G Model
JINJ 6746 No. of Pages 7

ARTICLE IN PRESS

Injury, Int. J. Care Injured xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Injury

journal homepage: www.elsevier.com/locate/injury

Twelve-month mortality and functional outcomes in hip fracture patients under 65 years of age

C.L. Ekegren[a,*], E.R. Edwards[a,b], R. Page[c,d], R. Hau[a,e], R. de Steiger[f,g], A. Bucknill[h], S. Liew[b,i], A. Oppy[h], B.J. Gabbe[a]

[a] Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Australia
[b] Department of Orthopaedic Surgery, Alfred Hospital, Melbourne, Australia
[c] Department of Orthopaedics, University Hospital Geelong, Geelong, Australia
[d] School of Medicine, Deakin University, Geelong, Australia
[e] Department of Orthopaedic Surgery, Northern Hospital, Epping, Australia
[f] Epworth Hospital, Richmond, Australia
[g] University of Melbourne, Parkville, Australia
[h] Department of Orthopaedic Surgery, Royal Melbourne Hospital, Parkville, Australia
[i] Department of Surgery, Monash University, Melbourne, Australia

ARTICLE INFO

Article history:
Accepted 24 May 2016

Keywords:
Hip fracture
Mortality
Trauma
Outcomes
Function
Orthopaedic injury

ABSTRACT

Introduction: There has been a recent call for improved functional outcome reporting in younger hip fracture patients. Younger hip fracture patients represent a different population with different functional goals to their older counterparts. Therefore, previous research on mortality and functional outcomes in hip fracture patients may not be generalisable to the younger population. The aims of this study were to report 12-month survival and functional outcomes in hip fracture patients aged <65 years and predictors of functional outcome.

Methods: Hip fracture patients aged <65 years (range 17–64) registered by the Victorian Orthopaedic Trauma Outcomes Registry over four years were included and their 12-month survival and functional outcomes (Extended Glasgow Outcome Scale) reported. Ordered multivariable logistic regression was used to identify predictors of higher function.

Results: There were 507 patients enrolled in the study and of the 447 patients (88%) with 12-month outcomes, 24 (5%) had died. The majority of patients had no comorbidities or pre-injury disability and were injured via road trauma or low falls. 40% of patients sustained additional injuries to their hip fracture. 23% of patients had fully recovered at 12 months and 39% reported ongoing moderate disability. After adjusting for all key variables, odds of better function 12-months post-fracture were reduced for patients with co-morbidities, previous disability or additional injuries, those receiving compensation or injured via low falls.

Conclusions: While 12-month survival rates were satisfactory in hip fracture patients aged under 65 years, their functional outcomes were poor, with less than one quarter having fully recovered 12 months following injury. This study provides new information about which patients may have difficulty returning to their pre-injury level of function. These patients may require additional or more intensive post-discharge care in order to fulfil their functional goals and continue to contribute productively to society.

Introduction

Hip fracture is a significant injury, associated with an increased risk of mortality, loss of mobility and reduced quality of life [1,2]. In Australia, 91.3 people per 100,000 population are hospitalised due to hip fracture each year, with 91 per cent occurring in people aged 65 years and over [3]. Considering the frequency of hip fractures in the elderly, it is understandable that most research up until now

* Corresponding author at: Monash University, Alfred Centre, 99 Commercial Rd, Melbourne, VIC, 3004, Australia.
E-mail address: christina.ekegren@monash.edu (C.L. Ekegren).

http://dx.doi.org/10.1016/j.injury.2016.05.033
0020-1383/© 2016 Elsevier Ltd. All rights reserved.

has focussed on this population [4]. However, with an increased risk of fracture healing complications and significant lifelong functional impairment, analysing the outcomes of younger hip fracture patients is warranted [5,6].

Younger hip fracture patients represent a different population to older hip fracture patients, with the majority being injured as a result of high energy trauma rather than falls [7]. They are also more likely to survive their hip fractures and have different functional recovery goals to older patients [8]. Therefore, previous research focussing on the outcomes of elderly hip fracture patients is unlikely to be generalisable to the younger population, and it has been acknowledged that there is a critical need for studies reporting outcomes in the younger patient subgroup [6]. In particular, a recent review of research on younger hip fracture patients (aged 15–60) identified a clear gap in the literature of studies including patient-reported functional outcomes, with the majority of previous research focussing on short-term clinical outcomes and mobility alone [6].

