

Original article

Second hip fracture in Hong Kong – Incidence, demographics, and mortality

Angela Wing Hang Ho^{*}, Sze Hung Wong

Department of Orthopaedics and Traumatology, Caritas Medical Centre, Hong Kong

ARTICLE INFO

Article history:

Received 1 August 2019

Received in revised form

16 March 2020

Accepted 14 May 2020

Available online 18 June 2020

Keywords:

Hip fracture

Hong Kong

Incidence

Mortality

Second hip fracture

ABSTRACT

Objectives: The aim of this study is to investigate the incidence of second hip fractures after a previous hip fracture and subsequent mortality in Chinese men and women.

Methods: Data of patients aged 65 years or above with operatively treated hip fracture in the years 2000–2011 in Hong Kong were retrieved from Hospital Authority clinical database. During the follow-up period, second contralateral operatively treated hip fractures were identified. The incidence of a second fracture was determined using survival analysis.

Results: A total of 2399 second hip fractures were identified. The cumulative incidence of a second fracture was 1.24% at 1 year and 4.42% at 5 years with 60% of second fractures occurring within 4 years after the initial fracture. In cox regression model, a higher incidence was observed as age increased (hazard ratio [HR], 1.08; $P < 0.001$). The cumulative mortality at 1 and 5 years after a second fracture was 16.9% and 54.8%, respectively. The median survival after single fracture was 4.9 years, while after a second fracture it was 3.8 years ($P < 0.05$). Lower survival was observed after the second fracture (HR, 5.44; $P < 0.05$), in men (HR, 1.91; $P < 0.05$) and older patients (HR, 1.061; $P < 0.05$).

Conclusions: Patients with history of hip fracture are at high risk to develop a second fracture. Initiation of treatment and fragility fracture prevention program after primary hip fracture should be started in order to reduce second fracture incidence and related mortality.

© 2020 The Korean Society of Osteoporosis. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

1. Introduction

Hip fractures are a well-known fragility fracture for which the lifetime risk is around 11%–23% and 3%–11% in women and men respectively [1–6]. In Hong Kong, the reported life time hip fracture risk was 7.2% for men at age 50 and 17% for women [7]. Hip fractures pose a significant economic burden to the society which will increase in the future, in part due to the increasing number of elderly [8]. A history of previous hip fracture is well established as risk factor for subsequent contralateral hip fracture [9,10]. However, there are few reports on the incidence of second hip fracture in the literature, and only one for Chinese patients [11]. Secondary prevention of fragility fractures in patients with osteoporosis is widely advocated. One way to assess the efficacy of secondary prevention is to observe a decrease in the incidence of second hip fracture. In

this study we report the incidence and mortality associated with a second hip fracture.

2. Methods

This was an observational study. The study population comprised men and women aged 65 years or above with a history of operatively treated femoral neck or trochanteric fracture. The primary outcome was second hip fracture. Secondary outcome was mortality after second hip fracture.

We used the clinical data from the Hospital Authority, which treats 99% of hip fracture patients in Hong Kong [5,8]. The records of surgically treated hip fracture patients were extracted from the Clinical Data Analysis and Retrieval System (CDARS), using International Classification of Disease code 820 under subdivision Operation Theatre Management System-linked diagnosis, with exclusion of high energy trauma, road traffic accident, and pathological fracture. Within this cohort of patients, a second fracture episode was identified in the same manner. The fractures were validated by matching the diagnosis of contralateral hip fracture,

^{*} Corresponding author. Department of Orthopaedics and Traumatology, Caritas Medical Centre, 111 Wing Hong Street, Shum Shui Po, Kowloon, Hong Kong.

E-mail address: angelaho@alumni.cuhk.net (A.W.H. Ho).

Peer review under responsibility of The Korean Society of Osteoporosis.

