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Prediction of osteoporosis in men and women through orthopantomograph

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ABSTRACT

Background: Osteoporosis is a systemic disease characterized by low bone mineral density, deterioration of bone structure and increased bone fragility most commonly seen in females of old age as a result of lack of estrogen. The mandibular cortical index, observed on panoramic radiograph, is useful for the screening of osteoporosis.

Aim: The aim of the study is to study and analyze thickness of mandibular cortical bone on orthopantomography as a representative for the preliminary diagnosis of osteoporosis.

Materials and Methods: The study was conducted on 100 subjects orthopantomographs which included both males and females of all ages. Patients with prior systemic diseases were not included.

Results: There were 50% males and 50% females in the age group of 21-90 with 43% in group 1 patients with all teeth, 57% in group 2 patients with few or no teeth. Group 1 had 60.5% males and 39.5% females, Group 2 had 42.1% males and 57.9% females. C1 had 43%, C2 42% and C3 15%. C1 had 52% males, 42% females, C2 had 48% males, 36% females, C3 had 30% females, 0% males.

Conclusion: There is relevant relation between age, gender and osteoporosis. With increased age there is decreased oral health seen in both males and females of middle aged. Due to decreased levels of estrogen in females they are more likely to develop osteoporosis. Use of radio morphometric indices on OPG can predict osteoporosis. There are high chances of osteoporosis in females than males.

1. Introduction

Osteoporosis is a systemic disease characterized by low bone mineral density [BMD] and microstructural deterioration, often leading to fractures. The term osteoporosis is derived from the Classical Greek words “osteon” meaning bone, “pore” meaning small passage or hole, and “osis” meaning condition. As defined by the World Health Organization (WHO) in 1994, osteoporosis is a systemic disease characterized by decreased bone mineral density (BMD), deterioration of bone structure, and increased bone fragility. In India, one in eight men and one in three women suffer from osteoporosis, making India one of the most affected countries in the world. According to the World Health Organization (WHO), 33% of women over the age of 65 suffer from osteoporosis.[1] Osteoporosis is a condition characterized by low bone density and microarchitectural deterioration of bone tissue, leading to fractures.[2] Osteoporosis is defined by the World Health Organization (WHO) as a young adult woman whose BMD is less than or equal to 2.5 standard deviations of hers.[3] Skeletal bones have different anatomy due to the different distribution of cortical and cancellous bone. Cancellous bone has a larger surface area and responds more quickly to metabolic changes than cortical bone. Moreover, due to different factors, BMD decreases at

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different rates in different bones at different stages of life.[4] Diagnosis of osteoporosis allows for preventive and therapeutic intervention and is usually accomplished by bone densitometry techniques.[5] The prevalence of osteoporosis in men is lower than in women due to their higher peak bone mass, absence of menopausal-like processes, and larger bones.[6]

Both men and women reach maximum bone density at age 30, after which peak bone mass slows and becomes more pronounced in postmenopausal women. Osteoporosis is the most common metabolic bone disease in adults, especially postmenopausal women.Osteoporosis is most common in older women due to oestrogen deficiency, known as menopausal osteoporosis.[7]

Various quantitative and qualitative indices calculated on panoramic oral radiographs have been proposed as useful screening tools for decreased bone mineral density (BMD).[8] Older people with osteoporosis have higher morbidity and mortality due to increased bone fragility and increased fracture frequency.[9] People with a history of osteoporotic fractures are also prone to increased resorption and thinning of the lower cortex of the mandible.[10] Risk factors: older age, female sex, rheumatoid arthritis, history of fracture in a first-degree relative, underweight, hormone deficiency, long-term use of glucocorticoids, chain smoking, vitamin D or calcium deficiency, alcoholism, sedentary lifestyle habits etc of life.[11]