Hip fracture can have a detrimental effect on many different aspects of function, including mobility, work, leisure and social function and all of these can impact upon a patient's quality of life [9]. Being able to capture these multiple dimensions of function is particularly important for younger patients, who may have increased functional demands and more active lifestyles than elderly hip fracture patients, and can provide an indication of the full extent of recovery expected.

The aims of this study were to i) describe the 12-month survival and functional outcomes in hip fracture patients aged <65 years of age; and ii) determine predictors of functional outcome in this population 12 months after hip fracture.

Patients and methods

Setting

The Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) is a comprehensive monitoring system for orthopaedic trauma in Victoria, Australia and one of very few registries in the world to routinely measure long-term functional outcomes of hip fracture patients [10]. The registry captures data about all adult patients (aged ≥16 years) with an orthopaedic emergency admission (>24 h) to four hospitals in Victoria, Australia: one regional trauma centre, one metropolitan trauma centre and the two adult major trauma services [10]. Patients are excluded if they have a metastatic fracture. Operating since 2003, the registry captures approximately 5800 patients per year and the opt-out rate is less than 2%.

All VOTOR-registered patients surviving to hospital discharge are followed up by telephone at six and 12 months post-injury. This methodology has been published previously [11] and a brief description is provided here. Trained interviewers telephone the patient to collect a range of functional, health-related quality of life and pain outcomes. If contact with the patient is not possible (e.g. language other than English, dementia, etc.), their next of kin is contacted. The registry has approval from the institutional ethics committees of each participating hospital and the Human Research Ethics Committee at Monash University.

Participants

For this study, we included all patients aged <65 years registered by VOTOR with a date of injury from 1 July 2009 to 30 June 2013 (corresponding with a phase of registry protocol consistency), and International Classification of Disease, 10th revision, Australian Modification (ICD-10-AM) codes representing hip fracture (S72.00–S72.11, inclusive) [12].

Procedures

The following data were extracted from the registry for all included patients: demographic information (gender, age); post-code of residence mapped to the Accessibility/Remoteness Index of Australia (ARIA) (a geographical index of remoteness), and the Index of Relative Socio-economic Advantage and Disadvantage (IRSAD) (which ranks areas in Australia according to relative socio-economic advantage and disadvantage); pre-injury level of disability (self-reported using World Health Organization definition [13]); presence of comorbidities; injury diagnoses (ICD-10-AM codes [12]); mechanism of injury; place of injury; compensable status; and surgical procedures performed (Australian Classification of Health Interventions (ACHI) codes [14]).

Outcomes extracted included survival to discharge and 12 months post-injury, and patients' level of functional recovery according to the Extended Glasgow Outcome Scale (GOS-E) [15]. This scale, shown to be reliable and valid with injured populations [16,17], captures a broad range of functional domains by scoring

Box 1. Summary of function at each level of the Extended Glasgow Outcome Scale (GOS-E) [18].

1 Death (D)
2 Vegetative state (VS)
Unable to obey simple commands, utter any words or communicate in any way.
3 Lower severe disability (SD−)
Assistance of another person at home is essential every day for activities of daily living.
4 Upper severe disability (SD+)
Able to look after themselves for up to 8 h during the day but unable to shop or travel locally without assistance.
5 Lower moderate disability (MD−)
Able to shop without assistance, drive or use public transport to get around. Unable to work or study if doing so prior to injury. Unable to participate in social or leisure activities, and experiences daily disruption to family and friendships.
6 Upper moderate disability (MD+)*Able to shop without assistance, drive or use public transport to get around. Able to work or study but at a reduced capacity. Much less participation in social or leisure activities, and experiences frequent disruption to family and friendships.*
7 Lower good recovery (GR−)
Returned to pre-injury work or study capacity. Participating less in social and leisure activities. Occasional disruption to family and friendships, or reporting other problems related to the injury that affect daily life.
8 Upper good recovery (GR+)
Returned to pre-injury capacity for work or study, social and leisure activities. No disruption to family and friendship.

patients according to their independence inside and outside the home and resumption of normal social roles, including work, social and leisure [15]. Box 1 includes a description of the scoring categories which range from 1 (death) to 8 (upper good recovery), with the upper end of the scale representing a return to preinjury function. In this study, the two lowest levels of the GOS-E (death and vegetative state) were combined because of small numbers in the vegetative state category.

