Bone Mineral Density Differences in Hip Fractures of the Elderly

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Purpose: *To evaluate the differences in bone mineral density (BMD) between the fracture and non-fracture sides in cases of femoral neck and intertrochanteric fractures in elderly.*
Methods: *A cross-sectional study in elderly patients admitted to Maharat Nakhonratchasima Hospital between March 1, 2012 and September 30, 2012. Each had a diagnosis of femoral neck or intertrochanteric fracture. After applying inclusion and exclusion criteria, one hundred patients were included. All answered the fracture risk assessment tool. BMD was measured by Dual energy X-ray absorptiometry prior to surgery. Data was analyzed statistically.*
Results: *Demographic data from the fracture groups, mean age, and body mass index displayed no statistical differences. BMD measurements were higher on the fracture side than on the non-fracture side and statistically different in nearly all areas of the hip. BMD measurements produced statistical differences in some areas when comparison was made between fracture groups, and between genders. The BMD in males was not statistically different between the femoral neck and intertrochanteric fracture groups, and between the fractured and non-fractured sides.*
Conclusion: *Overall the BMD was statistically different between the fracture and non-fracture sides. In addition, the BMD was not statistically different between the femoral neck fracture and intertrochanteric fracture groups in some areas.*

Keywords: *Bone mineral density, femoral neck fracture, intertrochanteric fracture*

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Introduction

Thailand's elderly population has increased, as has the prevalence and incidence of osteoporosis and osteopenia in both genders[1-7]. Osteoporosis is the leading risk factor for fractures, mortality rate[8-12], increased budget expense[13], decreased daily activities, and quality of life[14]. The World Health Organization defines the diagnosis of osteoporosis by bone mineral density (BMD), determined by Dual energy X-ray absorptiometry[15,16], and uses the fracture risk assessment tool (FRAX ®) to evaluate fracture risk[17,18]. There are reports that BMD is higher in femoral neck than in intertrochanteric fractures in all age groups[19-21], but was not statistically significant in age groups (p 0.44), in gender between hip fracture and control groups (non-fracture) (p 0.61), in total BMD (p 0.16), and in the greater and lesser trochanter areas. BMD values between femoral neck fracture and non-fracture groups were (p 0.59) and (p 0.21) respectively. Statistical significance was noted in the BMD of the greater trochanter area compared with the neck of the femur and the neck area, and between femoral neck fracture and non-fracture groups[22].

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Gnudi et al. studied BMD in post-menopausal women, and reported that the BMD difference was statistically significant between hip fracture and non-fracture (control) groups, intertrochanteric fracture and controlled non-fracture groups, but not statistically significant between femoral neck fracture and non-fracture groups[23].

The Orthopaedic Department of Maharat Nakhonratchasima Hospital admitted 689 cases of elderly hip fracture in 2011, of whom 421 underwent surgery. There are no previous studies of BMD in Thai hip fracture patients, and few overseas studies. This study will present BMD differences between two groups: femoral neck fracture and intertrochanteric fracture groups, between the fracture and non-fracture sides, and between males and females.

Materials and Methods

The Maharat Nakhonratchasima Hospital Institutional Review Board approved this study. It is cross–sectional, and included 100 patients admitted to the Orthopaedic Department, Maharat Nakhonratchasima Hospital from March 1, 2012 to September 30, 2012. Included were patients diagnosed with intertrochanteric or femoral neck fracture, who accepted admission to the study, who gave informed consent, and whose age was greater than 50 years. Exclusion criteria included previous

implantation in a different hip fracture, pathological fracture from cancer**,** cardiovascular aneurysm or previous stroke, and sero-positive for HIV antibody. All patients and/or close relatives answered the FRAX ® tool questionnaire, and BMD was measured shortly after admission prior to definitive surgical treatment. All patients were examined in the supine position with skin traction, without further manipulation. The hip area BMD alone was measured; the spine and wrist areas were not examined. BMD was measured by a single radiological technologist using a Hologic, Discovery W model (serial #81497). Data was analyzed using mean, standard deviation, chi-square test, and unpaired Student's t-Test. Statistical significance was accorded when $P<0.05$.

