A Comparative Study of Risk Factors of Femoral Neck and Intertrochanteric Fracture in Thai Men

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Objective: *The objective of this study was to compare the risk factors related to hip fracture between intertrochanteric fracture and femoral neck fracture in Thai men.*
Material and Method: *The study was conducted in Bangkok and its vicinity from July 1997 to September 1998. The cases were recruited and matched with the controls by age and sex. Multilogit model was performed for finding the significant factors associated to each type of hip fracture.*
Results: *There were 73 femoral neck fractures, 144 intertrochanteric fractures, and 177 controls. It was found that both types of hip fracture were associated with the physical activity and the cerebrovascular accident. However, the Chinese parent race was significantly related to the femoral neck only (adjusted odds ratio (OR) 2.59, 95% confidence interval (CI): 1.21, 5.54) whereas the walking disability was specifically associated with the intertrochanteric fracture (adjusted OR 3.23, 95% CI: 1.29, 8.08).*
Conclusion: *Types of hip fracture should be concerned for strategic prevention in men since they have significant difference of risk factors.*

Keywords: *Femoral neck, Intertrochanter, Risk factors, Thai, Men*

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Although osteoporotic hip fractures in men were less common than women, its incidence is quite high especially in the elderly aged more than 85 years[1-4]. Most studies about hip fracture in men did not focus on each type of hip fracture[1-6] which was different in terms of incidence, age of onset, bone geometry, mechanism of injury, and management[7-12,13]. Intertrochanteric fracture has been double short-term mortality of femoral neck fracture[12,13]. Therefore, the risks of having hip fracture possibly varied according to its types[14,15].

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Lower in bone mineral density (BMD) of both upper and lower parts increased risk of intertrochanteric fractures[4] while lower in BMD of upper part of the femoral neck and longer hip axis length was a predictor of femoral neck fractures[9]. Other potential factors related to each type of hip fractures were age, race, body mass index (BMI), current calcium use, alcoholic consumption, smoking, and health status[3,5].

Several existing studies of risks were based on Caucasian women[13,16,18]. The application to men especially in our setting was limited. Even though Suriyawongpaisal et al has been studied the risk factors related to hip fracture in Thai men[5]. The types of fracture did not take into account. Therefore, the aim

of this study was to define risk factors related to each type of hip fractures in Thai men.

Material and Method

A sub-study of risk factors related to hip fractures in Thai men had been conducted from June 1, 1997 to May 31, 1998 in Bangkok and its vicinity[5]. It was approved by The Committee on Human Rights Related to Researches involving Human Subjects, Faculty of Medicine Ramathibodi Hospital and all included trauma centers.

The Cases consisted of male patients whose ages were $\geq$ 51 years old and were diagnosed as intertrochanteric or femoral neck fracture. All participants provided verbal informed consent and were admitted in orthopedic wards of 14 hospitals. Subtrochanteric fractures were not included in the study since it was highly suspected to cause by tumor. The diagnosis was confirmed by orthopedists and radiographs according to ICD-9 code 820.0-820.9. Exclusion criteria were pathological hip fracture from tumor; the sufficient trauma was defined as the accidents those force more than fall from standing, inability to cooperate and had no proxy respondents to interview.

The controls were the neighborhoods of the cases whose ages were $\geq$ 51 years old matched by sex and age ($\pm$ 5 years), and not being the direct relatives of the cases. The exclusion criteria of the controls were hip fractures, inability to cooperate and no proxy respondents to interview.

The major study factor was physical activity which had protective effect in previous literatures[5,6]. Physical activities were categorized into recent and past activities in order to represent the production of peak bone mass at present, and in the past, as respectively. The recent activities included walking, walking upstairs, walking on slope, walking with load, performing housework, and laborious work. Each activity was categorized into 4 levels; 0, 1, 2, $\geq$3 times per week. Recent activity scores were calculated from the summation of scores from all activities and were divided into three groups; inactive, active, and very active. For the past physical activity, scores were calculated from the levels of performing housework (1-2 scores), doing laborious work (1-4 scores), and sporting (1-2 scores) at the ages of 18-24, 25-50 years old, and more than the age of 50 years old. Then the scores were divided into thirtile groups.