Pathologic fractures occur as a result of osteoporosis. Osteoporosis is a serious health and economic problem. Hence the importance of early diagnosis of this pathology.[12] Mandibular alterations and skeletal osteoporosis share many risk factors such as age, menopause, race, smoking, low-calcium diet, certain medications, and genetic factors such as familial osteoporosis.[13] The routine use of panoramic radiographs in the planning of prosthetic, orthodontic, and implant treatment in elderly patients has made it possible to create a database containing the mandibular features of these patients.[14]

Screening and diagnosis use bone mineral density (BMD) measurements to estimate bone strength. Dual-energy X-ray absorptiometry (DXA), densitometer evaluation of vertebral fractures, peripheral dual-energy X-ray absorptiometry, computed tomography-based absorptiometry (quantitative computed tomography) and quantitative Ultrasound densitometry, orthopantomography (OPG).[15]

Panoramic radiographs are a common diagnostic tool during routine dental examinations or before multiple dental procedures, so if dentists can use them to identify patients at increased risk for osteoporosis, clinical can be of great value. Orthopantomography (OPG) findings can be used as an early indicator of changes in total bone mineral density. Like the mandible, bones with high cortical bone content are also susceptible to resorption. Dental symptoms that may indicate loss of bone density include loose teeth, receding gums, and ill-fitting or loose dentures.[16]

Bone biomarkers such as serum alkaline phosphatase, bone specific alkaline phosphatase, serum osteocalcin are the main three bone biomarkers which are tested for osteoporosis. For the diagnosis of osteoporosis bone mineral density tests are much more preferred than bone biomarkers test. Bone biomarkers are not currently recommended for diagnosing osteoporosis, but may be useful for individual monitoring of osteoporotic patients treated with antiresorptive drugs.[17]

Recent studies have shown that his x-ray examination of the mandible is an effective method for early detection of osteoporosis.[18] Fractures due to osteoporosis result in reduced physical exercise, increased chances of death and more medical loss.[19] Recent investigators have demonstrated a significant association between mandibular and peripheral skeletal BMD in postmenopausal women. Several studies have associated low BMD of the mandible and peripheral skeleton with loss of mandibular alveolar bone and tooth loss.[20]

The diagnostic performance of cortical measurements for identifying postmenopausal women with osteoporosis is roughly comparable to that of questionnaire-based screening tools.[21] Edentulous women with low bone mass have deeper frontal regions. The thickness of the mandibular cortex is strongly influenced by age.[22] The mandibular cortex index, a qualitative index based on morphological changes in the lower cortex observed on panoramic radiographs, is a useful tool for screening postmenopausal patients with osteoporosis.[23] Panoramic radiographs are often used for routine examination of edentulous patients, especially before the fabrication of complete dentures.[24,25]

The aim of this study was to examine and analyse mandibular cortical thickness on orthopantomography as a representative preliminary diagnosis of osteoporosis.

The objectives of this study are:Group 1: Determination of mandibular cortical thickness analysis on her OPG in patients with all teeth for reliability of mandibular cortical thickness as an indicator of osteoporosis

Group 2: Determination of mandibular cortical thickness analysis for OPG in patients with few or no teeth

Determining the reliability of mandibular cortical thickness as an indicator of osteoporosis.

2. Materials and Methods

Ahmedabad Dental College was included in the study. This study was conducted on 100 orthopantomography.

Inclusion criteria were men and women of all ages and routine dental disease recommended for OPG.

Exclusion criteria were positive medical history of:

1. Metabolic bone disease (hyperparathyroidism, hyperthyroidism, osteocalcin, osteogenesis imperfecta,

renal osteodystrophy, and Paget's disease).
2. Hormone therapy (oestrogen or pharmaceutical supplements) or medications for osteoporosis and other medications that affect bone metabolism, such as corticosteroids.
3. Cancer with bone metastases.
4. Destructive lesions of the jawbone (e.g. malignant tumours and osteomyelitis).
5. Kidney failure or blood cancer.
6. Tobacco or alcohol use.

For patients presenting with maxillofacial problems and pain/without pain during 2012-2017, Department of Oral Medicine and Radiology (OMR), Ahmedabad Dental College and Hospital, Ahmedabad a cross-sectional clinical study was conducted in the study protocol was approved by the institutional ethics committee. They underwent a thorough clinical examination and OPG was taken if necessary. This study included a total of 100 cases, including 50 males and 50 females.

