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Bone mineral density measurements in post-menopausal women: When and which areas should be measured?

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ABSTRACT

The aim of this study is to evaluate perimenopausal and postmenopausal women with extensive bone pain, who were not undergoing any osteoporosis treatment, were non-smokers and who had a body mass index (BMI) below 30, to determine which age groups and which areas should have bone mineral density (BMD) measurements taken by Dual Energy X-Ray Absorptiometry (DXA). The study comprised 243 perimenopausal and postmenopausal (age range 42–78 years) women who presented at our clinic with extensive bone pain. All cases had BMD measurements taken by the same DXA machine on the right femoral neck (RT), the left femoral neck (LT) and lumbar vertebrae 1–4 (L1-4T). The patients were assigned to one of three groups; Group 1, under 50 years of age (n=83); Group 2, 50-60 years of age (n=103); Group 3, over 60 years of age (n=57). The difference between the T-scores obtained from the BMD measurements of the whole group was found to be significant with the Kruskar-Wallis test. To determine between which age groups the difference in the T-scores was statistically significant, the patients were allocated to 3 age-related groups. The T-scores of these three groups were compared and evaluated with the Mann-Whitney U-test. The T-score differences (RT, LT, L1-4T) between Group 1 and Group 2 were found to be statistically significant, between Group 1 and Group 3, statistically highly significant, and between Group 2 and Group 3 there was no statistical significance. The differences between the T-score measurements of left hip, right hip and lumbar 1–4 vertabrae of the 3 created groups were statistically evaluated with a 95% confidence interval. In each group RT, LT and L1-4T were evaluated with no statistical difference. Our results lead us to believe that postmenopausal women with extensive bone pain should undergo routine BMD measurement after the age of 60 and that these measurements will be sufficient from just one area.

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1. Introduction

Osteoporosis is defined by the American National Institute for Health (NIH) as an age-related disease, characterised by reduced bone mass, increased risk of fracture and increased bone loss (Concensus conference, 1984). In the diagnosis of osteoporosis and the monitoring of treatment, the measurement of bone mineral density (BMD) has an important role (Bonnick, 2005). Various techniques have been reported for BMD measurement. Dual-energy X-Ray Absorptiometry (DXA), Dual Photon Absorptiometry (DPA), Quantitative Computerised Tomography (QCT), and Quantitative Ultrasound (QUS) are specific headings of bone mineral density techniques (Sartoris et al., 1986; Hall et al., 1987; Baran et al., 1988; Bergot et al., 1988; Johnston et al., 1989; Slemenda et al., 1990; Comsan et al., 1992; Libanoti et al., 1992; Bonnick, 2005).

DXA was recommended by the U.S. Food and Drug Administration (FDA) in 1998 and is the most commonly used BMD measurement technique (Bonnick, 2005). It was recommended as the gold standard by Leviecki (2008) in

the diagnosis of osteoporosis and continuation of treatment. As the application is easy, cheap and easily understood, the DXA method was selected for the current study. Brown and Lewiecki recommended that BMD measurements are made at one or two year intervals (Brown et al., 2002; Lewiecki, 2008). Lenchick et al. (2002) stated that in the development of any secondary pathology in osteoporosis cases, 6-monthly follow-ups must be made.

Using the DXA method on perimenopausal and postmenopausal females with widespread bone pain, who did not smoke and had a body mass index (BMI) below 30, this study aimed to investigate for which age groups and on which body area BMD measurements are necessary.

2. Material and method

The study comprised 243 perimenopausal and postmenopausal female patients who presented at our clinic with complaints of widespread bone pain. All the patients selected were in primary menopause, had not received any osteoporosis treatment, were non-smokers and had BMI <30. Attention was paid that no patient had developed any osteoporotic fracture. BMD measurements were taken from all patients on the right femoral neck, the left femoral neck and lumbar 1-4 vertebrae using the same DXA machine.

The Kruskal-Wallis test showed the difference between the T-scores obtained from the BMD measurements of the patient group to be significant. To determine between which age groups this difference in the T-scores was statistically significant, the patient group was separated into 3 age groups. Group 1 (>60 years) comprised 83 cases, Group 2 (50-60 years), 103 cases and Group 3 (<50 years), 57 cases. The T-scores of these three groups were evaluated by comparison with each other using the Mann Whitney U-test.

3. Results

Rather than separating the 243 patients into groups according to the DXA measurements of right hip T-score difference (R-T), left hip T-score difference (L-T) or lumbar 1-4 vertebrae T-score difference (L 1-4 T), evaluation was made by the Kruskal-Wallis test. The difference between the T-scores of the whole patient group was determined to be significant in the confidence interval ($p<0.05$) (Table 1).

Table 1. Statistically significant difference between all groups with using Kruskal-Wallis test

Investigated area	Difference between T-Score
Right Hip	0.019
Left Hip	0.029
L1-4	0.000

The difference between the T-score measurements of all three areas of the whole patient group was determined to be significant. RT, LT and L1-4T between Groups 1 and 2 were found to be statistically significant. RT, LT and L1-4T between Groups 1 and 3 were found to be highly statistically significant. No statistical significance was determined in RT, LT and L1-4T between Groups 2 and 3 (Table 2).