Cumulative Incidence of 2nd Hip Fracture verse Time After 1st Hip Fracture

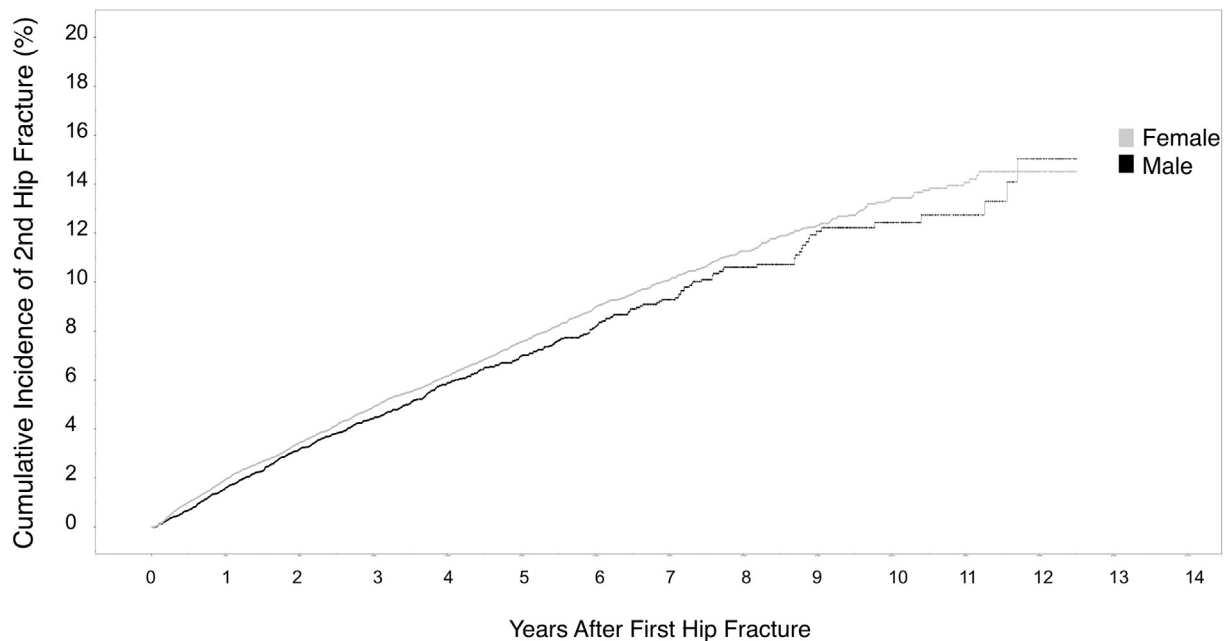


Fig. 1. Survival curve showing percentage of first hip fracture patients develop second hip fracture.

Table 1
Number and annual incidence (per 10,000) of first and second hip fracture by age and sex.

Age, yr	First hip fracture		Second hip fracture		Relative risk of 2nd fracture
	Number	Incidence	Number	Incidence	
Men					P < 0.001
65–69	89	7	3	32	4.37
70–74	146	12	21	118	9.43
75–79	257	26	35	125	4.72
80–84	412	67	53	160	2.42
≥85	512	125	79	202	1.61
Women					
65–69	98	8	8	64	7.37
70–74	241	21	37	121	5.71
75–79	502	46	65	113	2.44
80–84	778	95	155	198	2.13
≥85	1544	176	324	248	1.36
Overall	4579	46	780	181	3.91

excluding complications of initial hip operation or periprosthetic fractures. The data from CDARS are audited every 6 months to ensure the data accuracy. Mortality was retrieved using census data and death registry from Hong Kong Special Administrative Region Government.

We included patients aged 65 years or above with operatively treated hip fracture in years 2000–2011 in Hong Kong. Ethnicity was not considered since 94% of the Hong Kong population are Chinese (Census data 2011).

Incidence and mortality were age-adjusted. Data are shown as mean \pm standard deviation, median, or hazard ratio (and 95% confidence interval [CI]). Comparison between groups was performed using chi-square test. The cumulative incidence of second hip fracture was calculated using Kaplan-Meier survival analysis. Cox regression model was applied to assess the relationship between covariates (age and sex) and risk of second hip fracture. Analyses were performed using SPSS ver. 16.0 (SPSS Inc., Chicago, IL, USA). P-values < 0.05 were considered statistically significant.

The study was approved by Hospital Authority, Kowloon West Cluster Research Ethics Committee (Reference: KW/EX-13-088(64-19)). Version 4 of the STROBE (strengthening the reporting of observational studies in epidemiology) guidelines for cross-sectional studies were used in the preparation of this manuscript.