Table 1 Demographic data

Data	Femoral neck fracture group	Intertrochanteric fracture group	
Number (Cases)	47	53	
Age Range (years)	55-92	54-89	
Average age ± SD	74.3 ± 8.8	77.0 ± 8.1	*P*-value 0.1165
Left / Right side (Cases)	28 / 19	29 / 24	
Male / Female (Cases)	10 / 37	19 / 34	
Body mass index (BMI) (kg/m^2) Mean ± SD	21.2 ± 6.2	20.5 ± 8.3	*P*-value 0.6602

Results

Table1 shows patient data for both groups, with no statistical significance in average age, or body mass index. Male patients were fewer than female, as previously reported in Thailand[5]. Males suffered fewer fractures than did females, and the left side predominated in both groups. Falls are the most common cause of fracture, also reported previously[24]. Thirty-three cases in the femoral neck fracture group resulted from falls and four were idiopathic. Falls caused all fractures in the intertrochanteric group. Duration of symptoms prior to admission ranged from 1-40 days with an average of 9.48 days (SD ± 6.94) in the femoral neck group, and from 1-12 days with an average of 2.36 days (SD ± 1.98) in the intertrochanteric group. Using the Chi–square test, subgroups were evaluated for BMD versus duration of symptoms. No statistical differences were uncovered.

The FRAX ® tool questionnaire data indicated that each group included three cases of previous wrist fracture from falls. There were two cases of hip fracture in parents in the former group but no cases in the latter group. Glucocorticoid usage was found five cases in the former, and six in the latter group. Also found were current tobacco usage: 9 cases in the former group and 10 cases in the latter group; and alcohol consumption 13 and 9 cases. Rheumatoid arthritis occurred in only one case (interfrochanteric group). There were no cases of previous gynecological surgery, chemotherapy for breast cancer, malabsorption syndrome, chronic liver disorders, organ transplant, diabetes mellitus type 1, or osteogenesis imperfecta in either group. Secondary osteoporosis from premature menopause: 4 cases in the former group and 3 cases in the latter group. Gastrointestinal problems: three cases in each group. Common comorbidity diseases: hypertension 20/24 cases, diabetes mellitus 8/11 cases. Thus the difference between the two groups was minimal.

Table 2 Comparison of BMD by fracture area, and by side (fracture and non-fracture)

	Femoral neck fracture group		Intertrochanteric fracture group		*P*-value			
Area	Fracture side (A)	Non-fracture side (B)	Fracture side (C)	Non-fracture side (D)	(A) vs (B)	(A) vs (C)	(C) vs (D)	(B) vs (D)
Neck	0.5±0.16	0.47±0.14	0.45±0.16	0.45±0.13	0.0167	0.0156	0.5900	0.3794
Troch	0.45±0.12	0.40±0.10	0.47±0.13	0.37±0.10	0.0004	0.3052	0.0000	0.1086
Inter	0.80±0.22	0.70±0.18	0.89±0.25	0.69±0.20	0.0001	0.0636	0.0000	0.7829
Total	0.68±0.17	0.58±0.16	0.73±0.20	0.56±0.15	0.0000	0.2210	0.0000	0.5777
Ward	0.54±0.20	0.31±0.16	0.42±0.21	0.28±0.12	0.0000	0.0071	0.0000	0.3337

Note – Mean±Standard Deviation

In both fracture groups, the average BMD on the fracture side was higher than the non-fracture side with statistically significance at all areas except the neck area of the intertrochanteric fracture group. Comparison between the fracture groups yielded a statistically significant difference in the neck and ward area on the fracture side, but no statistical significance at trochanter, intertrochanter and total area on the fracture side, and all areas on the non-fracture side.

