Research Article

Panoramic radiograph as a possible diagnostic indicator of osteoporosis in post menopausal women

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Abstract

Background: Skeletal osteoporosis is more prevalent in postmenopausal women leading to increase morbidity and mortality due to late diagnosis and high cost of investigation. The objectives of this study were to investigate whether panoramic image can be used as a possible diagnostic indicator of osteoporosis in postmenopausal women and to correlate the Body Mass Index (BMI), Mandibular Cortical Width (MCW) and Bone Mineral Density (BMD). **Materials and Methods:** The study group comprised of 73 post menopausal women of Bangalore, Indian origin, aged between 45 to 75 years. In all the subjects, Bone Mineral Density and Body Mass Index was calculated. Width of the Mandibular inferior cortex below the mental foramen was traced, measured and correlated with Bone Mineral Density status and Body Mass Index values. **Results:** Mandibular Cortical Width and Bone Mineral Density status showed wide variation with Body Mass Index values. Bonferroni test was used to compare Mandibular Cortical Width with normal Bone Mineral Density, osteopenia and osteoporotic subjects. There was a statistical significant difference between normal and osteoporotic group ($p<0.01$). There was also a significant difference between osteopenia and osteoporotic group ($p<0.05$).There was no statistical significant difference between thenormal group and osteopenia group. **Conclusion:** The panoramic radiograph can be a useful aid for evaluating Mandibular Cortical Width in the diagnosis of osteoporosis.
Keywords: Osteoporosis, Panoramic radiography, Body Mass Index (BMI).

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INTRODUCTION

Women at risk of suffering osteoporosis and increased accessibility of dental radiographs has led to substantial research into the potential role of dentist in facilitating access to further study and health care.[1] Osteoporosis is one of the world wide tribulations faced by women and elderly population. It is also called as the silent epidemic, because of the chronic progressive nature for many years being asymptomatic until the fractures.[2] Osteoporosis is an asymptomatic slowly progressive disease in its early stages and is characterized by low bone mass and micro-architectural weakening of bone, thereby increased tendency for fractures.[3]The earliest suggestion of an association between osteoporosis and oral bone loss was made in 1960.[4] It is a clear fact that use of complete dentures and after extraction alveolar ridge manifest with continuous atrophy.[5] Few researchers have quoted the query of whether dental radiographs could have a role to play in the detection of osteoporosis. It has been suggested that possible connection exists between mandibular and skeletal osteoporosis. If such association is obtainable, then dental radiographs should play a significant role in the diagnosis of osseous changes.[6] A large number of panoramic radiographs taken every year offer greater opportunity for studying bones.[3] Relationship between mandibular cortical bone quality,

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quantity and BMD exist. Radiographic manifestations of osteoporosis can often be observed in the films of affected individuals.[3] The aim of this study was to evaluate the diagnostic efficacy of the panoramicimage with Bone Mineral Density (BMD) of the mandible. It would be very useful to answer whether radiographic changes in the mandible indicate skeletal osteopenia and could have a role in the detection of osteoporosis. As dental panoramic radiographs are frequently made during the general practice of dentistry, the findings on such radiographs like thinner mandibular cortex may help the dentist to identify patients with undetected low bone mineral density. They can be then referred to medical professionals for evaluation of bone densitometry, and this can prevent the morbidity due to osteoporosis. The recent clinical trials depicted the crucial part of panoramic radiograph in the diagnosis of subjects with low BMD and osteoporosis.[7]

OBJECTIVES OF THE STUDY

- To determine theuse of thepanoramic image for evaluation of loss of mandibular cortical width in osteoporotic patients.
- To compare diagnostic information of thepanoramic image with the bone mineral density in the assessment of osteoporosis.
- To correlate the Body Mass Index with Mandibular Cortical Width and Bone Mineral Density.

MATERIAL AND METHODS

The study group comprised of seventy three post menopausal women of Indian origin aged between 45-70 years who were randomly selected from the outpatients of Department of Oral Medicine and Radiology, D.A. Pandu Memorial R.V. Dental College and Hospital, Bangalore.

Inclusion criteria

All potential participants were explained the need and design of the study and the benefits of undergoing the evaluation. Subjects who agreed to undergo clinical, radiographic and BMD study procedures were included in the study. Patients were instructed about the procedure, and a written informed consent was obtained.

