Comparison of Central and Peripheral Bone Mineral Density Measurements in Postmenopausal Women

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ABSTRACT

Objectives: The purpose of the current study was to compare central and peripheral bone mineral density at different regions including spine, hip, and wrist in postmenopausal women.

Methods: Forty postmenopausal women participated in this study. Their mean age, body mass, height, and body mass index were 53.5 ± 2.75 y, 68.6 ± 8.68 kg, 167.8 ± 6.46 cm, and 24.31 ± 1.69 kg/m^2, respectively. Bone mineral density (BMD) *T*-scores of spine, hip, and wrist regions were measured for all participants with a dual-energy X-ray absorptiometry scan.

Results: All measured regions (spine, hip, and wrist) had low BMD *T*-scores. Bone mineral density of the wrist was significantly lower (−2.58 ± 2.18) than that of both spine (−1.79 ± 0.98) and hip (−1.69 ± 1.37). In addition, there were no statistically significant differences in BMD between the spine and hip.

Conclusions: In this group of postmenopausal women, wrist BMD decreased more than spine and hip BMD. Both spine and hip BMD decreased by nearly the same percentage in postmenopausal women. Peripheral sites may be more representative of osteoporosis than central sites. Trial Registration: PACTR201602001478123. (J Chiropr Med 2017;xx:1-5)

Key Indexing Terms: *Bone Density; Osteoporosis, Postmenopausal; Postmenopause; Spine; Hip; Wrist*

INTRODUCTION

Bone mineral content is the amount of hydroxyapatite relative to the area of bone[1] and is an excellent predictor of fracture risk. Bone mineral density (BMD) is similar to serum cholesterol as a predictor of heart disease and blood pressure as a predictor of stroke.[2] Bone turnover is a dynamic process and is important when considering the management of osteoporosis.[3] Bone turnover involves degradation of the bone matrix by osteoclasts and the formation of new matrix by osteoblasts.[4] Normally, these 2 processes are tightly balanced in a manner ensuring that formation adequately restores resorption.[5] Imbalance between these 2 processes leads to pathologies, such as low bone mass and quality, as seen in osteoporosis.[6]

Osteoporosis is the most common metabolic bone disease[7] and is an increasingly common disease in aging societies. Osteopenia is a condition of decreased BMD and is considered a precursor to osteoporosis. Osteopenia is analogous to prehypertension as it relates to cardiovascular disease.[8] During aging, muscle mass, force, and power and BMD decrease.[9] When BMD decreases, osteoporosis occurs. This problem typically has no signs or symptoms until a fracture occurs so it has often been referred to as a silent condition.[10]

Fractures are associated with osteoporosis, and the hip, spine, forearm, and shoulder are the most common sites.[11] However, the age-adjusted incidence of hip fractures in females is about twice that in males, which has been attributed to greater age-related bone loss. A higher incidence of falls is documented in females.[12,13] A 50-year-old white woman has a 15% to 20% lifetime risk of sustaining a hip fracture associated with long-term morbidity and a 20% to 33% mortality rate 1 year after fracture.[14] Osteoporosis is important to consider when developing a treatment plan such as when considering manual therapies or therapeutic exercise. When applying force to patients with osteoporosis (eg, high-velocity, low-amplitude manipulation), the caution that must be observed depends on the degree of osteoporosis and the fragility of the patient's bones.[15]

Dual-energy X-ray absorptiometry (DEXA) scans of the central skeleton of the hip, spine, and pelvis is used to measure BMD *T*-scores to screen for osteoporosis, predict fracture risk, and determine the need for treatment. Evaluation of the BMD of other sites, like the forearm, calcaneus, and hand (peripheral DEXA), is also recommended. This information may help in predicting the regions most

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Paper submitted June 15, 2017; in revised form August 9, 2017; accepted August 9, 2017.