Table 3 Comparison of BMD by fracture area and by side in male

	Femoral neck fracture group		Intertrochanteric fracture group		*P*-value			
Area	Fracture side (A)	Non-fracture side (B)	Fracture side (C)	Non-fracture side (D)	(A) vs (B)	(A) vs (C)	(C) vs (D)	(B) vs (D)
Neck	0.58±0.13	0.56±0.15	0.54±0.17	0.51±0.16	0.6489	0.4720	0.3141	0.3778
Troch	0.58±0.12	0.48±0.12	0.56±0.13	0.44±0.11	0.0561	0.6381	0.0004	0.3062
Inter	1.05±0.20	0.87±0.20	1.09±0.28	0.86±0.19	0.0086	0.7084	0.0003	0.9361
Total	0.87±0.17	0.71±0.21	0.88±0.22	0.69±0.15	0.0562	0.8827	0.0002	0.6796
Ward	0.68±0.20	0.42±0.24	0.52±0.22	0.32±0.14	0.0449	0.0691	0.0019	0.1543

Looking at the male subgroup alone, the BMD of both fracture groups displayed higher values on the fracture side. These were statistically significant different in the intertrochanteric and ward areas of the femoral neck fracture group and in nearly all areas, except in the neck of the intertrochanteric fracture group. There was no statistical significance when comparing the fracture groups in all areas, both on the fracture and the non-fracture sides.

Table 4 Comparison of BMD by fracture area and by side in female

	Femoral neck fracture group		Intertrochanteric fracture group		*P*-value			
Area	Fracture side (A)	Non-fracture side (B)	Fracture side (C)	Non-fracture side (D)	(A) vs (B)	(A) vs (C)	(C) vs (D)	(B) vs (D)
Neck	0.52±0.16	0.43±0.11	0.41±0.13	0.41±0.09	0.0043	0.0024	0.8091	0.3326
Troch	0.41±0.10	0.38±0.09	0.43±0.11	0.33±0.07	0.0015	0.4996	0.0000	0.0097
Inter	0.73±0.17	0.66±0.15	0.77±0.15	0.60±0.13	0.0023	0.2376	0.0000	0.0751
Total	0.63±0.14	0.54±0.12	0.64±0.13	0.49±0.10	0.0000	0.7189	0.0000	0.0571
Ward	0.50±0.18	0.28±0.12	0.37±0.18	0.26±0.11	0.0000	0.0048	0.0008	0.5251

In the female subgroup, the BMD of both fracture groups was higher on the fracture side, a result similar to that found in males (table3). There were statistically significant differences in all areas on the fracture side, neck and ward area on the non-fracture side of the femoral neck fracture group and nearly all areas, except the neck on the fracture side, and the inter area on the non-fracture side of intertrochanteric fracture group.

Table 5 Comparison of BMD by fracture area and by side (both genders)

	P-value			
	Femoral neck fracture group		Intertrochanteric fracture group	
Area	Fracture side (Male vs Female)	Non-fracture side (Male vs Female)	Fracture side (Male vs Female)	Non-fracture (Male vs Female)
Neck	0.2468	0.4072	0.0024	0.0056
Troch	0.0000	0.0030	0.0004	0.0000
Inter	0.0000	0.0007	0.0000	0.0000
Total	0.0000	0.0015	0.0000	0.0000
Ward	0.0104	0.0127	0.0132	0.1180

BMD comparison between genders were statistically significant in nearly all areas. Exceptions were the neck area in femoral neck fracture group on both sides, and the ward area of the intertrochanteric fracture group on the non-fracture side.

Discussion

BMD comparison between fracture groups for both genders, displayed statistically significant differences at the neck and ward of the femoral neck fracture group, with no statistical significant difference in other areas, nor in any area of the intertrochanteric fracture group. Chi-Chuan Woo[22] reported statistically significant differences in the greater trochanter area, but none in the total, lesser trochanter, and neck areas. BMD comparison between fracture groups (separating the genders) yielded no areas of statistical significance within the male subgroup in both the fracture and non-fracture side. However, BMD in the female subgroup did show statistical significance in some areas. Susan L et al. reported that trochanteric BMD was 13% lower in women and 11% lower in men for those patients with trochanteric fractures, compared to those with femoral neck fracture ($P < 0.01$)[25].

Comparison between the fracture and non-fracture sides yielded a mean BMD that was higher in the former group in all areas. Both fracture groups and both genders displayed statistical significance in nearly all of the areas in the overall trend. This is contrary to the study of Jacqueline R et al.[26] which showed that femoral neck bone density was lower in subjects with hip fractures when compared with non-fracture subjects (p-Value 0.0001). Chi-Chuan Woo[22] reported that the BMD of both groups were lower on the fracture side than non-fracture side in total, greater and lesser trochanter, and neck areas.