Other study factors related to the hip fractures were the age, race, body mass index (BMI), 10-item Mental test score from the information/orientation section of the Clifton Assessment Procedure (MST score), pre-fracture status, history of falls in a previous year, calcium intake in 1-week period prior to fracture (milligram per day), substance use, alcohol, smoking, and underlying diseases. BMI was categorized into thirtile groups as low, medium, and high. Pre-fracture status was assessed by walking ability before hip fractures into three categories: independent (subjects could walk by themselves without any help), partially dependent (subjects could walk by themselves with some helps, gait aid or assistants), and totally dependent (subjects could not walk even with some help).

Data collection was composed of the diagnosis, operation, radiographs, weight and height; from the medical records and questionnaires. All data were sent to the central center of Ramathibodi Hospital, and were checked by two investigators (PS, PW) to control the quality of data for the completeness.

Statistical analysis

The continuous variables were described using means $\pm$ SD, and the categorical variables were described using frequencies and percentage. T-test and Chi-square test were used to compare the baseline characteristics between the groups of continuous and categorical variables, as respectively.

Univariate analysis compared between each type of fracture and controls was performed by using multinomial logit models in order to decrease type I error. Odds ratio (OR) and its 95% confidence interval (CI) of each variable were estimated. Variables that had p-value of less than 0.20 were considered as the potential confounding factors and were included in multivariate analysis.

The main exposure variables (physical activity, age, race, and BMI) were included in the multivariate analysis. The likelihood ratio (LR) test was used to select other variables into the model. The goodness of fit was tested on the parsimonious model using Hosmer-Lemeshow goodness of fit test. All analyses were performed using STATA version 7.0. The p-value of less than 0.05 was considered as the statistical significance.

Sample size

The sample size was calculated based on the data of this study. As alpha error (0.05), the power of the study (0.8), the proportion of having active physical activity was 0.25 among femoral neck fractures, 0.22 among intertrochanteric fractures, and 0.6 among

the controls. The sample size estimation by Power and Sample Size Program 3.0 (Vandebilt) was respectively as 30 and 25.

Results

Five-hundred and fifty men were recruited but only 394 men were eligible in this study. There were 73 femoral neck fractures, 144 intertrochanteric fractures, and 177 controls. The average age was 69.8 ± 8.7 years old. Seventy percents of them had Thai parent race, and the rests were Chinese parent race. For the hip fracture, 86.3% of the femoral neck fracture and 51.7% of intertrochanteric fracture fell on the ground before getting fracture. Both fractures were found in men with nearly the same age. But the left side of the hip (53.5%) was slightly more predominate than the right side. Most of them underwent the surgical treatment for hip fracture (83.6% of femoral neck, and 87.7% of intertrochanter).

The demographic baseline characteristics of men included in this study were shown in Table 1. Intertrochanteric fracture group had slightly higher BMI than the femoral neck fracture group. Normal range of the Mental status score (more than 90%) was found in all groups except the intertrochanteric fracture (88.6%).

According to the physical activity, the controls had the highest proportion of independent walking ability and respectively followed by the femoral neck fracture, and the intertrochanteric fracture. Intertrochanteric fracture group was more active in recent physical activity, but was less active in past physical activity than the femoral fracture (Table 2). As the controls were physically active comparing to the other groups, the history of fall, number of falls in a previous year, and history of fracture were lower than the other groups (Table 2).

The distribution of smokers was highest in controls and respectively followed by the femoral neck fracture and the intertrochanteric fracture. The average smoking was 24.6 ± 30.6 pack per year in the controls compared to 19.3 ± 24.9 pack per year in the intertrochanteric fracture group. According to alcohol, the femoral neck fracture group became the highest level of intake and respectively followed by the intertrochanteric group, and the controls (Table 3). The distribution of calcium intake was highest in the controls and was lowest in the femoral neck fracture (Table 3).