Patients' comorbid status was defined using the Charlson Comorbidity Index (CCI), mapped from ICD-10-AM codes [18–20], with a CCI of zero representing no CCI conditions. Compensable status was classified as i) Non-compensable/Medicare, ii) Private health insurance or Department of Veteran's Affairs (DVA); or iii) Compensable (WorkSafe Victoria or Transport Accident Commission (TAC)). Medicare is Australia's publicly funded universal healthcare agreement which provides healthcare coverage for all Australian citizens and permanent residents. Private health insurance is held by approximately 57% of Australian adults [21], and 46% of injury patients [22]. The DVA provides financial support for war veterans and their dependents, members of the Australian Federal Police and Australian Defence Force personnel. WorkSafe Victoria and the TAC are the no-fault, third party insurers for work and transport injury, providing compensation for treatment, income replacement and long-term care services.

Hip fractures were categorised as fractured neck of femur (i.e. subcapital, transcervical or basicervical) or trochanteric fracture (i.e. pertrochanteric or intertrochanteric). Type of hip surgery was categorised as internal fixation, other or conservative management (non-surgical). The 'other' category included hemiarthroplasties and total joint replacements.

Statistical analysis

Patient characteristics were summarised using descriptive statistics and compared for patients lost to follow up using chi-square tests. Patient characteristic were compared across GOS-E outcomes using ordered logistic regression. Ordered multivariable logistic regression was used to identify demographic and injury variables that were important predictors of a higher GOS-E score. Variables showing a significant association ($p < 0.25$) with GOS-E scores on preliminary univariable analyses were entered into the model [23]. Non-significant variables were identified using Wald tests, and were removed from the model individually in a backward stepwise approach ($p < 0.05$). The reduced model was compared with the initial model using likelihood ratio tests and the remaining variable coefficients assessed to ensure that they had not substantially changed, indicating potential confounding [23]. This process was repeated until a parsimonious final model was achieved. Variables excluded from the initial model were then included to ensure that important variables had not been missed [23]. Adjusted odds ratios (AORs) with 95% confidence intervals (CI) for patients with a higher GOS-E score at 12 months are reported. All analyses were performed using Stata Version 13.

Results

Profile of patients

From July 2009 to June 2013, there were 3607 hip fracture cases recorded in the VOTOR dataset representing 16% of all VOTOR patients. The flow of patients through the study is presented in Fig. 1. A total of 507 patients (14%) were aged under 65 years and 447 of these patients (88%) were followed up at 12 months. At 12 months post-injury, 24 of these patients (5%) had died, seven before discharge from their initial hospitalisation and 17 in the 12 months following discharge from hospital. There was no association between whether or not a patient was followed up at 12 months and any patient characteristic except for the IRSAD, with patients from lower socio-economic levels being more highly represented in the group lost to follow up (Table 1).

The profile of the 507 included patients is presented in Table 1. The mean (SD) age of patients was 48.0 (13.5) years (range: 17–64 years) and two-thirds were men. Most patients had no pre-existing conditions or pre-injury disability, and 82% resided in a major city. Over half of patients were in the highest two quintiles of socio-economic advantage. Low falls (<1 m height) were the main cause of hip fracture (40%), followed by road trauma (38%), and the main places of injury were the street/highway and the home. Almost one third of patients were compensated for their injury by a third party insurer (i.e. TAC, Worksafe). Approximately two-thirds of all patients sustained a fracture to the neck of femur (65%), with the remainder sustaining trochanteric fractures (35%). While the majority of hip fractures were isolated injuries, 40% of patients sustained additional injuries, including other orthopaedic injuries (37.1% of all patients), chest injuries (15.4%), head injuries (12.0%) and abdominal injuries (8.1%). The majority of patients (80%) underwent internal fixation for their hip fracture. There were 29 hemiarthroplasties and 34 total joint replacements within the 'other' category.

