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Assessment of bone mineral density of lumbar spine in anteroposterior and lateral views in elderly postmenopausal females

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Abstract: Aim of the work: Osteoporosis is a metabolic bone disease with a high risk of fractures among elderly population with negative health and economic outcomes. Lumbar spine is one of the major sites for osteoporosis with high risk for vertebral fractures. We aimed to assess bone mineral density (BMD) at lumbar spine in anteroposterior view and compare it with lateral view in elderly females.

Patients and methods: It was a cross-sectional study that included 40 Egyptian females ≥ 55 years old. Evaluation of BMD was done using Dual-energy X-ray absorptiometry (DXA) scan at lumbar spine (L2-4) anteroposterior (AP) view and lateral view. The lowest T-score at each site was recorded.

Results: 10 patients (25 %) had normal lumbar spine BMD, 16 patients (40 %) had lumbar spine osteopenia and 14 (35%) of patients had lumbar spine osteoporosis. T-score at lumbar spine in lateral view was about twice lower than anteroposterior view. The BMD mean value was recorded at lateral lumbar spine (-2.632± 2.219 SD). Mean BMD value at anteroposterior lumbar spine was (- 1.613 ± 1.8462 SD) with a statistically significant difference of BMD between the 2 sites (p value <0.05).

Conclusions: Lateral spine BMD T-score is 2 folds lower than anteroposterior lumbar spine BMD in elderly females. So, lateral view imaging is recommended to be complementary to anteroposterior view for better lumbar BMD assessment in the elderly.

Keywords: BMD, osteoporosis, Elderly, DXA

Introduction

Osteoporosis is a metabolic bone disease with reduced bone mass resulting in bone fragility and increased fracture risk. Vertebral fractures are one of the reported major sites of osteoporosis together with femoral neck at hip, distal radius and the wrist. It is a quiet disease with no clinical symptoms till fractures occur, resulting in catastrophic secondary health issues and even death. It was reported that lumbar with or without hip osteopenia was 43.1% and it was higher in females (51.5%) than males (33.5%) aged ≥50 years old (1). Also, it is estimated that about 6 to 21 % of people aged 50 to 80 years had asymptomatic vertebral fractures (2).

Another study reported that the incidence of lumbar vertebral fractures in the United States has increased over the last decade up to 66.3% with incidence increasing with aging (3). Accordingly, this study aimed to evaluate bone mineral density at anteroposterior lumbar spine compared to lateral view imaging of the lumbar spine in elderly postmenopausal females.

Patients and methods:

This study was a cross-sectional study that included 40 postmenopausal females ≥ 55 years old. Patients were collected from Internal Medicine inpatient departments, Internal Medicine and Rheumatology outpatient clinics, Faculty of medicine, Cairo University. All history taking and data collection was in privacy and all the patients' data was kept confidential. Informed written consents were taken from all participants before being enrolled in the study according to the principles of the Declaration of Helsinki (2008). The study gained the approval of the research ethics committee of Faculty of Medicine, Cairo University. Patients who had chronic liver or kidney functions, malignancies or autoimmune diseases were excluded from the study.

Full laboratory work up including complete metabolic panel, liver and kidney functions were assessed. All patients with abnormal laboratory results were excluded from the study. All participants had bone mineral density (BMD) assessed using DXA scan. The T-score was assessed at the lumbar spine (L2-L4) anteroposterior (AP) view. Lateral spine views were evaluated while the patients were in left lateral position with knee flexion and placing the arms above the head to allow proper view of lateral spine away from obscuring ribs. The lowest values were recorded at each site. The T score was used to estimate the risk of developing a fracture. T-score is expressed as standard deviation (SD) which is the difference between a subject's BMD and that of a normal reference population. A score of ≥ -1 SD was considered normal. A score between -1.1 SD and -2.4 SD was classified as osteopenia (low bone mass). A score of ≤ -2.5 SD was classified as osteoporosis.

Statistical analysis: Data were statistically described using mean ± standard deviation (± SD), and range, or frequencies (number of cases) and percentages. Comparison of numerical variables was done using One Way analysis of Variance (ANOVA) test. *P* -values less than 0.05 were considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses.

Results:

Our study included 40 postmenopausal females ≥ 55 years old with mean age 60.33 ± 5.224. BMD evaluation by T-score was assessed using DXA scan at spine anteroposterior view and lateral spine view.

Regarding BMD at lumbar spine AP, 10 patients (25%) had normal BMD, 16 patients (40%) had osteopenia, and 14 patients (35%) had osteoporosis.

Regarding BMD at spine lateral view, 9 patients (22.5%) had normal BMD, 7 patients (17.5%) had osteopenia, and 24 patients (60%) had osteoporosis.

This means that the incidence of lumbar osteoporosis in our sample was 2 folds higher in lateral view than anteroposterior view.

The mean value of BMD T-score at spine AP was -1.613±1.8462 SD. The mean value of BMD T-score at lumbar spine lateral view was -2.575 ± 1.992 SD. The lowest BMD mean value was recorded at lateral view of lumbar spine (Table 1, Figure 1).

Comparison of T-score BMD between T-score BMD at lumbar spine in anteroposterior versus lateral views showed that (Table 2):

There was a statistically significant difference in BMD at both sites with lateral view was about twice lower than the values of anteroposterior view with worse BMD (p value < 0.001).

