Original Article

Prognostic Factors of Refractures among Post-Surgical Hip Fracture Patients in Chiang Rai Provincial Hospital, Chiang Rai Province

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Objective: To investigate which of the prognostic factors affects the post-surgical first hip fracture patients and continues to affect the development of the refractures later.

Materials and Methods: The present study was the retrospective case-control. The data were collected from 232 of the first hip fracture patients aged 50 years or more that included 75 males and 157 females. The comparison was observation of the patients from 58 refracture patients (group 1) to 174 first hip fracture patients (group 2). Most of them were admitted and evaluated at Chiang Rai Prachanukroh Hospital between October 1, 2013 and September 30, 2020.

Results: The findings of the present study indicated that the prior fracture history patients (adjusted OR 19.836; 95% CI 1.674 to 235.015, p=0.018) with lower Singh index grades 3 or less (adjusted OR 8.082; 95% CI 2.535 to 25.466, p≤0.001) and eye disease (adjusted OR 11.361; 95% CI 0.971 to 11.708, p=0.055) were the prognostic factors of refractures.

Conclusion: In the prior fracture history, a lower Singh index (grade 3 or lower) and eye disease were the prognostic factors of refractures in the post-surgical hip fracture patients. Early detection of these factors can help to identify the high risk of the refracture group and improve the efficiency and targeting the prevention of refractures.

Keywords: Prognostic factors; Refractures; Post-surgical first hip fracture

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Hip fracture is a major public health problem because of its high occurrence rate and its severe impact on social, economic, and human livelihood[1,2]. A survey conducted in Chiang Mai, Thailand in 2006 indicated that 181 out of 100,000 persons had experienced a hip fracture[3]. A successful primary preventive intervention for hip fractures would be extremely valuable. It has been previously reported that patients with hip fractures showed high mortality rate[4]. The prognosis has now improved due to better perioperative care and rehabilitation. It has recently been reported that more than 90% of patients with hip fracture have returned to their homes after surgery[5]. However, patients who have suffered hip fracture have an increased risk of subsequent refracture of the other site, especially at the major site of osteoporosis fractures such as vertebra, hip, distal radius, or proximal humerus[6-8]. It is, therefore, important to act appropriately to prevent the occurrence of a refracture through medicine supplementation, the use of hip protectors, correction of other medical conditions, rehabilitation, and improvement of the environment for fall prevention. The more expensive the prophylaxis regime to be used, the greater the requirement for targeting treatment to those at the greatest risk of a refracture. By means of retrospective case-control study, the present study attempted to clarify the risk factors for refractures in post-surgical first hip fracture patients.

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Materials and Methods

Population

Between October 1, 2013 and September 30, 2020, the post-surgical first hip fracture patients

from Chiang Rai Prachanukroh Hospital aged over 50 years old were chosen for the present study. The exclusion criteria were pathological fractures from cancer or high-energy trauma such as traffic accidents or falls from greater than standing height, concomitant bilateral hip fractures, hip fractures secondary to a metabolic bone disease. Altogether, six patients were excluded from the present study.

The sample size underpinned the study of Angthong et al[9] that reported a strong relationship between lower Singh index grades and the occurrence of a refracture. The random sampling of post-fixation of first hip fracture patients in Chiang Rai Prachanukroh Hospital indicated that the proportion of the lower Singh index in cases group (refractures) per controls group was 5:3, which was used for sample size calculation by comparing two proportions (independent) that accepted 80% of statistical power and 0.05 of alpha error with one-sided testing. The calculated sample size was 220 divided into two groups with 55 for cases and 165 for controls, respectively, (1:3 of cases:controls).

The patients were divided into two groups. Those with first hip fracture followed by refractures at any site of the major osteoporosis fractures such as vertebra, hip, distal radius, or proximal humerus and were the cases group with 45 females and 13 males. Those with first hip fracture without refractures were the controls group with 112 females and 62 males. The data were recorded from the first hip fracture occurrence in both groups and followed up for four years to define refracture[7] and verified that occurrence of the first hip fracture in the control group was in the same month of the case group, thus concurrently-selected of control group.