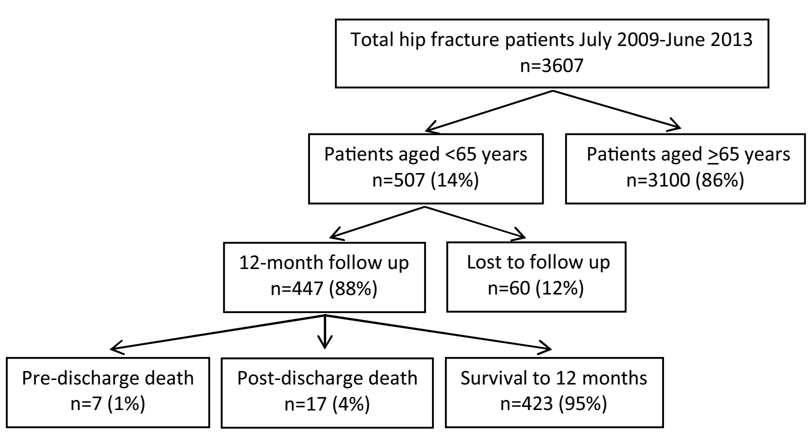

Fig. 1. Participant flowchart.

Table 1
Profile of total hip fracture patients <65 years and patients lost to follow-up 12 months following hip fracture.

Population descriptor	Total patients (n = 507) n (%)	Lost to follow up (n = 60) n (%)	P
Age group			
16–24 years	38 (7.5)	7 (11.7)	0.718
25–34 years	68 (13.4)	8 (13.3)	
35–44 years	59 (11.6)	8 (13.3)	
45–54 years	123 (24.3)	13 (21.7)	
55–64 years	219 (43.2)	24 (40.0)	
Gender			
Male	330 (65.1)	39 (65.0)	0.988
Female	177 (34.9)	21 (35.0)	
Comorbid status			
None	359 (70.8)	43 (71.7)	0.876
CCI ≥ 1	148 (29.2)	17 (28.3)	
Pre-injury level of disability[a]			
None	324 (71.7)	20 (76.9)	0.541
Disability present	128 (28.3)	6 (23.1)	
IRSAD (quintiles)[b]			
1st (Most disadvantaged)	57 (11.5)	7 (13.2)	0.014[h]
2nd	68 (13.7)	12 (22.6)	
3rd	87 (17.5)	13 (24.5)	
4th	135 (27.1)	15 (28.3)	
5th (Most advantaged)	151 (30.3)	6 (11.3)	
ARIA[c]			
Major cities of Australia	409 (82.1)	42 (79.3)	0.562
Inner/outer regional/remote Australia	89 (17.9)	11 (20.8)	
Mechanism of injury[d]			
Low fall	200 (39.5)	21 (35.6)	0.442
High fall	70 (13.8)	12 (20.3)	
Road trauma	191 (37.8)	20 (33.9)	
Other external cause	45 (8.9)	6 (10.2)	
Place of injury[e]			
Home	141 (31.0)	21 (39.6)	0.251
Street/highway	187 (41.1)	23 (43.4)	
Trade/service/industrial/construction area/mine	30 (6.6)	2 (3.8)	
Other specified	97 (21.3)	7 (13.2)	
Compensable status[f]			
Medicare/not compensable	275 (55.9)	39 (62.1)	0.341
Private/DVA	62 (12.6)	4 (6.9)	
TAC/WorkSafe/other compensable	155 (31.5)	18 (31.0)	
Type of hip fracture			
Fractured neck of femur	327 (64.5)	41 (68.3)	0.508
Trochanteric fracture	180 (35.5)	19 (31.7)	
Isolated vs non-isolated hip fracture			
Isolated hip fracture	307 (60.6)	33 (55.0)	0.349
Other injuries present	200 (39.5)	27 (45.0)	
Type of hip surgery[g]			
Internal fixation	360 (79.5)	46 (83.6)	0.311
Other	63 (13.9)	8 (14.6)	
Conservative	30 (6.6)	1 (1.8)	
Total	507 (100)	60 (100)	

CCI, Charlson Comorbidity Index; IRSAD, Index of Relative Socio-economic Advantage and Disadvantage; ARIA, Accessibility/Remoteness Index of Australia; DVA, Department of Veterans Affairs; TAC, Transport Accident Commission.
[a] Data missing for n = 55 cases.
[b] Data missing for n = 9 cases.
[c] Data missing for n = 9 cases.
[d] Data missing for n = 1 case.
[e] Data missing for n = 52 cases.
[f] Data missing for n = 15 cases.
[g] Data missing for n = 54 cases.
[h] Significant at the $P < 0.05$ level.