The univariate analysis demonstrated that the race, the past and recent physical activity, the history of falls, the history of fractures, smoking, alcohol consumption, calcium intake, diuretics, sedatives, antihistamine, steroid-containing traditional medicine, and cerebrovascular disease (CVA). These factors were kept into the mutivariate analysis.

The multivariate analysis was performed by using the multinomial logit model at order to compare each type of fracture to control group at the same time. Factors related to the femoral neck fracture comparing to the reference groups after controlling for other factors were Chinese race [adjusted odds ratio (OR) 2.59 (95% CI 1.21-5.54)], active in recent physical activity [adjusted OR 0.20 (95% CI 0.07-0.54)], active in past physical activity [adjusted OR 0.30 (0.13-0.67)], very active in past physical activity [adjusted OR 0.03

Table 1. Demographic data

Characteristics	Femoral neck (%) n = 73	Intertrochanteric (%) n = 114	Controls (%) n = 177
Age (year) (mean ± SD)	71.6 ± 9.6	71.1 ± 10.0	69.8 ± 8.7
Race			
Thai	42 (57.5)	73 (64.0)	127 (71.7)
Chinese	31 (39.0)	41 (36.0)	50 (28.3)
BMI (kg/m^2) (mean ± SD)	21.8 ± 3.1	22.0 ± 3.6	22.4 ± 3.8
Low	19 (26.0)	31 (27.2)	52 (29.4)
Medium	24 (32.9)	29 (25.4)	48 (27.1)
High	30 (40.1)	54 (47.4)	77 (43.5)
Mental status (MST score)			
≥7	68 (93.1)	101 (88.6)	170 (96.0)
<7	5 (6.9)	13 (11.4)	7 (4.0)

Table 2. Physical activities and falls by types of hip fractures

Characteristics	Femoral neck (%) n = 73	Intertrochanteric (%) n = 114	Controls (%) n = 177
Walking activity before hip fracture			
Independent	54 (74.0)	77 (67.5)	164 (92.7)
Partially dependent	18 (24.7)	36 (31.6)	10 (5.6)
Totally dependent	1 (1.4)	1 (0.9)	3 (1.7)
Total recent activity score (mean ± SD)	4.6 ± 3.7	4.8 ± 4.1	7.6 ± 3.7
Inactive	55 (75.3)	84 (73.7)	67 (37.8)
Active	9 (12.3)	18 (15.8)	70 (39.5)
Very active	9 (12.3)	12 (10.5)	40 (22.6)
Total past activity scores (mean ± SD)	17.2 ± 2.2	16.8 ± 2.3	19.8 ± 3.1
Inactive	54 (74.0)	88 (77.2)	65 (34.5)
Active	17 (23.3)	23 (20.2)	59 (33.9)
Very active	2 (2.7)	3 (2.6)	53 (31.6)
Ever fall in a previous year	25 (34.2)	32 (28.1)	25 (14.1)
No. of fall in a previous year (median, range)	2 (1-7)	2 (1-10)	2 (1-5)
History of fracture	6 (8.2)	14 (12.3)	8 (4.5)

Table 3. Substances, drugs used, and underlying diseases according to types of hip fractures

Characteristics	Femoral neck (%) n = 73	Intertrochanteric (%) n = 114	Controls (%) n = 177
Smoking			
Non-smoker	17 (23.3)	41 (36.0)	62 (35.0)
Ex-smoker	36 (49.3)	54 (47.4)	54 (30.5)
Current smoker	20 (27.4)	19 (16.7)	61 (34.5)
Alcohol consumption			
Non-drinker	32 (43.8)	60 (52.6)	119 (67.2)
Drinker	41 (56.2)	54 (47.4)	58 (32.8)
Calcium intake (mg/day)	244.0 ± 470.5	213.8 ± 338.6	108.0 ± 269.3
Low	21 (28.8)	38 (33.3)	59 (33.3)
Medium	28 (38.4)	42 (36.8)	59 (33.3)
High	24 (32.9)	34 (29.8)	59 (33.3)
Diuretics	9 (13.2)	12 (10.8)	4 (2.3)
Sedatives	11 (16.2)	9 (8.3)	3 (1.7)
Steroid	1 (1.6)	0	0
Antihypertensives	20 (28.6)	26 (23.4)	36 (20.4)
Thyroid drug	2 (2.9)	0	0
Anticonvulsant	1 (1.4)	4 (3.6)	0
Antihistamine	9 (13.2)	5 (4.5)	1 (0.6)
Steroid-containing traditional medicine	7 (10.1)	2 (1.8)	5 (2.8)
Hypertension	35 (47.9)	41 (36.0)	49 (27.7)
CVA	15 (20.5)	21 (18.4)	3 (1.7)
DM	15 (20.5)	24 (21.0)	24 (13.6)
Thyroid	2 (2.7)	2 (1.7)	0
Kidney disease	3 (4.1)	12 (10.5)	3 (1.7)
Parkinsonism	2 (2.7)	3 (2.6)	0
Cancer	2 (2.7)	4 (3.5)	4 (2.3)
Malabsorption	5 (6.8)	7 (6.1)	4 (2.3)
Heart diseae	9 (12.3)	4 (3.5)	7 (3.9)