1556-3707

http://dx.doi.org/10.1016/j.jcm.2017.08.001

susceptible to fracture. Current osteoporosis management guidelines recommend routine BMD screening with the use of DEXA scans.[16] Central DEXA of the lumbar spine and proximal femur is the preferred method for BMD testing.[17,18]

The World Health Organization (WHO)[19] has proposed a diagnostic classification for BMD based on the *T*-scores measured by DEXA scan. The *T*-score is the number of standard deviations above or below the normal mean value of BMD for young adults. The BMD was classified as follows: normal, *T*-score ≥ -1; osteopenia, *T*-score between -1 and -2.5; osteoporosis; *T*-score ≤ -2.5. Because the widely accepted WHO definition for osteoporosis is based on the BMD *T*-score, this measure must serve as the reference standard against which other BMD modalities are compared and validated.[17] Many researchers have concentrated on assessing BMD via central DEXA scan and did not pay considerable attention to the peripheral sites such as forearm (wrist) and calcaneus. Therefore, the purpose of the current study was to measure both central and peripheral BMD at different regions including lumbar spine, hip (femur), and wrist (distal radius) and to compare the measured outcome among these regions.

Methods

Participants

Forty postmenopausal women from 50 to 60 years of age participated in this study. All participants did not engage in regular sports or athletic activities. They were admitted to El-Haram Hospital, Giza, Egypt, to assess their BMD with DEXA scans. The participants' mean age, body mass, height, and body mass index were 53.5 ± 2.75 y, 68.6 ± 8.68 kg, 167.8 ± 6.46 cm, and 24.31 ± 1.69 kg/m^2, respectively. All participants gave written consent on agreement to participate in the study. The Research Ethics Committee of the Faculty of Physical Therapy, Cairo University, approved this study. The clinical trial registry number is PACTR201602001478123.

Central and Peripheral DEXA Scan

Spine DEXA scan is a central scan starting at L5 and ending at T12. During examination, the patient is asked to assume a supine position on the table, with knees flexed and shins elevated to decrease lumbar lordosis and flatten the spine against the table. The BMD measure is detected for L1–L4 in the posterior-anterior projection, while the X-ray tube is placed behind the patient and the screen over the abdomen. In scanning the proximal femur (hip region), which is a central scan, the leg is abducted and internally rotated. If the femur is not adequately rotated, the femoral neck is foreshortened and falsely increases the BMD. Peripheral DEXA scanning of the forearm (wrist region) is performed with the patient sitting next to the table. The forearm rests on the table and BMD measurements are reported for the ultradistal radius, distal (midradius), and shaft (one-third radius). The ultradistal site contains the highest percentage of trabecular bone in the forearm and, thus, is the region most often used clinically. The one-third radius region also contains entirely cortical bone.[20]

Statistical Analysis

Before starting the study procedures, a power analysis was done to determine the appropriate sample size for the study. A pilot study was conducted on 6 participants to obtain data necessary for calculating the sample size at a significance level of 5% and a test power of 80%. The test revealed that a minimum of 18 participants were required for the study. Because a sample size (n = 40) greater than that predetermined by the power analysis was used, the study achieved a 93% power of significance.

One-way within subject analysis of variance (ANOVA) was conducted to assess if there were any significant differences in mean BMD values among the 3 tested regions. The study included 1 independent variable: tested region with 3 levels (spine, hip, and wrist). Only 1 dependent variable (BMD) was measured. All statistical measures were calculated using the Statistical Package for Social Sciences (SPSS), Version 20 for Windows (IBM, Armonk, New York). The level of significance for all statistical tests was set at $P < .05$.

Results

The results revealed that all measured regions in the postmenopausal women had low BMD *T*-scores based on the normal standard BMD values mentioned in the Introduction. Descriptive statistics (mean ± standard deviation [SD]) for BMD *T*-scores of the spine, hip, and wrist were -1.79 ± 0.98, -1.69 ± 1.37, and -2.58 ± 2.18, respectively. These values indicate that the same women who had spine and hip osteopenia also had wrist osteoporosis. The wrist BMD *T*-score was found to be significantly lower than that of both spine and hip regions ($P < .05$). In addition, there were no statistically significant differences in BMD *T*-scores between the spine and hip ($P > .05$) (Table 1).

Table 1. *Results of Bone Mineral Density T-Scores in the 3 Body Regions Tested*

Body Location	Bone Mineral Density *T*-Score (Mean ± SD)
Spine	−1.79 ± 0.98
Hip	−1.69 ± 1.37
Wrist	−2.58 ± 2.18
	P Value
Spine vs hip	1.000
Spine vs wrist	.009
Hip vs wrist	.000

SD, standard deviation.