Baseline data collection

Overall information and complete health history were obtained from medical history including duration between the first hip fractures and refracture (timeframe), and the location of refracture such as vertebra, hip, distal radius, or proximal humerus, were reviewed from radiographic studies for first hip fracture and record in Group 1. Gender and age of the patients, comorbid medical condition, causes of fracture, prior fracture history, first hip fracture type, operative implant, length of hospitalization, Singh index, and history for lack of osteoporosis treatment after first hip fracture were recorded in both groups.

Data on comorbid medical conditions were based on the presence of the following conditions, hypertension, eye diseases with visual acuity (Snellen) of both eyes were less than 20/30 with cataracts, glaucoma, diabetic retinopathy, or hypertensive retinopathy, neurological diseases such as cerebro-vascular accident, dementia, or Parkinson's disease, benign prostatic hyperplasia, respiratory diseases such as chronic obstructive pulmonary disease or asthma, and ischemic heart diseases such as myocardial infarction or angina pectoris. The fracture causes were categorized as fall from a standing height or less and simple fall. The prior fracture history referred to any fracture from a fall from a standing height or less and simple fall that occurred before the first hip fracture.

For radiographic study, fracture types were classified as intertrochanteric and femoral neck fractures. Hypotrophic changes in proximal femoral trabeculae were observed on the anteroposterior radiographs of the contralateral unfractured hip according to the Singh criteria[10]. Trabecular changes were graded separately by three orthopedists, two from the same hospital and one from another hospital, at least two of three orthopedist opinions were the agreement of grading.

The surgical choices were hemiarthroplasty and internal fixation with dynamic hip screw (DHS). The lack of osteoporosis treatment after the first hip fracture referred to loss of the prescription of calcium, vitamin D, or bisphosphonate at the day discharged from the hospital including the outpatient.

The present study was conducted in accordance with the principles of the Declaration of Helsinki and the approval was obtained from the Chiang Rai Prachanukroh Hospital Ethic Committee (Protocol Number: EC CRH 0035/62 ln).

Statistical analysis

Frequencies and percentages described the categorical variable and mean (standard deviation) described continuous variables as appropriate. Categorical data were analyzed by Fisher's exact probability test. An independent t-test was used for continuous data with a normal distribution and the Wilcoxon rank sum test was used for skewed data. The binary outcome data were analyzed with univariable logistic regression analysis and then the variables which showed statistical significance (p-value less than 0.05) will be analyzed with multivariable logistic regression analysis by backward eliminated variables with wide range of p-value (more than 0.05) until receiving the results.

Results

The duration between the first hip fractures and

Table 1. Baseline characteristics of the first hip fracture with refracture group

Characteristic	Cases (n=58); n (%)
Timeframe (month)	
≤12 month	25 (43.1)
>12 month	33 (56.9)
Mean±SD	22.2±16.6
Refracture location	
Spine	11 (18.9)
Hip	34 (58.7)
Radius	6 (10.3)
Humerus	6 (10.3)
Hip & humerus	1 (1.8)

SD=standard deviation

Timeframe refers to the duration between the first hip fractures and refracture

refracture was 22.2±16.6 months on average. The refracture occurred within one year after surgery of first hip fracture accounting for about 43.1%, and about 56.9% over one year. The most location of refracture was hip fracture accounting for about 58.7% as shown in Table 1.

Most of the patients, about 77.6%, were female in Group 1, which showed significant differences between the two groups. There were no significant differences between the two groups with respect to the average age, cause and type of fracture, and length of hospitalization. Among comorbid medical conditions, hypertension (p=0.004), eye diseases (p=0.021), neurologic diseases (p=0.023), benign prostatic hyperplasia (p=0.001), and ischemic heart disease (p=0.049) were seen significantly more frequently in Group 1. The operative implant for hip surgery (DHS) (p=0.027) and the lack of vitamin D supplement (p=0.046) after the first hip fracture were significantly found in Group 1. There was an obvious relationship between refracture and prior fracture history (p=0.001), including lower Singh index (grade 3 or lower) (p=0.001). The bisphosphonate treatment was seldom prescribed in both fracture groups (98.3%, p=0.686) as shown in Table 2.