3. Results

A total of 41,433 operatively treated primary hip fractures were identified during the year 2000–2011. The mean age was 82 ± 7 years. Male to female ratio was 3:7. Within this cohort, 2399 second hip fractures were identified. Male to female ratios of first hip fracture and second hip fracture were 1:2.38 and 1:3.34 respectively and females had a higher incidence of second hip fracture (relative risk, 1.38; $P < 0.0001$). The mean ages at first hip fracture and second hip fracture were 81 ± 7 and 84 ± 6 years, respectively ($P < 0.05$).

The cumulative incidence of a second fracture was 0.88% at 6

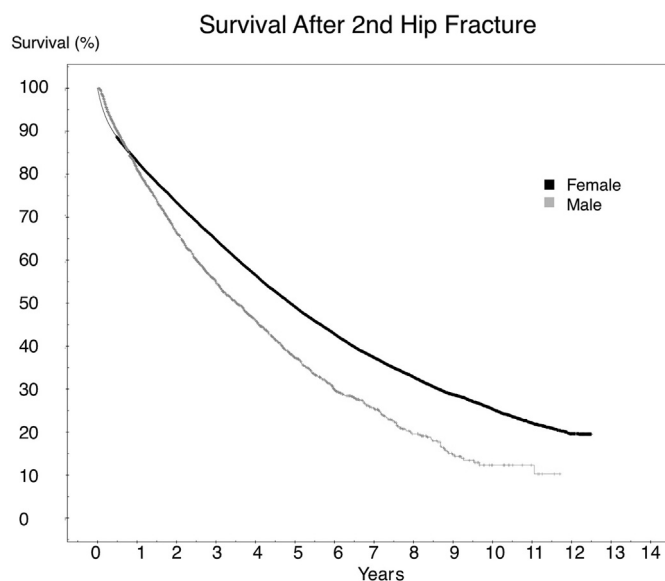


Fig. 2. Survival after second hip fracture.

Table 2
One-year and 5-year mortality (%) of first and second hip fracture by age and sex.

Age, yr	First hip fracture		Second hip fracture	
	1 Year	5 Years	1 Year	5 Years
Men				
65–69	14.1	39.9	18.2	73.6
70–74	16.5	47.5	23.3	64.1
75–79	20.0	55.8	26.1	63.4
80–84	25.9	64.7	23.7	66.9
≥85	35.4	75.7	34.2	79.7
Women				
65–69	6.3	23.4	0.0	19.4
70–74	7.2	27.8	9.7	43.4
75–79	9.8	33.7	9.6	41.8
80–84	12.4	42.8	12.8	46.7
≥85	18.4	58.1	17.7	59.7

months, 1.24% at 1 year, 4.42% at 5 years, and 6.79% at 10 years. Second hip fracture occurred at a mean 2.7 years after the primary hip fracture. 60% of second fractures occurred within 4 years after the initial fracture (Fig. 1).

In cox regression model, there were higher incidences of second hip fracture observed as age increased (HR, 1.08; 95% CI, 1.07–1.09; $P < 0.001$) and female sex (HR, 2.51) but not statistically significant ($P = 0.10$). The age and sex specific 1-year incidence of primary and second hip fractures is given in Table 1. Highest relative risk of 2nd fracture was observed in male aged 70–74 and female aged 65–69.

Table 3
The incidence of second hip fracture (%) following a first hip fracture.

Study	Country	Population	1 Year	5 Years	10 Years
Current study 2019	Hong Kong	43,832	1.2	4.4	6.8
Omsland et al. (2013) [13]	Norway	81,867	M 3.2 F 4.4	8.3 11.5	11.0 15
Lawrence et al. (2010) [14]	UK	6331	2.7		
Ryg et al. (2009) [15]	Denmark	169,145	9	20	
Lönnroos et al. (2007) [10]	Finland	501	5		
Nymark et al. (2006) [16]	Denmark	9900			8.7
Yamanashi et al. (2005) [17]	Japan	714	3.8		
Rodaro et al. (2004) [18]	Italy	2771			7.6
Chiu et al. (1992) [11]	HKSAR	1514	0.8	2.3	

The mortality at 1 and 5 years after a second fracture was 16.9% and 54.8%, respectively. The median survival after the first hip fracture was 4.9 years (95% CI, 4.8–5.0), whilst for the second fracture it was 3.8 years (95% CI, 3.5–4.0) ($P < 0.001$) (Fig. 2).