12. -month functional outcome

Fig. 2 shows the 12 month functional outcomes of hip fracture patients, measured using the GOS-E. In total, 23% of patients had fully recovered (upper good recovery) and 39% reported ongoing moderate disability. Only 5% of patients fell into the death/ vegetative state category.

Table 2 presents median GOS-E scores for variables found to independently predict functional outcome and adjusted odds ratios for these variables. Variables which showed a significant association ($p < 0.25$) with GOS-E scores on preliminary univariable analyses and entered into the multivariable model included co-morbidities, pre-injury disability, IRSAD score, mechanism of injury, compensable status, and presence of other injuries. After adjusting for these variables, odds of a better functional outcome 12 months post-hip fracture were reduced for patients with co-morbidities, for patients reporting any level of pre-injury disability and for patients sustaining other injuries in addition to their hip

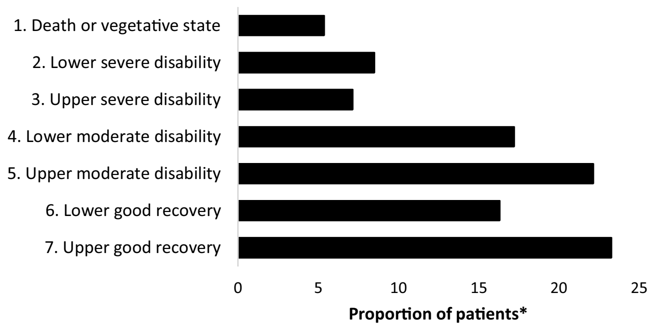

Fig. 2. 12 month functional outcomes in hip fracture patients (Extended Glasgow Outcome Scale).
*Proportion of patients followed up at 12 months (n = 447).

fracture. Odds of a better functional outcome were also reduced if the patient had received compensation for their injury from a third party insurer or were injured via a low fall. Although there were differences in IRSAD scores between the group lost to follow-up and the remaining cohort, adjusting for this variable in the multivariable model did not alter the predictors of functional outcome.

Discussion

Younger hip fracture patients are a small, but important subgroup within the wider hip fracture population. This study reported the 12-month survival and functional outcomes, and predictors of functional outcome in hip fracture patients aged under 65 years of age. Patients in this study were distinctly different from the usual cohort of hip fracture patients, who are older, mainly female, often frail with multiple comorbidities, and most commonly injured by falling [24].

The proportion of younger patients surviving to 12 months post-hip fracture was much higher than that reported for older hip fracture patients, where, depending on the specific population studied, survival has been reported at between 67 and 82% at 12 months [2,9]. In this study, the low mortality rate precluded the ability to analyse predictors of mortality but previous studies have shown increasing age to be an important predictor of mortality in hip fracture patients [25,26].

Despite satisfactory survival rates, functional outcomes were worse than expected in this cohort, with less than one quarter of patients having fully recovered after 12 months. Over one-third of patients reported moderate disability, indicating problems in the areas of work, study, relationships and/or social and leisure activities, and approximately one-tenth reported lower severe disability, indicating that some degree of assistance would be required for activities of daily living. These findings highlight the significant impact of hip fractures on global function in an otherwise healthy group of patients and may partly reflect the fact that younger patients have a higher risk of developing healing complications as a result of the surgical preference for internal fixation over arthroplasty for the femoral neck fracture patients in this age group [6,27].

Previous studies of functional recovery in younger hip fracture patients have been limited by small sample sizes, retrospective designs, non-standardised follow-up periods, the use of outcome measures of the authors' own devising or reporting components of function in isolation (e.g. pain, return to work, etc.) [6]. While it is difficult to contextualise our results within the younger hip fracture population, comparison of outcomes is possible with older hip fracture patients. In a sample of 674 hip fracture patients aged over 65 years who required no assistance pre-fracture, the proportion of patients requiring assistance with activities of daily living was reported to range from 20% to 90% at 12-months [9]. Another study of 398 patients of the same age reported that 27–52% of patients failed to recover their activities of daily living status before fracture [28]. In our study, approximately one-tenth of patients required assistance with activities of daily living 12 months following fracture, which compares favourably with outcomes of older patients. However, it is notable that over three-quarters of patients reported that they were yet to achieve full functional recovery (i.e. GOS-E score below 'Upper good recovery') at 12 months. Using a measure such as the GOS-E, which evaluates a broader range of function than just activities of daily living (e.g. social and leisure activities), enables further discrimination at higher functional levels and provides a more detailed representation of the impact of injury on patients' lives.