The univariable logistic regression analysis revealed that patients older than 85 years (crude OR 2.676; 95% CI 1.049 to 6.825, p=0.039), benign prostatic hyperplasia (crude OR 17.99; 95% CI 2.167 to 149.51, p=0.007), neurologic diseases (crude OR 2.715; 95% CI 1.132 to 6.508, p=0.025), hypertension (crude OR 2.420; 95% CI 1.295 to 4.524, p=0.006), eye diseases (crude OR 2.273; 95% CI 1.099 to 4.703, p=0.027), prior fracture history (crude OR 12; 95% CI 2.548 to 56.508, p=0.002), dynamic hip screw (crude OR 16.150; 95% CI 1.929 to 135.182, p=0.010) and a lower Singh index (grade 3 or lower) (crude OR 4.485; 95% CI 1.966 to 10.229, p=0.001) were associated with an increased risk for refractures as shown in Table 3.

The multivariable logistic regression analysis revealed that the remaining factors still highly associated with an increased risk for refractures were prior fracture history (adjusted OR 19.836; 95% CI 1.674 to 235.015, p=0.018), Singh index (grade) 1 to 3 (adjusted OR 8.082; 95% CI 2.535 to 25.466, p≤0.001), eye diseases (adjusted OR 11.361; 95% CI 2.720 to 47.437, p=0.001), and hypertension (adjusted OR 3.373; 95% CI 0.971 to 11.708, p=0.055) as shown in Table 4.

Discussion

Osteoporosis-related fractures usually affect people over 50 years old and females rather than males. Distal radius, hip, proximal humerus, and vertebra are frequent positions of fracture[11]. Hip fractures tend to occur more frequently in elderly population[12,13]. Risk factors for first hip fracture have been well documented[14,15]. These include previous fracture at any site due to advanced age, low body weight, and low bone mineral density. Many patients who suffer a hip fracture remain untreated and have a high risk for a refracture, especially at a major site of osteoporotic fractures[6-8]. Therefore, the present study investigated which of the prognostic factors involved in the first hip fracture affected the occurrence of refractures in the post-surgical of first hip fracture patients.

The present study revealed that the average duration between the first hip fractures and the refracture was 22.2 months, which is shorter than the study of Wen-dong et al and Hsiao et al (3.7 years)[7,16]. The refracture occurred within one year after the first hip fracture accounting for about 43.1%, similar to the study in Taiwan (44.1%)[16]. The most location of refracture after the first hip fracture was hip region (58.7%), which conformed to the previous studies reporting the patients with hip fracture that the hip was the most common subsequent fracture[6,8]. Most of the patients were female in the refracture group, which agreed with the previous studies[7,8]. The patients over 85 years showed 2.67-fold greater risk for refracture compared to the younger in the previous studies[7,9].

The present study revealed that impaired vision due to eye diseases and impaired postural control due