Risk factors (age and sex) of mortality after hip fracture were analysed using cox regression model. Lower survival was observed following the second fracture in women (HR, 5.44; 95% CI, 1.67–11.1; $P < 0.001$) and men (HR, 1.91; 95% CI, 1.86–1.96; $P < 0.05$). Age had a minimal risk for increase mortality (HR, 1.061; 95% CI, 1.059–1.063; $P < 0.05$). The age and sex specific 1-year mortality of primary and second hip fractures is shown in Table 2.

4. Discussion

In our study, the cumulative incidence of second hip fracture was 1.24% at 1 year and 4.42% at 5 year.

According to our recent study on the epidemiology of operative geriatric hip fracture of Hong Kong, the annual incidence of geriatric hip fracture during 2001–2011 was rising. The annual risk of hip fracture in 2010 were 3.0 per 1000 patients for male 6.1 per 1000 for female [12]. The incidence of second hip fracture was 2–4 times higher than first fracture. This is in echo that patient with first fracture are at higher risk to develop another fragility fracture than people without fragility fracture.

The incidence rate of second hip fracture reported in our study and previously reported data are summarized in Table 3 [10,11,13–18]. Omsland et al. [13] and Ryg et al. [15] reported large-scale studies in Norway and Denmark. The 1-year incidence and 5-year incidence of second hip fracture was higher than the current study. However direct comparison is not possible as the population and social backgrounds are so different. Compare with previous reported by Chiu et al. [11] in 1992 for Hong Kong population, we have a higher 1-year and 5-year incidence of second hip fracture. Our study is also the largest study in our locality, southern Chinese and Asia. The results are summarized in Table 3.

We also found that around 60% second fracture occurs within around 4 years after the initial fracture. Prior hip fracture is a known risk factor of further hip fracture [6,9,10]. Second hip fracture incidence can act as an indicator of the successful of fragility fracture prevention program. The result of our study can be useful to monitor the effectiveness of drug treatment of osteoporosis and other fragility fracture prevention program.

We also reported the age and sex specific 1-year and 5-year mortality of second hip fracture. The median survival after single fracture was 4.9 years (95% CI, 4.8–5, while second fracture was 3.8 years (95% CI, 3.5–4). As previously reported, age and female sex are important risk factors for hip fracture [6,7,12]. However, in second hip fracture, neither age nor sex affected the occurrence [14]. In our study we have the similar result. Indeed, osteoporotic fracture prevention should not be limited to a specific age group or sex.

Our study population was representative. Almost 99% of geriatric hip fracture patients were treated in Hospital Authority, the only public hospital network in Hong Kong Special Administrative Region. By using the Clinical Data Analysis and Retrieval System which capture all patient data in Hospital Authority, all operated treated hip fracture cases in Hong Kong can be retrieved by using specific diagnosis code. Demographic data and mortality can also be retrieved. Our results were also age and sex-adjusted. However other data such as social demographics, vital status and comorbidity cannot be accurately retrieved. And the study population was mixed with patient who receive antiosteoporotic treatment and those who did not. In future the development of geriatric hip fracture registry is advocated, which can systematically gather more information, so the provide more valuable data concerning the treatment and prevention of osteoporosis.

Comparing with the previous report figure of second hip fracture in Hong Kong 20 years ago, our study shows a much higher incidence (1-year cumulative incidence 0.79% versus 1.24% and 5-year cumulative incidence 2.3% versus 4.42%). First our study has the largest number of population at risk compare with previous studies. Secondly the population of the geriatric population is rising so the risk of second hip fracture will be increased. Thirdly it may reflect the importance of implementation of antiosteoporosis and fragility fracture prevention program in order to reduce the incidence of second hip fracture.

The limitation of our study is this is a retrospective cohort review. We only included patients with surgical treated hip fracture. The nonsurgical treated hip fracture patients were excluded, usually they were medically unfit for surgery, which potentially underestimate the incident and mortality.

5. Conclusions

The cumulative incidence of a second hip fracture is 1.24% at 1 year and 4.42% at 5 years. Sixty percent of second fractures occur within around 4 years after the initial fracture and has a lower survival compare with single fracture. Our study also provides a base line figure of subsequent hip fracture to monitor the effect of anti-osteoporotic program.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

CRedit author statement

Angela Wing Hang Ho: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Visualization, Project

administration, Funding acquisition. **Sze Hung Wong:** Conceptualization, Methodology, Investigation, Resources, Writing - review & editing, Supervision.