Table 2
Factors affecting functional outcome (GOS-E) 12 months following hip fracture.[a]

Population descriptor	GOS-E median (IQR)	Univariate analysis	Multivariate analysis	
		p	AOR (95% CI)	p
Comorbid status				
None	5 (4–7)	<0.001[e]	1.00 (ref.)	0.001[e]
CCI ≥ 1	4 (2–5)		0.49 (0.32, 0.73)	
Pre-injury level of disability[b]				
None	5 (4–7)	<0.001[e]	1.00 (ref.)	<0.001[e]
Disability present	4 (2–6)		0.36 (0.23, 0.56)	
Mechanism of injury[c]				
Low fall	5 (3–6)	0.015[e]	1.00 (ref.)	<0.001[e]
High fall	5 (4–7)		1.97 (1.08, 3.59)	
Road trauma	5 (4–6)		3.48 (1.96, 6.17)	
Other external cause	5 (3–7)		2.26 (1.10, 4.63)	
Compensable status[d]				
Medicare/not compensable	5 (3–7)	0.033[e]	1.00 (ref.)	<0.001[e]
Private/DVA	6 (4–7)		0.95 (0.56, 1.64)	
TAC/WorkSafe/other compensable	5 (4–5)		0.30 (0.17, 0.53)	
Isolated vs non-isolated hip fracture				
Isolated hip fracture	5 (4–7)	0.008[e]	1.00 (ref.)	0.002[e]
Other injuries present	5 (4–6)		0.50 (0.32, 0.78)	

GOS-E, Extended Glasgow Outcome Scale; CCI, Charlson Comorbidity Index; DVA, Department of Veterans Affairs; TAC, Transport Accident Commission.
[a] Data missing for n = 60 cases.
[b] Data missing for n = 55 cases.
[c] Data missing for n = 1 case.
[d] Data missing for n = 15 cases.
[e] Significant at the P < 0.05 level.

Our study also sought to determine factors associated with functional outcome. Independent predictors of worse functional outcome at 12 months post-injury included the presence of co-morbidities, previous disability and additional injuries. These factors have also been shown to predict worse outcomes in older hip fracture patients [28,29]. It is understandable that patients with co-morbidities and disabilities may be less able to recover from hip fracture as their physical capacity for healing may be reduced and they may lack the necessary physical reserve to participate fully in rehabilitation. Patients with additional injuries such as head injuries or internal organ injuries, may also be limited in their capacity for full recovery.

Receiving compensation from a third party work or transport insurer was also associated with a worse functional outcome. This finding, while not reported before in the hip fracture literature, has been reported in other patient groups, including chronic pain [30], post-surgical [31] and general trauma [32]. There are a range of hypotheses suggested to account for these associations, including having low financial motivation to recover, having a negative experience dealing with the compensation system and having a sense of perceived injustice relating to the initial injury, contributing to reduced self-efficacy, anger and depression [31,33]. Further research is necessary to determine whether any of these factors may be amenable to intervention.

The final factor predictive of functional outcome was the mechanism of injury. Even after adjusting for age, gender, comorbidities, level of disability and presence of additional injuries, patients injured via low falls fared significantly worse than those injured via road trauma and high falls. This is a surprising finding considering that a low fall would presumably cause less harm than a high energy mechanism. It is possible that the rehabilitation provided to patients with more severe injuries may be more intensive than that provided to patients injured via low falls and this may account for their improved outcomes. Alternatively, there may be confounding factors such as reduced bone density or other physical conditions more common in those injured via low falls, such as deconditioning, reduced mobility or poor balance, which we were unable to fully adjust for in the multivariable model.