Table 2. Demographic and clinical features of the two first hip fracture groups

Characteristic	Cases (n=58) (with refracture); n (%)	Controls (n=174) (without refracture); n (%)	p-value
Sex			
Male	13 (22.4)	62 (35.6)	0.042
Female	45 (77.6)	112 (64.4)	
Age (years)			
<85	49 (84.5)	163 (93.7)	0.054
≥85	9 (15.5)	11 (6.3)	
Mean±SD	75.7±9.7	72.9±9.6	0.067
Comorbid medical condition			
Hypertension	39 (67.2)	80 (45.9)	0.004
Eye diseases	16 (27.6)	25 (14.4)	0.021
Neurologic diseases	11 (18.9)	14 (8.0)	0.023
Benign prostatic hyperplasia	6 (10.3)	1 (0.6)	0.001
Respiratory diseases	4 (6.9)	11 (6.3)	0.543
Ischemic heart disease	3 (5.2)	1 (0.6)	0.049
Causes of fracture			
Falling from height (lesser than standing height)	2 (3.5)	3 (1.7)	0.367
Simple fall	56 (96.5)	171 (98.3)	
Prior fracture history			
No fracture	50 (86.2)	172 (98.8)	0.001
Fracture	8 (13.8)	2 (1.2)	
First hip fracture type			
Femoral neck	42 (72.4)	142 (81.6)	0.097
Intertrochanter	16 (27.6)	32 (18.4)	
Operative implant			
Hemiarthroplasty	49 (89.1)	166 (97.1)	0.027
Dynamic hip screw (DHS)	6 (10.9)	5 (2.9)	
Length of hospitalisation (days); mean±SD	11.4±5.7	11.7±5.7	0.756
Singh index (grade)			
4 to 6	11 (26.2)	74 (58.3)	0.001
1 to 3	31 (73.8)	53 (41.7)	
Lack of osteoporosis treatment after first hip fracture			
Calcium	17 (29.3)	55 (31.9)	0.439
Vitamin D	28 (48.3)	108 (62.1)	0.046
Bisphosphonate	57 (98.3)	171 (98.3)	0.686

SD=standard deviation

to neurologic diseases were common conditions found in refracture patients as shown in many studies[9,17].

Among comorbid medical conditions, hypertension was seen significantly more frequent in the refracture group, although no obvious statistical significance in multivariable analysis but it is possible that this condition still illustrates clinical significance in the refracture group. The present study revealed that all hip fracture patients with comorbid medical disease of hypertension received antihypertensive drugs, which can cause orthostatic hypertension that is considered one of the high risks for fall in older adults[18,19] and may cause subsequent refracture. Benign prostatic hyperplasia and ischemic heart disease were found more frequently in the refracture group. This may be due to orthostatic hypotension that caused fall and refracture. Orthostatic hypotension was a side effect of α-blockers and blood lowering

Table 3. Univariable analysis of factors associated with refractures

	Crude odds ratio	95% confidence interval		p-value
		Lower	Upper	
Sex				
Male	-	(Reference)		
Female	1.816	0.934	3.532	0.078
Age (years)				
<85	-	(Reference)		
≥85	2.676	1.049	6.825	0.039
Comorbid medical condition				
Benign prostatic hyperplasia	17.990	2.167	149.51	0.007
Ischemic heart disease	8.999	0.936	86.521	0.057
Neurologic diseases	2.715	1.132	6.508	0.025
Hypertension	2.420	1.295	4.524	0.006
Eye diseases	2.273	1.099	4.703	0.027
Respiratory diseases	1.095	0.330	3.536	0.879
Causes of fracture				
Falling from height	-	(Reference)		
Simple fall	0.434	0.058	3.250	0.417
Prior fracture history				
No fracture	-	(Reference)		
Fracture	12	2.548	56.508	0.002
First hip fracture type				
Femoral neck	-	(Reference)		
Intertrochanter	1.764	0.855	3.637	0.124
Operative implant				
Hemiarthroplasty	-	(Reference)		
Dynamic hip screw (DHS)	13.182	1.524	113.989	0.019
Length of hospitalisation (days)	0.991	0.940	1.045	0.756
Singh index (grade)				
4 to 6	-	(Reference)		
1 to 3	4.485	1.966	10.229	0.001
Lack of osteoporosis treatment after first hip fracture				
Calcium	0.893	0.461	1.731	0.739
Vitamin D	0.543	0.290	1.014	0.056
Bisphosphanate	1	0.104	9.613	1.000

Table 4. Multivariable analysis of factors associated with refractures

	Adjusted odds ratio	95% confidence interval		p-value
		Lower	Upper	
Prior fracture history	19.836	1.674	235.015	0.018
Singh index (grade) 1 to 3	8.082	2.535	25.766	<0.001
Eye diseases	11.361	2.720	47.437	0.001
Hypertension	3.373	0.971	11.708	0.055

drugs, which were commonly used in Benign prostatic hyperplasia and ischemic heart disease, respectively[19,20].