Exclusion Criteria

Subjects with medical problems "which alter the" bone metabolism such as Chronic Obstructive Pulmonary Diseases, Gastrectomy, Hyperparathyroidism, Hypogonadism, Multiple Myeloma, Coeliac Disease. Subjects taking medications such as Glucocorticoids, anticonvulsants, Gonadotropin releasing hormone, Excessive thyroxine doses and Lithium. Subjects with thehistory of Fractures, low body weight, smoking, alcohol, impaired vision, dementia, poor health and back pain.

Assessment of BMI (Body Mass Index)

The data regarding menopausal status, age, "height and weight" were obtained and recorded in the proforma. The body mass index was computed as weight divided by the square of height in metres.

Assessment of Mandibular cortical width using Panoramic Radiograph

Panoramic radiograph was made for all the study subjects using the GENDEX OrthoralixPlus Italy.

Exposure parameters used were:

- Total exposure time: 12 seconds.
- Total cycle: 24 seconds.
- Magnification: 1.25
- Adaptation of focal trough to jaw morphology from 0 to 14 mm (default=7mm)
- Default kV factor: 70 kV for underweight patient, 74 kV for ideal weight patient, 78 kV for overweight patient.
- Current - 10mA

Measurement of mandibular cortical width was made unilaterally (left side) at the site of mental foramen. A tracing sheet was attached to the panoramic radiograph. A line was drawn parallel to the long axis of the lower margin of the mandible, and a line perpendicular to this tangent was drawn intersecting the inferior border of mental foramen, along which the mandibular cortical width was measured with a millimeter scale. Two sets of measurements were made at an interval of one week, by two observers. A total of four sets of readings were recorded.

Procedure for Bone Mineral Density assessment (BMD)

Sunlight omniscience 7000/8000S (omniscience) ultrasound device capable of measuring the speed of sound (SOS) in bone was used for assessment of BMD. SOS was assessed at the distal third of theradius (which was obtained by measuring the length of the radius using a measuring tape), and Personal Information was entered using the Windows XP graphic user interface. The probe was used to measure SOS along the distal one third of the radius of the arm. After application of clear ultrasound gel to the hand held probe and the measurement area, the probe is moved around the circumference of the radius, with its longest dimensions approximately parallel to the long axis of the bone (fig 1). The measurement consists of three consistent measurement cycles, each of which is comprised of three bone scans. Results were expressed in meters per second (m/sec) reflecting the upper 95th percentile of the sorted SOS values. Densitometer reports the bone SOS, together with the T-score which is the unit of standard deviation relative to the population reference

values of healthy young adults. The data obtained was analyzed by the software provided by the manufacturer, this was displayed as a graph with a summary of the bone density measurements.

The Assessment Index appears in the details section for each measurement.

In order to assist in the interpretation of the measurement the background of the graph has 3 colored regions:

1. T score of > -0.1, which is the WHO criteria forahealthy population.
2. T score of -0.1 and lower than -2.5, which are the WHO criteria for Osteopenia.
3. T score of < -2.5, which is the WHO criteria for Osteoporosis.

The results of BMI, "Mandibular cortical width and BMD" were tabulated. These results were statistically analyzed. The interobserver and intra observer variability was analyzed by Gage R and R study and ANOVA method. The correlation between Bone Mineral Density and Mandibular Cortical Width was assessed using Bonferroni test.

RESULTS

Body Mass Index (BMI): BMI ranged from 15.29 to 36.87, and average BMI was 26.07.

Bone Mineral Density (BMD)

The BMD was assessed utilizing the criteria for osteoporosis classification by WHO on the basis of "t score". Subjects were categorized as normal, osteopenia and osteoporotic. Among the study subjects, 34 (46%) had normal bone mineral density, 20 (27%) were osteopenia, and 19 (26%) were osteoporotic (Table 1) (Figure 2)

Assessment of Mandibular Cortical Width (MCW) on Panoramic Radiograph

The variation between the two readings of each observer (intra observer) was very low ($p>0.05$) and therefore thecontribution "by this component towards total variation was low. Similarly, the variation in readings between the two observers (interobserver) was also low ($p>0.05$). (Table 2and3)

Comparison of BMI and BMD

It was found that out of 34 subjects showing normal Bone Mineral Density, the Body Mass Index range from 18.46 to 36.87 with an average of 27.66. In 20 patients with Osteopenia, Body Mass Index ranged from 16.26 to 33.81 with an average of 25.03. In 19 patients with osteoporosis, Body Mass Index ranged from 15.29 to 34.63 with an average of 24.96 (table 3) (Figure 2).