There are some limitations to the study. Only the four VOTOR hospitals contributed data to this study, meaning that data were not necessarily representative of all hip fracture patients in the state of Victoria. However, the inclusion of the state's two major trauma services ensured a substantial sample of young hip fracture patients was captured. It is also acknowledged that there is potential for functional improvement beyond 12 months post-injury and therefore, longer follow-up is needed. The registry has recently added 24-month follow-up interviews to its protocol and these results will be available in future. Furthermore, as the study was observational, only association was shown and causality cannot be confirmed. In spite of these potential limitations, our study had several strengths. Relative to previous studies, this study included one of the largest cohorts of younger hip fracture patients ever investigated, and provides new information regarding functional outcomes in this population, critical for informing and better targeting post-discharge care. The follow-up rate was also a strength of this study, with 88% of eligible patients followed up at 12 months.

Conclusions

While 12-month survival rates were satisfactory in hip fracture patients aged under 65 years, their functional outcomes were poor, with less than one quarter having fully recovered 12 months following injury. Patients who are at risk of a poor functional outcome are those who have co-morbidities, previous disability or additional injuries, are receiving compensation or are injured via a low fall. These patients may require more intensive rehabilitation or a more graded approach to therapy in order to return to their pre-injury level of function. Considering that the focus of this study was a cohort of patients of working age, our findings highlight the importance of providing adequate post-discharge care and rehabilitation in order to reduce the socio-economic burden of hip fracture and ensure that patients can continue to contribute productively to society following injury.

Conflict of interest

The authors of this manuscript certify that they have NO affiliations with or involvement in any organisation or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Acknowledgements:

Melissa Hart, Sue McLellan, Adrian Buzgau, David Attwood and the Steering Committee of VOTOR are thanked for their assistance with this project. The Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) is funded by the Transport Accident Commission via the Institute for Safety, Compensation and Recovery Research (ISCRR). Christina Ekegren is supported by a National Health and Medical Research Council of Australia Early Career Fellowship (GNT1106633). Belinda Gabbe was supported by a National Health and Medical Research Council of Australia Career Development Fellowship (GNT1048731).

References

[1] Griffin XL, Parsons N, Achten J, Fernandez M, Costa ML. Recovery of health-related quality of life in a United Kingdom hip fracture population. The Warwick Hip Trauma Evaluation–a prospective cohort study. Bone Joint J 2015;97-B:372–82.
[2] Ireland AW, Kelly PJ, Cumming RG. Risk factor profiles for early and delayed mortality after hip fracture: analyses of linked Australian Department of Veterans' Affairs databases. Injury 2015;46:1028–35.
[3] Kreisfeld R, Newson R. Hip fracture injuries. Adelaide: AIHW National Injury Surveillance Unit Briefing; 2006.
[4] Karantana A, Boulton C, Bouliotis G, Shu KS, Scammell BE, Moran CG. Epidemiology and outcome of fracture of the hip in women aged 65 years and under: a cohort study. J Bone Joint Surg Br 2011;93:658–64.
[5] Damany DS, Parker MJ, Chojnowski A. Complications after intracapsular hip fractures in young adults: a meta-analysis of 18 published studies involving 564 fractures. Injury 2005;36:131–41.
[6] Sprague S, Slobogean GP, Scott T, Chahal M, Bhandari M. Young femoral neck fractures: are we measuring outcomes that matter? Injury 2015;46:507–14.
[7] Holt G, Smith R, Duncan K, Hutchison JD, Gregori A. Epidemiology and outcome after hip fracture in the under 65s-evidence from the Scottish Hip Fracture Audit. Injury 2008;39:1175–81.
[8] Davidovitch RI, Jordan CJ, Egol KA, Vrahas MS. Challenges in the treatment of femoral neck fractures in the nonelderly adult. J Trauma 2010;68:236–42.
[9] Magaziner J, Hawkes W, Hebel JR, Zimmerman SI, Fox KM, Dolan M, et al. Recovery from hip fracture in eight areas of function. J Gerontol Ser A Biol Sci Med Sci 2000;55:M498–507.
[10] Edwards E, Graves S, McNeil J, Williamson O, Urquhart D, Cicuttini F. Orthopaedic trauma: establishment of an outcomes registry to evaluate and monitor treatment effectiveness. Injury 2006;37:95–6.
[11] Gabbe B, Sutherland A, Hart M, Cameron P. Population-based capture of long-term functional and quality of life outcomes after major trauma—the experiences of the Victorian State Trauma Registry. J Trauma 2010;69:532–6.
[12] National Centre for Classification in Health. The international statistical classification of diseases and related health problems, 10th revision, Australian modification (ICD-10-AM). 7th ed. Sydney : National Centre for Classification in Health: Faculty of Health Sciences, The University of Sydney; 2010.
[13] World Health Organization. International classification of functioning, disability and health: ICF. Geneva: World Health Organization; 2001.