The surgical treatment with internal fixation (DHS) was found more significant in Group 1. The difficult walking after hip fixation resulted from weight bearing protection after surgery, which may cause fall and refracture in post-fixation hip fractures. This conformed to some papers mentioning the reduction of hip fracture risk after hip prosthesis[21]. The lack of osteoporosis treatments after the first hip fracture was the ignored problem of the most orthopedists and government, especially the lack of vitamin D supplement after the first hip fracture, which causes muscle dysfunction[22], can cause fall and subsequent refracture.

The present study also found an obvious relationship between the refracture and the prior fracture history including a lower Singh index (grade 3 or lower). The patients with prior fractures have an increased risk of future fracture as reported in many studies[6,8,23]. Many studies reported that the reliability of the Singh index can measure osteopenia and fracture risk of the hip[9,24,25]. The present study, thus, employed this tool for predicting the occurrence of refracture and showed a strong relationship between lower Singh index grades and the occurrence of refracture.

Limitations of the present study were a smaller number of sample size in some comorbid medical conditions, especially in hypertension that precluded the clearly identified statistical significance of this condition in refracture patients and the prospective evaluation of risk factors that may allow a greater degree of sensitivity in predicting the risk of refracture following index fractures.

Conclusion

The previous fracture history, a lower Singh index (grade 3 or lower) and eye disease were the prognostic factors of refractures in post-surgical hip fracture patients. Early detection of these factors can help identify high risk of the refracture group and improve the efficiency in targeting the prevention of refractures.

What is already known on this topic?

Risk factors of refracture after the first time of major osteoporosis fractures (vertebra, hip, distal radius or proximal humerus) were reported in many studies including old age, female sex, prior fracture at any site of major osteoporosis fractures, BMD T-score of less than –3.5, weakened motor skills, high Charlson Comorbidity Index (CCI) score, patients undergone osteoporotic fracture-related surgery, and used bone-related medications[6-8,16,23].

What this study adds?

Most studies were conducted in other countries. However, in Thailand, little is known about the risk factors of refracture after the first time of major osteoporosis fractures, especially the hip region. Therefore, this study aimed to investigate the risk factors of refracture after the first hip fracture in Thai elders. The results may assist health practitioners in designing appropriate interventions to reduce refracture among the elderly hip fracture patients, and eventually limit fracture-related healthcare costs in the future.

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Conflicts of interest

The authors declare no conflict of interest.

References

1. Magaziner J, Simonsick EM, Kashner TM, Hebel JR, Kenzora JE. Survival experience of aged hip fracture patients. Am J Public Health 1989;79:274-8.
2. Roos LL, Fisher ES, Sharp SM, Newhouse JP, Anderson G, Bubolz TA. Postsurgical mortality in Manitoba and New England. JAMA 1990;263:2453-8.
3. Wongtriratanachai P, Luevitoonvechkij S, Songpatanasilp T, Sribunditkul S, Leerapun T, Phadungkiat S, et al. Increasing incidence of hip fracture in Chiang Mai, Thailand. J Clin Densitom 2013;16:347-52.
4. Vaseenon T, Luevitoonvechkij S, Wongtriratanachai P, Rojanasthien S. Long-term mortality after osteoporotic hip fracture in Chiang Mai, Thailand. J Clin Densitom 2010;13:63-7.
5. Roobsoong A, Permyao J, Chantiratikul S. Clinical outcomes of peritrochanteric hip fracture in the intermediate postoperative care project between the regional and district hospitals in Chiang Rai province: preliminary comparative results. J Health Syst Res 2020;14:88-100.
6. Robinson CM, Royds M, Abraham A, McQueen MM, Court-Brown CM, Christie J. Refractures in patients at least forty-five years old. a prospective analysis of twenty-two thousand and sixty patients. J Bone Joint Surg Am 2002;84:1528-33.