Comparison of Mandibular Cortical Width and Bone Mineral Density

It was found that out of 34 subjects showing normal BMD; the MCW was ranging from 2.3 to 5.5 with an average of 3.90. In 20 patients with Osteopenia, the MCW ranged from 1.9 to 5.1 with an average of 3.50. In 19 patients with Osteoporosis, the MCW ranged from 1.8 to 4.9 with an average of 3.35 (Table 4) (Figure 4 and 5). It was statistically proven that there was a significant difference between the normal group and osteoporotic group ($p<0.01$)and there was also a significant difference between osteopenia group and osteoporosis group ($p<0.05$). There was no significant difference between normal group and osteopenia group (table 5).

Table 1: Classification of Subjects based on Bone Mineral Density

BMD Group	T score	No. of patients (%)	Range	Average
Normal	>-1	34 (46)	0 to -0.9	-0.45
Osteopenic	-1 to -2.5	20 (27)	-1.2 to -2.3	-1.75
Osteoporotic	< -2.5	19 (26)	-2.6 to -4.8	-3.7

Table 2: Variation in Intra observer and Inter observer p value

Source	DF	SS	MS	F	P
Sample	72	188.23	2.61	15.1572	>0.05
Observer	1	0.15	0.15	0.8913	0.348
Sample * Observer	72	12.42	0.17	1.177	0.204
Repeatability	146	21.40	0.15	-	-
Total	**291**	**222.20**	**-**	**-**	**-**

Table 3: Inter observer and Intra observer variability of MCW

Components of variation	Variance in Components	% contribution to total variation
Intra observer	0.01	1.68
Inter observer	0.15	19.03
Total Variation	**0.77**	**100**

Table 4: Comparison of BMD Status With Average BMI Values

BMD status	BMI values	
	Range	Average

Normal (n=34)	18.46 – 36.87	27.66
Osteopenic (n=20)	16.26 -33.81	25.03
Osteoporotic (n=19)	15.29 – 34.63	24.96

Table 5: Comparison of MCW and BMD

BMD Status	MCW Values	
	Range	Average
Normal (n=34)	2.3 – 5.5	3.90
Osteopenic (n=20)	1.9 – 5.1	3.50
Osteoporotic (n=19)	1.8 – 4.9	3.35

