Similarity of Bone Mass Measurement among Hip, Spines and Distal Forearm

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Abstract

From January - December 1995, bone mineral density (BMD) of lumbar spine, hip and distal forearm were studied in 325 healthy women visiting the menopause clinic, Chulalongkorn Hospital. This retrospective analysis was conducted to assess the correlation of BMD among various measurement sites. Bone mass measurement at hip and spine were performed utilizing dual energy X-ray absorptiometer (DEXA), Hologic QDR 2000 and at distal forearm by single energy X-ray absorptiometer (SEXA), Hologic DTX 100. By canoconical correlation, the results revealed a significant correlation of BMD of distal and ultra-distal part of forearm with various sites of hip ($r = 0.602$, $p<0.001$). There was also significant correlation of distal and ultra-distal part of forearm with various sites of spines ($r=0.619$, $p<0.001$). Though there is some heterogeneity of bone mass density among different measurement sites, practically with this fairly good level of correlation, bone mass measurement of distal forearm might be used to predict the BMD of hip and spine in Thai women. The accuracy of predicting the BMD of hip and spine by BMD of distal forearm in the mass screening programme in Thailand is now going on. The results will be followed.

Osteoporosis exacts a huge toll in suffering and health care costs, hip fractures are the most serious and costly outcome of this process(1). Low bone mass is a major determinant of osteoporotic fracture, and its measurement is a predictor of subsequent fracture(2). Bone mass measurement can be measured safely, accurately and precisely by bone densitometry, particularly dual energy X-ray absorptiometer(3-5).

The distal forearm BMD measurement by Single energy X-ray absorptiometer (SEXA) is easy to perform and the machine is smaller and less expensive than BMD measurement by Dual energy X-ray absorptiometer (DEXA). But the predictive value of distal forearm to spine and hip is controversial. There are few reports about the correlation of BMD between the distal forearm and hip or spine(6-8). Up to now there is no data in an Asian

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population. Hence, the aim of this study is to assess the correlation among various measurement sites of distal forearm, hip and spine in women attending the menopause clinic, Chulalongkorn Hospital.

MATERIAL AND METHOD

Three hundred and twenty five healthy women visiting the menopause clinic, Chulalongkorn Hospital from January to December 1995 were recruited for the analysis. Bone mass measurements of hip and spine were performed utilizing dual energy X-ray absorptiometer (DEXA), Hologic QDR 2000 and at distal forearm by Single energy X-ray absorptiometer (SEXA), Hologic DTX 100. A standard region of measurement, including lumbar spines (LS : L1-4) was scanned. Patients with severe osteoarthritic changes or compression of vertebrae were excluded from the study. Bone mineral density (BMD) of hip, comprising BMD of femoral neck, trochanter, intertrochanter, Ward's triangle and total hip, was measured at the nondominant side. BMD of distal forearm; comprising BMD of distal and ultra distal part of forearm, was measured at the non dominant side. Results are expressed in grams of ashed bone per unit area of bone scanned (gram per square centimetre, gm/cm^2). The correlation of BMD among various measurement sites was analysed using linear regression analysis and canoconical correlation.

RESULTS

The mean age, height, weight and body mass index (BMI) are shown in the Table 1. The correlation of BMD of distal forearm and hip is shown in Table 2. By Canoconical correlation analysis, significant correlation between distal forearm and hip is noted with r=0.602 and p<0.001. The correlation of BMD of distal forearm and spine is shown in Table 3. By canoconical correlation analysis, significant correlation between distal forearm and spine is noted with r = 0.619 and p<0.001. The correlation of BMD of Hip and Spine is shown in Table 4. By Canoconical correlation analysis, significant correlation between hip and spine is noted with r=0.7418 and p<0.001.

Table 1. Patients characteristic (N=325).

Characters	Mean±SD
1. Age (year)	51.57±6.62
2. Height (cm)	154.48±4.93
3. Weight (Kg)	57.30±8.90
4. BMI	23.94±3.78

DISCUSSION

Regarding pathophysiology of fracture, there are two main causes i.e. falls and a reduction in bone mass which leads to increase bone fragility[9,10]. Measurement of bone mass and several other skeletal characteristics that can effectively identify women at high risk of fractures, are now widely available. Other clinical risk indicators, however, do not seem to provide equivalent information for prediction of osteoporosis and fracture as bone densitometer. The value of distal forearm BMD measurement to predict BMD of spine and hip is questionable[6-8].

Table 2. The correlation of BMD of distal forearm and hip at various measurement sites.

Correlations	Distal	Ultra	Neck	Troch	Inter	Total	Ward
Distal	1.0000	0.8367*	0.5547*	0.5341*	0.5496*	0.5755*	0.5988*
Ultra	0.8367*	1.0000	0.6125*	0.6089*	0.5635*	0.6114*	0.6544*
Neck	0.5547*	0.6125*	1.0000	0.8055*	0.8090*	0.8718*	0.8805*
Troch	0.5341*	0.6089*	0.8055*	1.0000	0.8453*	0.9171*	0.8272*
Inter	0.5496*	0.5635*	0.8090*	0.8453*	1.0000	0.9796*	0.7859*
Total	0.5755*	0.6114*	0.8718*	0.9171*	0.9796*	1.0000	0.8471*
Ward	0.5988*	0.6544*	0.8805*	0.8272*	0.7859*	0.8471*	1.0000

*p<0.001 by Linear regression analysis
(by Canoconical Correlation, r = 0.602, P < 0.001)
Troch = trochanter; Inter = intertrochanter

Table 3. The correlation of BMD of distal forearm and spine at various measurement sites.