[14] National Centre for Classification in Health. The Australian Classification of Health Interventions (ACHI). National Centre for Classification in Health: Faculty of Health Sciences. 6th ed. Sydney: The University of Sydney; 2008.
[15] Wilson JT, Pettigrew LE, Teasdale GM. Structured interviews for the glasgow outcome scale and the extended glasgow outcome scale: guidelines for their use. J Neurotrauma 1998;15:573–85.
[16] Williamson O, Gabbe B, Forbes A, Wolfe R, Sutherland A, Cameron P. Comparing the responsiveness of functional outcome assessment instruments for trauma registries. J Trauma 2011;71:63–8.
[17] Ekegren CL, Hart MJ, Brown A, Gabbe BJ. Inter-rater agreement on assessment of outcome within a trauma registry. Injury 2015;47:130–4.
[18] Charlson M, Pompei P, Ales K, MacKenzie C. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. J Chronic Dis 1987;40:373–83.
[19] Deyo R, Cherkin D, Ciol M. Adapting a clinical comorbidity index for use with ICD-9CM administrative databases. J Clin Epidemiol 1992;45:613–9.
[20] Gabbe B, Magtengaard K, Hannaford A, Cameron P. Is the Charlson Comorbidity Index useful for predicting trauma outcomes? Acad Emerg Med 2005;12:318–21.
[21] Australian Bureau of Statistics. Socio-Economic Indexes for Areas (SEIFA) 2011. 2013.
[22] Clay F, Ozanne-Smith J. Private hospital insurance status among a state-wide injured population. Aust Health Rev 2006;30:252–8.
[23] Hosmer JDW, Lemeshow S, Sturdivant RX. Model-building strategies and methods for logistic regression. Applied logistic regression. John Wiley & Sons, Inc.; 2013. p. 89–151.
[24] Auais M, Morin S, Nadeau L, Finch L, Mayo N. Changes in frailty-related characteristics of the hip fracture population and their implications for healthcare services: evidence from Quebec, Canada. Osteoporos Int 2013;24:2713–24.
[25] Sexson SB, Lehner JT. Factors affecting hip fracture mortality. J Orthop Trauma 1987;1:298–305.
[26] Paksima N, Koval KJ, Aharanoff G, Walsh M, Kubiak EN, Zuckerman JD, et al. Predictors of mortality after hip fracture: a 10-year prospective study. Bull NYU Hosp Jt Dis 2008;66:111–7.
[27] Slobogean GP, Sprague SA, Scott T, McKee M, Bhandari M. Management of young femoral neck fractures: is there a consensus? Injury 2015;46:435–40.
[28] Koval KJ, Skovron ML, Aharonoff GB, Zuckerman JD. Predictors of functional recovery after hip fracture in the elderly. Clin Orthop Relat Res. 1998;22–8.
[29] Kammerlander C, Gosch M, Kammerlander-Knauer U, Luger TJ, Blauth M, Roth T. Long-term functional outcome in geriatric hip fracture patients. Arch Orthop Trauma Surg 2011;131:1435–44.
[30] Rohling ML, Binder LM, Langhinrichsen-Rohling J. Money matters: a meta-analytic review of the association between financial compensation and the experience and treatment of chronic pain. Health Psychol 1995;14:537–47.
[31] Harris I, Mulford J, Solomon M, van Gelder J, Young J. Association between compensation status and outcome after surgery. JAMA 2005;293:1644–52.
[32] Gabbe B, Cameron P, Williamson O, Edwards E, Graves S, Richardson M. The relationship between compensable status and long-term patient outcomes following orthopaedic trauma. Med J Aust 2007;187:14–7.
[33] Trost Z, Agtarap S, Scott W, Driver S, Guck A, Roden-Foreman K, et al. Perceived injustice after traumatic injury: associations with pain, psychological distress, and quality of life outcomes 12 months after injury. Rehabil Psychol 2015, doi: http://dx.doi.org/10.1037/rep0000043.