The study protocol was approved by the institutional ethics committee. OPG was collected from each patient at the Department of Oral Medicine and Radiology, Ahmedabad Dental College. Prior to collection, each individual was thoroughly examined and a dental history was recorded. Dental issues such as mobility, carious lesions, percussion pain, gingival and periodontal health were thoroughly examined.

The individual has been referred to OPG regarding the complaint. Allorthopantomography's were recorded on an OPG machine (model Satellac X Mind Pano D+) with Digora software. All radiographs were acquired using the technique developed by Klemetti et al. The proposed criteria were anal. Visual analysis was performed by radiographic imaging of the inferior margin of the mandible near the mental foramen on panoramic radiographs based on the mandibular cortical index (MCI). MCI of the mandibular inferior margin on panoramic radiographs was essentially a 3-point index (C1, C2, C3) and was scored using the following criteria:

C1: The endosteal margin of the cortex was even and sharp on both sides

C2: The endosteal margin showed semilunar defects (lacunar resorption) or seemed to form endosteal cortical residues (one to three layers) on one or both sides

C3: The cortical layer formed heavy endosteal cortical residues and was clearly porous

The MCI, which consisted of intimal cortical debris and was clearly porous, is simple, does not require special equipment for quantification, compared to other densitometry and morphometric indices considered. Save time. In addition, it mainly uses the lower cortex of the mandible away from the alveolar bone, and is a component of the basal bone that is relatively difficult to absorb due to local factors such as periodontitis. Based on the WHO criteria for osteoporosis, patients with confirmed osteopenia, osteoporosis, or normal status were recorded and the results compared to previously collected OPGs to generate interpretations.

Results were indexed and evaluated data were analysed using the discriminant method of the statistical software package SPSS 21.0 for MS Windows and $p<0.05$ was considered statistically significant. Discriminant function analysis is used to determine variables that distinguish between osteopenia and osteoporosis.

3. Results

This clinical study was conducted in patients attending the Department of Oral Medicine and Radiology at Ahmedabad Dental College Hospital. This study included a total of 100 cases with OPG provisionally diagnosed by clinical examination as either C1, C2, or C3 based on the mandibular cortex index.

Table 1 shows the distribution of the study population by age group and gender. The monitored population in the age group from 21 to her 90 was 50% male and 50% female. For men, the distribution of the observed population was 2 in the age group 21-30, 13 in the age group 31-40, 24 in the age group 41-50, and 11 in the age group 51-60 was there were no patients in the 61–90-year-old group. For women, the distribution of the monitor population was 23 in the 51-60 age group, 19 in the 61-70 age group, 7 in the 0-71-80 age group, and 1 in the 81-90 age group was a person Age group; 21 to 50-year-old group had no patients. This indicates a highly significant relationship ($p<0.001$) between age and gender.

Table 2 shows the distribution of the study population by age and group. Group 1 represented 43% of the population and Group 2 represented 57% of the population. Group 1 consisted of 4.3% in the 21-30 group, 23.3% in the 3140 group, 27.9% in the 41-50 group, 37.2% in the 51-60 group, and 7% in the 61-70 group. There were no patients in the 71–90-year-old group. In group 2, 5.3% aged 31-40, 21.1% aged 41-50, 31.6% aged 51-60, 28.1% aged 61-70, 12.3% aged 71-80, and 1, 81-90 8% in the age group. There were no patients in the 21–30-year-old group. This shows a highly significant relationship ($p<0.001$) between age and group.

Table 3 shows the distribution of the study population by gender and group. Of the total population examined, 50% are male and 50% are female. 43% of the population belongs to Group 1 and 57% of the population belongs to Group 2. Group 1 consisted of 60.5% males and 39.5% females. Group 2 consists of 42.1% male, 57.9% female. There is no significant association between sex and group ($p>0.71$), as dentition depends on other factors.