Correlations	Distal	Ultra	L1	L2	L3	L4	L1-L4
Distal	1.0000	0.8367*	0.5471*	0.5713*	0.4358*	0.4526*	0.5670*
Ultra	0.8367*	1.0000	0.6191*	0.6372*	0.5413*	0.5651*	0.6564*
L1	0.5471*	0.6191*	1.0000	0.9316*	0.7864*	0.7701*	0.9325*
L2	0.5713*	0.6372*	0.9316*	1.0000	0.8470*	0.8186*	0.9633*
L3	0.4358*	0.5413*	0.7864*	0.8470*	1.0000	0.8996*	0.8749*
L4	0.4526*	0.5651*	0.7701*	0.8186*	0.8996*	1.0000	0.9110*
L1-L4.	0.5670*	0.6564*	0.9325*	0.9633*	0.8749*	0.9110*	1.0000

*p<0.001 by Linear regression analysis
(by Canoconical Correlation, r = 0.619, P < 0.001)

Table 4. The correlation of BMD of hip and spine at various measurement sites.

Correlations	Neck	Troch	Inter	Total	Ward
L1	0.6899*	0.7002*	0.6510*	0.7034*	0.7116*
L2	0.7001*	0.7201*	0.6659*	0.7188*	0.7337*
L3	0.5953*	0.5900*	0.5353*	0.5883*	0.6199*
L4	0.6265*	0.6349*	0.5753*	0.6285*	0.6337*
L1-L4.	0.7125*	0.7295*	0.6695*	0.7260*	0.7418*

* P< 0.001 by Linear regression analysis
(by Canoconical correlation, r = 0.7418, P<0.001)

From this study, there are significant correlations between distal forearm and hip, distal forearm and spine. The ward area has the highest correlation to distal and ultra-distal part of forearm. (Table 2) The L2 and L4 area have the highest correlation to distal and ultra-distal part of forearm respectively. (Table 3)

Since osteoporosis is a systemic disorder in most individuals, bone mass measured distant to the fracture site should reflect a deficit comparable to measurements at the fracture site[11,12]. This study revealed fairly good correlation of BMD of distal/ultra distal forearm with those of hip and spines. Hence, bone mass measurement of distal forearm might be used to predict the BMD of hip and spines at least in Thai women. The accuracy of predicting the BMD of hip and spines by BMD of distal forearm in the mass screening programme in Thailand is now going on. The result will be followed.

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ความคล้ายคลึงของความหนาแน่นของกระดูกในแต่ละตำแหน่งที่ตรวจวัด : กระดูกสะโพก กระดูกไขสันหลัง และกระดูกปลายแขน

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ได้ตรวจวัดความหนาแน่นของกระดูกสันหลัง กระดูกสะโพกและกระดูกปลายแขนในสตรีไทย จำนวน 325 ราย ที่มารับการตรวจที่คลินิกวัยหมดระดู ระหว่างเดือนมกราคมถึงธันวาคม พ.ศ. 2538 เพื่อศึกษาหาความสัมพันธ์ระหว่างความหนาแน่นของกระดูกในส่วนต่าง ๆ โดยการตรวจที่บริเวณกระดูกสะโพก และกระดูกสันหลังโดยใช้เครื่อง Dual energy X-ray absorptiometer (DEXA), Hologic QDR 2000 และที่กระดูกปลายแขนโดยใช้เครื่อง Single energy X-ray absorptiometer (SEXA), Hologic DTX 100 จากการวิเคราะห์ด้วย Canoconical correlation พบว่า ความหนาแน่นของส่วนของ distal และ ultra distal ของกระดูกปลายแขน มีความสัมพันธ์กับการตรวจที่ตำแหน่งต่าง ๆ ของสะโพก (r = 0.602, $p<0.001$) และมีความสัมพันธ์กับการตรวจที่ตำแหน่งต่าง ๆ ของกระดูกสันหลัง (r = 0.619, $p<0.001$) ถึงแม้จะมีความแตกต่างกันของความหนาแน่นของกระดูกในแต่ละจุด แต่จากการวิเคราะห์โดยรวมแล้วพบว่า การวัดความหนาแน่นของกระดูกปลายแขนอาจนำมาใช้พยากรณ์ความหนาแน่นของกระดูกสันหลังและกระดูกสะโพกในสตรีไทยได้ การศึกษาความแม่นยำของการพยากรณ์ความหนาแน่นของกระดูกสันหลังและกระดูกสะโพก โดยการใช้ค่าความหนาแน่นของกระดูกปลายแขนนั้น กำลังอยู่ในระหว่างการศึกษา ซึ่งจะรายงานให้ทราบต่อไป

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