Comparison between genders confirmed higher mean BMD values in males, and there were statistically significant in nearly all areas, between fracture and non-fracture sides, and between fracture groups. This finding is similar to that of many others [3,7,25]. Jane A. Cauley et al. reported a study in women in which the BMD was found to be lower in a femoral neck fracture group than in an intertrochanteric fracture group. Both results were statistically significant compared to a control (no-fracture group)[26]. Male BMD measurements between femoral neck and intertrochanteric fracture groups were not statistically significant in our study. Because number of male sample in this study was small, results should be used with caution.

There are limitations to this study: few studies available for review, the number of appropriate cases, short period of BMD examination prior to definitive surgical treatment, available radiological support, and the small number of prior studies. An increased number of reports, on larger populations would yield information of greater validity.

Conclusion

Overall, the BMD was statistically significant between the fracture and non-fracture sides and in some areas between the femoral neck and intertrochanteric fracture groups.

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ความแตกต่างของค่าความหนาแน่นของมวลกระดูกในผู้ป่วยสูงอายุที่มีกระดูกสะโพกหักที่ส่วนคอและระหว่างโทรแคนเตอร์

สุรัตน์ ส่งวิรุฬห์, พบ, สม (บริหารสาธารณสุข)

วัตถุประสงค์: *เพื่อศึกษาความความแตกต่างของค่าความหนาแน่นของมวลกระดูกบริเวณสะโพกระหว่างข้างที่หักและไม่หักในผู้ป่วยสูงอายุที่มีกระดูกสะโพกหัก*

วัสดุและวิธีการ: *เป็นการศึกษาแบบการสำรวจ โดยวิธีเลือกผู้ถูกสำรวจเพื่อให้ได้สถิติคล้ายคลึงกับการสำรวจพลเมืองทั้งหมด ในผู้ป่วยสูงอายุที่มานอนรักษาตัวที่โรงพยาบาลมหาราชนครราชสีมา ระหว่างวันที่ 1 มีนาคม พ.ศ.2555 ถึงวันที่ 30 กันยายน พ.ศ.2555 ซึ่งได้รับการวินิจฉัยว่ามีกระดูกสะโพกหักที่ส่วนคอและระหว่างโทรแคนเตอร์ จำนวน 100 รายซึ่งกำหนดเกณฑ์เข้าร่วมและคัดออกไว้ ผู้ที่เข้าร่วมการศึกษาทุกรายได้ตอบแบบสอบถามตามเครื่องมือประเมินความเสี่ยงกระดูกหักและรับการตรวจค่าความหนาแน่นของมวลกระดูกบริเวณสะโพกด้วยเครื่องตรวจวัดมวลกระดูกก่อนรับการรักษาด้วยการผ่าตัด นำข้อมูลที่ได้มาวิเคราะห์ทางสถิติ*

ผลการศึกษา: *ลักษณะข้อมูลพื้นฐานระหว่างบริเวณกระดูกที่หัก อายุเฉลี่ย ดัชนีมวลกาย ไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ค่าความหนาแน่นของมวลกระดูกบริเวณสะโพกข้างที่หักมีค่าเฉลี่ยสูงกว่าข้างที่ไม่หัก โดยมีความแตกต่างอย่างมีนัยสำคัญทางสถิติเกือบทุกตำแหน่ง และมีความแตกต่างอย่างมีนัยสำคัญทางสถิติในบางตำแหน่งเมื่อเปรียบเทียบระหว่างกลุ่ม ตำแหน่งที่หัก และเพศ ในเพศชายไม่มีความแตกต่างอย่างมีนัยสำคัญทางสถิติค่าความหนาแน่นของมวลกระดูกทุกตำแหน่งเมื่อเปรียบเทียบระหว่างกลุ่มของข้างที่หักและข้างที่ไม่หัก*

สรุป: *ค่าความหนาแน่นของมวลกระดูกมีความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างข้างที่หักและไม่หักในภาพรวม*