Table 1: Values of age, BMD at lumbar spine in anteroposterior and lateral views.

Variable	Mean (n=40)	SD (n=40)	Minimum (n=40)	Maximum (n=40)
Age (years)	60.33	± 5.224	55	85
BMD (T-score):				
Spine AP	-1.613	± 1.8462	-5.7	2.9
BMD at spine lateral	-2.575	± 1.992	-5.9	2.2

Abbreviations: SD: standard deviation, BMD: bone mineral density, AP: anteroposterior

Table 2: comparison between BMD of lumbar spine in anteroposterior versus lateral view.

	Mean (T-score)	SD	95% Confidence Interval of the Difference		P value
			Upper	Lower	
BMD spine AP and lateral views	0.9618	1.3656	0.6312	1.2923	< 0.001

Abbreviations: BMD: bone mineral density, AP: anteroposterior, SD: standard deviation

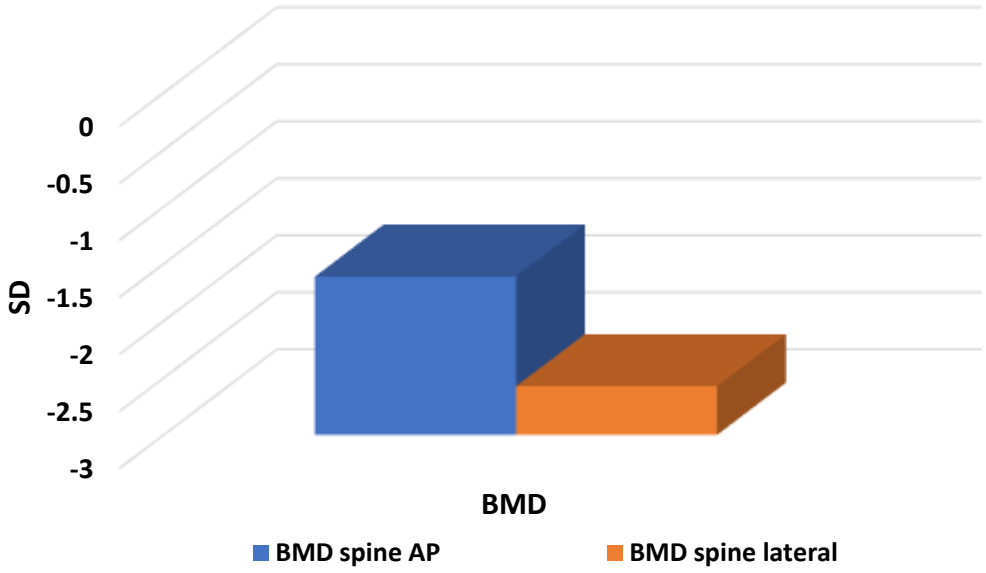

Figure 1: Comparing mean BMD of lumbar spine in anteroposterior view versus lateral view

Discussion:

Osteoporosis is a worldwide problem as the world's population ages and with a longer life span. More than 200 million people worldwide have osteoporotic fractures, according to statistics(4). There is an estimated increase of osteoporotic hip fractures from (1.66 million) in 1990 to (6.26 million) in 2050 (5). According to the International Osteoporosis Foundation, one in every 3 females over the age of 50 and one in every 5 males will have an osteoporotic fracture during their lifetime (6). Effective management of skeletal health includes

appropriate selection of patients for bone density testing and assessment of risk factors for fracture. Lumbar spine is reported as one of the major sites of osteoporotic fractures (7).Vertebral fractures are estimated to affect about more than 50,000 elderly females every year (8).

When assessing BMD at lumbar spine in our study, we found that most of the patients had osteopenia of lumbar spine at AP view (40%), with 35 % had osteoporosis and 25% had normal lumbar spine. However, when BMD spine was assessed in lateral view, prevalence of osteoporosis increased from 35% to 60% reflecting that incidence of BMD spine in lateral view is about 2 folds that of AP view.

This agrees with findings of a study that reported that 66 % females assessed for lateral spine BMD had osteoporosis in contrary to 29% using the AP view and this may be due to osteoarthritis that affects the spine in the elderly and are not relevant on lateral view recommending a lateral BMD measurement of the spine for more accurate evaluation of vertebral skeletal integrity in the elderly(8).

Also, another study reported that lateral spine BMD measurements were significantly more sensitive at the lateral spine than at the AP spine (9).

However, another study reported larger accuracy error in the lateral than in the AP projection resulting from a lower ratio of bone to soft tissue (10)

We recommend correlation between BMD and trabecular bone score of lumbar spine in both views and with age and sex matched normal controls in our population to assess which site would be more sensitive in assessment of lumbar spine osteoporosis in this age group. Meanwhile, we recommend lateral view lumbar spine complementary to AP lumbar spine imaging for better lumbar BMD assessment in the elderly.

Conclusions:

Lateral view lumbar spine BMD T-score is twice lower than anteroposterior view in elderly postmenopausal females, so lateral view imaging is recommended to be complementary to anteroposterior view for better lumbar BMD assessment in the elderly.

Conflict of interest: The authors have no conflict of interest.

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