According to these results, the difference between the T-scores obtained from the BMD measurements between the below 50 years age group and the 50-60 years age group was evaluated as non significant. However, the difference between the T-scores obtained from the BMD measurements between the over 60 years age group and the below 50 years age group and the 50-60 years age group was significant. Therefore, as the difference between the measurements of the groups was only significant in the over 60 years age group, BMD measurements as an important indicator in the evaluation of osteoporosis, should be applied routinely after the age of 60 years.

Table 2. T-score differences in three age groups, compared by Mann-Whitney U test.

Compare groups	Right Hip T-Score differences	Left Hip T-Score differences	L 1-4 Vertebrae T-Score differences
Group 1-Group 2	0.010	0.017	0.001
Group 1-Group 3	0.040	0.040	0.001
Group 2-Group 3	0.642	0.638	0.543

The second question of the current study was to ascertain which area or areas should be measured. The differences between the T-scores of the right hip, left hip and lumbar 1-4 vertebrae of the three groups were statistically evaluated as in the 95% confidence interval. In all three groups, no statistical significance was determined in RT, LT and L1-4T (Table 3).

No difference was determined in respect of the T-scores of the BMD measurements taken from any of the areas in any of the age groups.

Table 3. T Score differences between right hip, left hip and L1-4 vertebrae in three age groups

Groups	Right-Left Hip T-Score difference	Right Hip-L1-4 vertebrae T-Score difference	Left Hip-L1-4 vertebrae T-Score difference
Group 1	0.920	0.617	0.690
Group 2	0.161	0.672	0.205
Group 3	0.792	0.683	0.428

4. Discussion

Osteoporosis is an abnormal process characterised by loss of bone mass without any reduction of the organic matrix ratio (Riggs and Melton, 1986; Simon, 2007). Therefore, the bone mass decreases in osteoporosis. Although the osteoid cells have a normal histomorphological appearance, the cortex thickness decreases (Riggs and Melton, 1986). Associated with this, reduced trabecular connectivity causes bone compression and reduced tensile strength absorption. Consequently, fractures occur because of the reduced strength.

Osteoporosis is a process which leads to fractures, so to prevent the development of fractures, the diagnosis and treatment of osteoporosis is important. In the diagnosis of osteoporosis, the methods of DXA, DPA, QCT and QUS are used. DXA radiographically analyses the separate energy between soft tissue and BMD (Bonnick, 2005). Various techniques have been reported for BMD measurement. DXA, DPA, QCT, QUS are specific headings of BMD techniques (Sartoris et al., 1986; Hall et al., 1987; Bergot et al., 1988; Johnston et al., 1989; Slemenda et al., 1990; Comsan et al., 1992; Libanoti et al., 1992)

Baran et al. (1988) reported that as DXA is cheaper, quicker and easier to apply than others, it is a widely used method. In DXA, T-score values below -2.5 SD have been

defined as osteoporosis and values between -1 and -2.5 SD as osteopenia (World Helath Orginazation, 1994; Gonelli et al., 1995). Poss et al. (1990) reported a direct ratio between decreased BMD and increased risk of fracture. In the same study, it was stated that for every reduction of 1SD in BMD the fracture risk doubled.

As perimenopausal and post-menopausal patients with chronic widespread pain are candidates for osteoporosis, they are at high risk of fractures developing. The increased risk of fracture in these menopausal women with widespread bone pain emphasises the need for regular BMD measurements. Brown et al. (2002) stated that after the start of osteoporosis treatment, annual BMD measurements are necessary, whereas according to Lewiecki (2008), the measurements are necessary at intervals of one or two years. Bonnick (2005) recommended that no more than 20 months should pass between measurements, which are absolutely necessary once a year. As annual BMD measurements increase radiation exposure, albeit a small amount, and increase costs and loss of workforce, Lenchik et al. (2002) opposed routine annual BMD measurements.

Lenchik et al. (2002) stated that in cases of steroid use or increasing bone destruction such as hyperparathyroidism six-monthly BMD follow-up is required but this is not necessary in primary osteoporosis cases. In accordance with the information in literature that routine BMD follow-up is necessary at intervals of one or two years in postmenopausal women, it was considered in the current study as to when these routine BMD measurements should start. In the three groups of the current study of women in the primary menopause stage with widespread bone pain and who had not received any osteoporosis treatment, a significant difference in the T-scores of the BMD measurements was only determined in the over 60 years age group. A statistically significant difference was determined in the changes between the T-scores of the cases over 60 years. However, no significant difference was determined in the T-score measurements in the patient groups up to that age. No significant difference could be determined between the T-scores of all the cases in the patient groups of postmenopausal women aged below 60 years. In the light of these findings, it can be considered that routine BMD measurements should be started after the age of 60 years.

Another aim of the current study was to determine in which area of the body BMD measurements should be taken. In the study published in 2004 by Bonnick (2005) while various American and international societies defined proposed body areas, it was recommended that BMD measurements are taken from both hips and lumbar 1-4 vertebrae. In the current study, no statistically significant difference was determined within the groups between the three measurement values of the T-scores of both hips and L1-4 vertebrae. According to this result, it can be concluded that T-score measurement of any one of right hip, left hip or L1-4 vertebrae will be sufficient in the diagnosis and treatment of osteoporosis.

In conclusion, routine BMD measurements in postmenopausal cases with widespread bone pain should be started after 60 years old and taking the measurement from just one area will be sufficient.

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