Figure 1: Probing to Assess the Bone Mineral Density

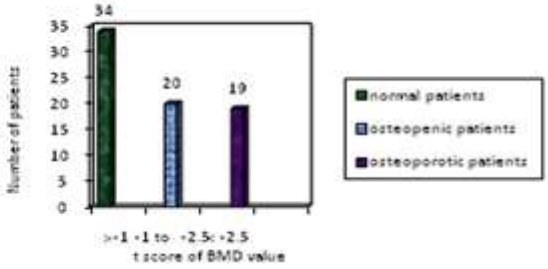

Figure 2: Study Subjects Categorized based on BMD Values

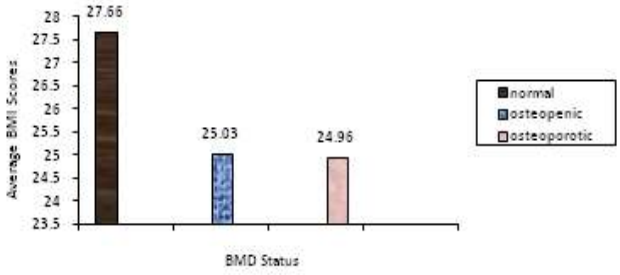

Figure 3: Comparison of BMD status with average BMI values

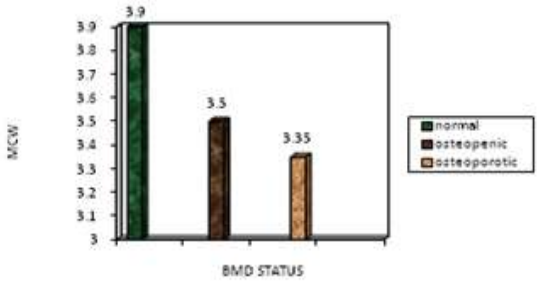

Figure 4: Comparison of MCW and BMD Status

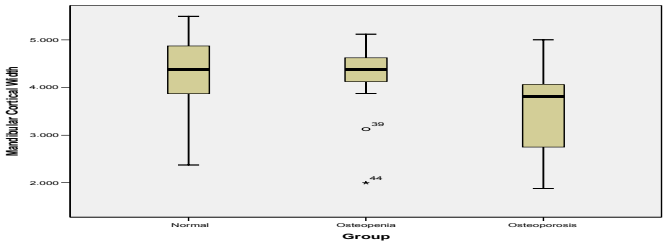

Figure 5: Comparison of MCW and BMD Status

DISCUSSION

Osteoporosis is a condition typified by low bone mass and structural deterioration of bone tissue, resulting in increased bone fragility and susceptibility to fracture.8 According to National Osteoporosis Foundation (NOF), bone deterioration is greater in women than men, and there is increase bone deterioration in postmenopausal women.[9] Systemic conditions associated with increased risk for osteoporosis include chronic obstructive pulmonary disease (COPD), gastrectomy, hyperparathyroidism, hypogonadism, multiple myeloma and celiac disease.[9]Various methods have been used to assess bone density. These include Single Photon Absorptiometry (SPA), Dual Photon Absorptiometry (DPA), Dual Energy X-Ray Absorptiometry (DXA), and Quantitative Computed Tomography (QCT).[10] All these techniques use ionizing radiations to assess bone mineral density (BMD). Quantitative ultrasound (QUS) has been

introduced as an alternative for bone mass assessment and bone mineral density, may be superior to DXA or bone biopsy. The advantages include low cost, portability, and no ionizing radiation exposure.[11] Clinical trials have indicated that a Panoramic Radiograph may be used to recognize subjects with low Bone Mineral Density, high bone turnover or fractures due to osteoporosis.[12]The present study analyzed the use of the panoramic image for evaluation of Mandibular Cortical Width in osteoporotic patients. The study also compared the diagnostic information obtained from the panoramic image with the bone mineral density in the assessment of osteoporosis and correlated them accordingly. In the present study, morphology of the Mandibular cortex was not considered as it was a subjective criterion. BMD was assessed using Quantitative Ultrasound of the distal radius as it resembles other peripheral measurements in terms of ability to predict fracture. The advantages of this method are, it is non invasive, cost effective, there is no exposure to ionizing radiation, there is easy access to the distal radius, and it can also be performed on an outpatient basis. We found that healthy patients had a BMI as low as 18.46 and osteoporotic subjects had BMI as high as 34.63, which imply that BMI values do not correlate with BMD status. This is in contrast with a study which reported that BMI significantly correlates with BMD.[13] A Turkey study of postmenopausal women evaluated the risk of osteoporosis and BMI and other parameters. The results were in accordance to one's study where the parameters like Body Mass Index were found to differ significantly between the osteoporotic andnon osteoporotic group.[14] BMD was assessed using noninvasive quantitative ultrasound of the distal radius and subjects were categorized as normal, osteopenia and osteoporotic on the basis of their BMD values of T scores recommended by WHO. Among one's study subjects, only 26% were osteoporotic which is much less when compared to the Turkey study which reported 56% osteoporotic cases based on similar criteria.[14] Decrease in cortical thickness "in postmenopausal women" suggested that the mandibular cortical width may be useful as a parameter to evaluate metabolic bone loss.[15] Measuring thickness from panoramic radiographs is associated with intrinsic errors and observer variability; hence we used two observers to measure cortical width, interobserver variation as well as intra observer variation and the difference was insignificant. ($p > 0.05$). In the present study, it was observed "in some patients with normal BMD status", MCW was as low as 2.3 mm and in some osteoporotic patients MCW was as high as 4.9 mm. Thus, there was a high variation in the cortical thickness "in different study groups". However, there was a statically significant difference in MCW between these groups. These observations were similar to the Finnish studies in which osteoporotic patients' MCW was high. In Finnish women, BMD was higher than American women.[16]Further, investigations in thelarger population would explain about the variations noted. It can be concluded from one's study that the panoramic radiograph can be a useful aid for evaluating MCW in diagnosis of osteoporosis. The panoramic image showed a statistically significant change in MCW "in patients with normal Bone Mineral Density, osteopenia and osteoporotic patients with low Inter and Intra observer variations in MCW". Body Mass Index showed drastic variations with MCW and BMD values.

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