7. Ruan WD, Wang P, Ma XL, Ge RP, Zhou XH. Analysis on the risk factors of second fracture in osteoporosis-related fractures. Chin J Traumatol 2011;14:74-8.
8. Toth E, Banefelt J, Åkesson K, Spångeus A, Ortsäter G, Libanati C. History of previous fracture and imminent fracture risk in swedish women aged 55 to 90 years presenting with a fragility fracture. J Bone Miner Res 2020;35:861-8.
9. Angthong C, Suntharapa T, Harnroongroj T. Major risk factors for the second contralateral hip fracture in the elderly. Acta Orthop Traumatol Turc 2009;43:193-8.
10. Singh M, Nagrath AR, Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. J Bone Joint Surg Am 1970;52:457-67.
11. Kanis JA, McCloskey EV, Johansson H, Strom O, Borgstrom F, Oden A. Case finding for the management of osteoporosis with FRAX--assessment and intervention thresholds for the UK. Osteoporos Int 2008;19:1395-408.
12. Keene GS, Parker MJ, Pryor GA. Mortality and morbidity after hip fractures. BMJ 1993;307:1248-50.
13. Anderson GH, Raymakers R, Gregg PJ. The incidence of proximal femoral fractures in an English county. J Bone Joint Surg Br 1993;75:441-4.
14. Cummings SR, Nevitt MC, Browner WS, Stone K, Fox KM, Ensrud KE, et al. Risk factors for hip fracture in white women. Study of Osteoporotic Fractures Research Group. N Engl J Med 1995;332:767-73.
15. Dargent-Molina P, Favier F, Grandjean H, Baudoin C, Schott AM, Hausherr E, et al. Fall-related factors and risk of hip fracture: the EPIDOS prospective study. Lancet 1996;348:145-9.
16. Hsiao PC, Chen TJ, Li CY, Chu CM, Su TP, Wang SH, et al. Risk factors and incidence of repeat osteoporotic fractures among the elderly in Taiwan: a population-based cohort study. Medicine (Baltimore) 2015;94:e532.
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. Juraschek SP, Simpson LM, Davis BR, Beach JL, Ishak A, Mukamal KJ. Effects of antihypertensive class on falls, syncope, and orthostatic hypotension in older adults: The ALLHAT trial. Hypertension 2019;74:1033-40.
19. Di Stefano C, Milazzo V, Totaro S, Sobrero G, Ravera A, Milan A, et al. Orthostatic hypotension in a cohort of hypertensive patients referring to a hypertension clinic. J Hum Hypertens 2015;29:599-603.
20. Sarasin FP, Louis-Simonet M, Carballo D, Slama S, Junod AF, Unger PF. Prevalence of orthostatic hypotension among patients presenting with syncope in the ED. Am J Emerg Med 2002;20:497-501.
21. Wiklund R, Toots A, Conradsson M, Olofsson B, Holmberg H, Rosendahl E, et al. Risk factors for hip fracture in very old people: a population-based study. Osteoporos Int 2016;27:923-31.
22. Bischoff-Ferrari HA, Dawson-Hughes B, Willett WC, Staehelin HB, Bazemore MG, Zee RY, et al. Effect of vitamin D on falls: a meta-analysis. JAMA 2004;291:1999-2006.
23. Klotzbuecher CM, Ross PD, Landsman PB, Abbott TA 3rd, Berger M. Patients with prior fractures have an increased risk of future fractures: a summary of the literature and statistical synthesis. J Bone Miner Res 2000;15:721-39.
24. Cooper C, Barker DJ, Hall AJ. Evaluation of the Singh index and femoral calcar width as epidemiological methods for measuring bone mass in the femoral neck. Clin Radiol 1986;37:123-5.
25. Masud T, Jawed S, Doyle DV, Spector TD. A population study of the screening potential of assessment of trabecular pattern of the femoral neck (Singh index): the Chingford Study. Br J Radiol 1995;68:389-93.