Table 4. Multivariate analysis of factors related to each type of hip fracture

Variable	Femoral neck vs. controls		Intertrochanteric vs. controls	
	OR[a] (95% CI)	p-value	OR[a] (95% CI)	p-value
Race				
Thai*				
Chinese	2.59 (1.21-5.54)	0.014[#]	1.72 (0.90-3.32)	0.100
Recent activity				
Inactive*				
Active	0.20 (0.07-0.54)	0.002[#]	0.33 (0.15-0.70)	0.004[#]
Very active	0.41 (0.13-1.32)	0.138	0.63 (0.26-1.52)	0.310
Past activity				
Inactive*				
Active	0.30 (0.13-0.67)	0.004[#]	0.27 (0.13-0.54)	<0.001[#]
Very active	0.03 (0.00-0.27)	0.002[#]	0.05 (0.01-0.19)	<0.001[#]
Calcium intake				
Low*				
Medium	0.50 (0.20-1.26)	0.145	0.90 (0.42-1.93)	0.802
High	1.11 (0.47-2.62)	0.800	1.42 (0.67-3.02)	0.355
Walking activity before hip fracture				
Independent*				
Partially dependent	1.75 (0.61-5.05)	0.296	3.23 (1.29-8.08)	0.012[#]
Totally dependent	0.24 (0.01-5.51)	0.378	0.15 (0.01-3.15)	0.228
CVA	19.79 (3.68-106.23)	<0.001[#]	18.01 (3.66-88.66)	<0.001[#]
Sedatives	4.39 (0.95-20.17)	0.057	2.26 (0.50-10.08)	0.283
Antihypertensive	0.45 (0.17-1.17)	0.105	0.46 (0.20-1.05)	0.067
Antihistamine	9.41 (0.92-95.76)	0.058	4.98 (0.48-51.77)	0.178
Steroid-containing traditional medicine	3.54 (0.57-21.74)	0.172	0.51 (0.06-3.92)	0.523

[a]Multivariate analysis included age and BMI
*Reference group
[#]p-value < 0.05

(95% CI 0.00-0.27)], and CVA [adjusted OR 19.79 (95% CI 3.68-106.23)] (Table 4). Factors related to the intertrochanteric fracture comparing to the reference groups were active in the recent physical activity [adjusted OR 0.33 (95% CI 0.15-0.70)], active in past physical activity [adjusted OR 0.27 (95% CI 0.13-0.54)], very active in past physical activity [adjusted OR 0.05 (95% CI 0.01-0.19)], partially dependent in walking activity before hip fracture [adjusted OR 3.23 (1.29-8.08)], and CVA [adjusted OR 18.01 (3.66-88.66)] (Table 4).

These results revealed the dose-response relationship of the past physical activity in both types of fracture. Chinese race was associated with the femoral neck fracture while the walking ability before hip fracture was specifically associated with the intertrochanteric fracture. Age, BMI, calcium intake, and drugs did not show the significant association with both types of hip fracture.

After concerning the proxy respondents, the results did not differ from the non-proxy respondent model.