Acknowledgments

The institution received research grant 2012 for the above study from Hong Kong Orthopaedic Association. The funder had no role in study design, data collection/analysis/interpretation or manuscript preparation. **ORCID** Angela Wing Hang Ho: 0000-0002-4370-5452. Sze Hung Wong: 0000-0002-4441-477X.

References

- [1] Cummings SR, Black DM, Rubin SM. Lifetime risks of hip, Colles', or vertebral fracture and coronary heart disease among white postmenopausal women. *Arch Intern Med* 1989;149:2445–8.
- [2] Kanis JA, Johnell O, Oden A, Sembo I, Redlund-Johnell I, Dawson A, et al. Long-term risk of osteoporotic fracture in Malmö. *Osteoporos Int* 2000;11:669–74.
- [3] Melton 3rd LJ, Chrischilles EA, Cooper C, Lane AW, Riggs BL. Perspective. How many women have osteoporosis? *J Bone Miner Res* 1992;7:1005–10.
- [4] van Staa TP, Dennison EM, Leufkens HG, Cooper C. Epidemiology of fractures in england and wales. *Bone* 2001;29:517–22.
- [5] Lau EM, Cooper C, Wickham C, Donnan S, Barker DJ. Hip fracture in Hong Kong and britain. *Int J Epidemiol* 1990;19:1119–21.
- [6] Kanis JA, Johnell O, De Laet C, Jonsson B, Oden A, Ogelsby AK. International variations in hip fracture probabilities: implications for risk assessment. *J Bone Miner Res* 2002;17:1237–44.
- [7] Tsang SW, Kung AW, Kanis JA, Johansson H, Oden A. Ten-year fracture probability in Hong Kong Southern Chinese according to age and BMD femoral neck T-scores. *Osteoporos Int* 2009;20:1939–45.
- [8] Lau EM, Cooper C, Fung H, Lam D, Tsang KK. Hip fracture in Hong Kong over the last decade—a comparison with the UK. *J Publ Health Med* 1999;21:249–50.
- [9] Chapurlat RD, Bauer DC, Nevitt M, Stone K, Cummings SR. Incidence and risk factors for a second hip fracture in elderly women. The Study of Osteoporotic Fractures. *Osteoporos Int* 2003;14:130–6.
- [10] Lönnroos E, Kautiainen H, Karppi P, Hartikainen S, Kiviranta I, Sulkava R. Incidence of second hip fractures. A population-based study. *Osteoporos Int* 2007;18:1279–85.
- [11] Chiu KY, Pun WK, Luk KD, Chow SP. Sequential fractures of both hips in elderly patients—a prospective study. *J Trauma* 1992;32:584–7.
- [12] Man LP, Ho AW, Wong SH. Excess mortality for operated geriatric hip fracture in Hong Kong. *Hong Kong Med J* 2016;22:6–10.
- [13] Omsland TK, Emaus N, Tell GS, Ahmed LA, Center JR, Nguyen ND, et al. Ten-year risk of second hip fracture. A NOREPOS study. *Bone* 2013;52:493–7.
- [14] Lawrence TM, Wenn R, Boulton CT, Moran CG. Age-specific incidence of first and second fractures of the hip. *J Bone Joint Surg Br* 2010;92:258–61.
- [15] Ryg J, Rejnmark L, Overgaard S, Brixen K, Vestergaard P. Hip fracture patients at risk of second hip fracture: a nationwide population-based cohort study of 169,145 cases during 1977–2001. *J Bone Miner Res* 2009;24:1299–307.
- [16] Nymark T, Lauritsen JM, Ovesen O, Röck ND, Jeune B. Short time-frame from first to second hip fracture in the funen county hip fracture study. *Osteoporos Int* 2006;17:1353–7.
- [17] Yamanashi A, Yamazaki K, Kanamori M, Mochizuki K, Okamoto S, Koide Y, et al. Assessment of risk factors for second hip fractures in Japanese elderly. *Osteoporos Int* 2005;16:1239–46.
- [18] Rodaro E, Pasqualini M, Iona LG, Di Benedetto P. Functional recovery following a second hip fracture. *Eur Medicophys* 2004;40:179–83.