hip fracture patients may either be managed by a trained orthopaedic trauma surgeon or a general orthopaedic surgeon has no significant impact on the functional outcomes. The modern orthogeriatric management of hip fracture patients adopts

a multidisciplinary approach involving geriatricians, orthopaedic surgeons, physiotherapists, occupational therapists, and nursing staffs. The outcomes are affected by all the components and the impact of the orthopaedic surgeon may be mitigated as a result.

However, our study reveals that being admitted under a non-trauma surgeon is a significant risk factor for delayed surgery. We postulate that this is because non-trauma surgeons may not be as pro-active in clearing or optimising patients for surgery. Deficiencies in the understanding of care for orthogeriatric patients may contribute to this. Non-trauma surgeons may also be more reliant on the geriatrician's assessment and may delay surgery to obtain geriatric opinion before listing patients for surgery.

Numerous studies [10–18] and meta-analyses [19, 20] have also shown the association between performing hip fracture surgery in under 48 h and better outcomes. Most of these used mortality as the primary outcome. A study of 129,522 elderly patients with NOF fractures in England revealed that delays in surgery was associated with an increased risk of inpatient death but not readmission within 28 days [10]. Another study in Canada with 57,315 hip fracture patients found delays in surgery was not only associated with inpatient mortality, but also mortality at 3 months and 1 year postoperatively [12]. The benefit of early surgery in reducing mortality was also reported by Italian, Danish and Israel studies with large sample sizes [13–15]. Making early surgery a policy and instituting disincentives for surgical delay beyond 48 h has proven to significantly improve survival [16]. Besides mortality, Anthony et al. [17] also found surgical delays of more than 2 days was associated with the increased risk for pneumonia, stroke, cardiac arrest, myocardial infarction, bleeding requiring transfusion, sepsis and septic shock. Additional benefits of early surgery include reduced pain and LOS [18]. Shiga et al. [19] performed a meta-analysis to examine the effect of surgical delay on 30-day and 1-year mortality. Sixteen studies (5 prospective and 11 retrospective) were included. They found that delays beyond 48 h after admission may increase the odds of 30-day all-cause mortality by 41% and of 1-year all-cause mortality by 32%. Another meta-analysis of 35 eligible studies with 191,873 participants showed that elderly patients operated for hip fractures within 24 or 48 h had significantly less mortality than those scheduled for surgery after the second day. After adjustment for age, female prevalence, location, and year, or after omitting low-quality and retrospective studies, this association remained consistently significant [20].

In our study, despite the time to surgery being shorter for patients managed by trauma surgeons, this did not translate into a shorter LOS, better functional outcomes, less morbidity, or lowered mortality. We believe this to be due to the functional outcomes, morbidity and mortality being affected by numerous other factors that are difficult to account for,

such as participation and compliance to postoperative rehabilitation. Despite there being a significant difference in time to surgery between groups, surgeries were performed beyond 48 h for >60% of the patients in both groups (62.5% and 69.5%). The median time to surgery were 62.7 and 73.1 h, respectively. The overall delay of surgeries may be a reason for insignificant results as well.

Only a few studies have investigated the influence of orthopaedic subspecialty or subspecialty expertise on the outcomes of hip fracture patients. In 1997, Chiasson et al. [21] compared the quality of hip fracture care provided by “generalist” general surgeons and orthopaedic specialists. They found significant differences in length of operation, use of C-arm imaging, management of Garden class 1 and 2 subcapital fractures, number of intensive care unit admissions, length of stay, and postoperative stay. But the study also found similar rates of medical and wound complications, reoperations, readmissions, deaths, and level of function on discharge. Guerado et al. [22] compared the rate of the surgical site infections (SSI) between 212 cases managed by specialist hip unit surgeons and 602 cases managed by general orthopaedic surgeons. They found similar rates of SSI. Instead, age was the only determinant factor among all the factors assessed. In contrast, Treskes et al. [23] compared the complications of reoperation and SSI between patients operated by trauma surgeons and those by general surgeons. Multivariate analysis showed that surgeries by trauma surgeons were associated with less reoperations and SSIs. In another study, by surveying a 100 trauma consultants on surgical treatment of AO type 31-A2 fractures, Murray et al. [24] suggested that less experienced consultants and consultants who did not subspecialize in lower limb surgery, tended to use cephalomedullary devices more often than compression hip screws. Although the authors did not investigate the outcomes, the study reflected different treatment approaches of surgeons with different training backgrounds.

The current study is distinguishable from the previous studies in several ways. First, we focused on the results of different managing surgeons instead of just operating surgeons. Second, all the surgeons were orthopaedic surgeons instead of general surgeons performing orthopaedic trauma surgery. Last, the outcome measurements of the current study were more comprehensive, particularly including the MBI score at different time points and the time to surgery.

The strength of this study is that it is the only study to look at the functional outcomes of operatively treated geriatric hip fracture patients based on the training background of their managing surgeons. Our study has also achieved large numbers from a single centre.

We recognise that there are several limitations in our study. First, of the 871 patients included in the study, only 760 patients with complete MBI scores at all time points were selected for analysis to eliminate bias. We do not

believe the 12.7% of patients with incomplete data will affect the results adversely. Second, there was a delay to surgery in both groups. Less than 40% of patients in either group underwent surgery within 48 h. This is mainly due to the heavy trauma load and busy emergency operating theatre schedule in our trauma centre. Preoperative investigations and optimization for sick patients may contribute to the delay as well. Third, the unequal sample size between the two groups, as well as inability to control for confounders may have influenced statistical outcomes. Finally, the years of experience of surgeons were not differentiated as this was difficult to quantify, and arguably does not contribute to generalisable recommendations.

Conclusions

Management of elderly hip fracture patients by orthopaedic trauma surgeon or general orthopaedic surgeons does not affect their functional outcomes, length of stay, complication and 1-year mortality rates. However, hip fracture patients managed by trauma surgeons received their surgeries faster, with shorter surgical times for fixation of intertrochanteric fractures.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

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