Discussion

Physical activity and CVA were equally protectively associated with both types of hip fracture in men. Chinese parent race increased the risk of femoral neck fracture about 2.6 times compared to Thai parent race, whereas partially dependent in walking activity before hip fracture increased the risk of intertrochanteric fracture about 3 times comparing to the reference group. BMI, calcium intake, and drug use were not statistically related to any type of hip fracture. The results were not consistent with those of women[13,16,17] which was determined that the intertrochanteric fractures were older and thinner while the femoral neck fractures were more likely to

have functional impairment and had history of steroid use[3]. Genetic variability such as estrogen receptor, which differs among race, may explain the different effects.

The study of hip geometry found that the hip axis length (HAL) and the femoral neck angle were longer and higher in Americans than in Japanese[19]. According to the racial difference, Chinese race may have long femoral axis length, lower BMD, and/or wider femoral neck length leading to the femoral neck fracture[20,21].

Partially dependent in walking led to decrease load on bone and then decreased bone mass, especially in cancellous bone[16,20]. So it could affect more intertrochanteric fracture. Totally dependent walking ability did not increase the intertrochanteric fracture because the bed-ridden subjects could not move themselves resulting in decreasing the risk of falls.

Even though the results could bring some ideas about the risk and preventive factors of these types of hip fractures, this study has some limitations. Most of data were based on the interview and medical records. Therefore the recall bias, measurement and ascertainment bias could not be avoided. However, standardized questionnaire, and pictures of calcium-containing food were used to reduce those biases. Some important factors such as BMD, and bone geometry did not include in this study due to limitation of budget so they were possibly confounders.

Conclusion

The comparison between factors related to each type of hip fracture was shown that the physical activity was an important protective factor in both types of fractures. Men can specifically reduced the intertrochanteric fracture by preventing the diseases causing walking disability. However, the femoral neck fracture which was associated with the Chinese parent race may need further study than could be genetic engineering, bone geometry i.e. hip axis length, femoral neck width, and femoral neck angle. Strategic planning for the hip fracture prevention should be specified by the type of fracture and exploring genetic epidemiology combined with the geometry of the femoral neck, might enlighten the effective way of prevention.

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การศึกษาเปรียบเทียบปัจจัยเสี่ยงของการเกิดภาวะการหักของกระดูกคอสะโพกและกระดูกสะโพกส่วนต้นในชายไทย

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วัตถุประสงค์*: การศึกษานี้มีวัตถุประสงค์เพื่อเปรียบเทียบปัจจัยเสี่ยงต่อการหักของกระดูกคอสะโพก และกระดูกสะโพกส่วนต้นในชายไทย*

วัสดุและวิธีการ*: ทำการศึกษาในกรุงเทพมหานครและปริมณฑลระหว่าง เดือนกรกฎาคม พ.ศ. 2540 ถึง กันยายน พ.ศ. 2541 ด้วยการรวบรวมผู้ป่วยที่มีกระดูกหักและจับคู่กับกลุ่มควบคุมโดยอายุและเพศ วิเคราะห์หาความสัมพันธ์ระหว่างปัจจัยเสี่ยงกับชนิดการหักของกระดูกสะโพกหักโดยใช้ multilogit model*

ผลการศึกษา*: ผู้เข้าร่วมวิจัยมีภาวะกระดูกคอสะโพกหัก 73 ราย กระดูกสะโพกส่วนต้นหัก 144 รายและกลุ่มควบคุม 177 ราย พบว่ากระดูกสะโพกหักทั้งสองชนิดสัมพันธ์กับการออกกำลังกาย และโรคหลอดเลือดสมอง (cerebrovascular accident) อย่างไรก็ดีการหักของกระดูกคอสะโพกมีความสัมพันธ์ เฉพาะกับเชื้อชาติจีน ในขณะที่การหักของกระดูกสะโพกส่วนต้นสัมพันธ์กับการเดินผิดปกติ*

สรุป*: การวางแผนป้องกันการหักของกระดูกสะโพกในผู้ชาย ต้องคำนึงถึงชนิดของการหักเนื่องจากมีปัจจัยเสี่ยงแตกต่างกัน*