Table 4 shows the distribution of the study population by age group and type c. The distribution of the C-type study population is 43% C1, 42% C2 and 15% C3. Group C1 divides the study population by age group. 21-30 is 2, 31-40

is 10, 41-50 is 12, 51-60 is 16, 61-70 is 3. Group C1 has no patients in the age group 71-90 years. For group C2, the distribution of the study population is: 31-40 is 3, 41-50 is 12, 51-60 is 18, 61-70 is 9. C2 has no patients in the 21-30 and 71-90 age groups. Group C3 is the distribution of the study population. 61-70 is 7, 71-80 is 7, 81-9- is 1. Group C3 has no patients in the age group 21-60 years. There is a highly significant relationship (p<0.001) between age and type c, indicating a decrease in cortical bone thickness with age.

Table 5 shows the distribution of the study population by sex and C genotype. The distribution of type c study population is 43% C1, 42% C2, and 15% C3. In group C1, 52% were male and 43% were female. In the C2 group, 48% were male and 36% were female.

Table 1: Distribution of study population according to age group and gender

Age	Gender		Total
	Male	Female	
21-30	2 (100.0%)	0 (0.0%)	2 (100.0%)
31-40	13 (100.0%)	0 (0.0%)	13 (100.0%)
41-50	24 (100.0%)	0 (0.0%)	24 (100.0%)
51-60	11 (32.4%)	23 (67.6%)	34 (100.0%)
61-70	0 (0.0%)	19 (100.0%)	19 (100.0%)
71-80	0 (0.0%)	7 (100.0%)	7 (100.0%)
81-90	0 (0.0%)	1 (100.0%)	1 (100.0%)
Total	50 (50.0%)	50 (50.0%)	100 (100.0%)
Chi-square test	0.001 (highly significant)		

Table 2: Distribution of study population according to age and groups

Age	Group		Total
	Group 1	Group 2	
21-30	2 (4.7%)	0 (0.0%)	2 (2.0%)
31-40	10 (23.3%)	3 (5.3%)	13 (13.0%)
41-50	12 (27.9%)	12 (21.1%)	24 (24.0%)
51-60	16 (37.2%)	18 (31.6%)	34 (34.0%)
61-70	3 (7.0%)	16 (28.1%)	19 (19.0%)
71-80	0 (0.0%)	7 (12.3%)	7 (7.0%)
81-90	0 (0.0%)	1 (1.8%)	1 (1.0%)
Total	43 (100.0%)	57 (100.0%)	100 (100.0%)
Chi-square test	0.001(highly significant)		

4. Discussion

Osteoporosis is a systemic disease characterized by low bone mineral density [BMD] and microstructural deterioration, often leading to fractures. As defined by the World Health Organization (WHO) in 1994, osteoporosis

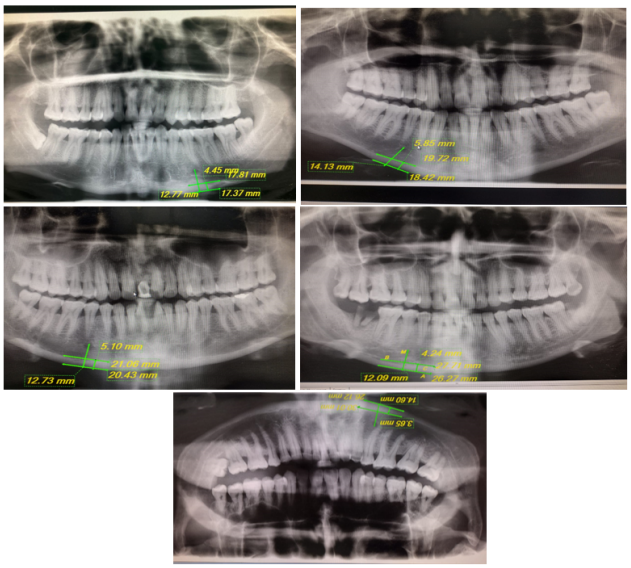

Fig. 1: Normal cortex

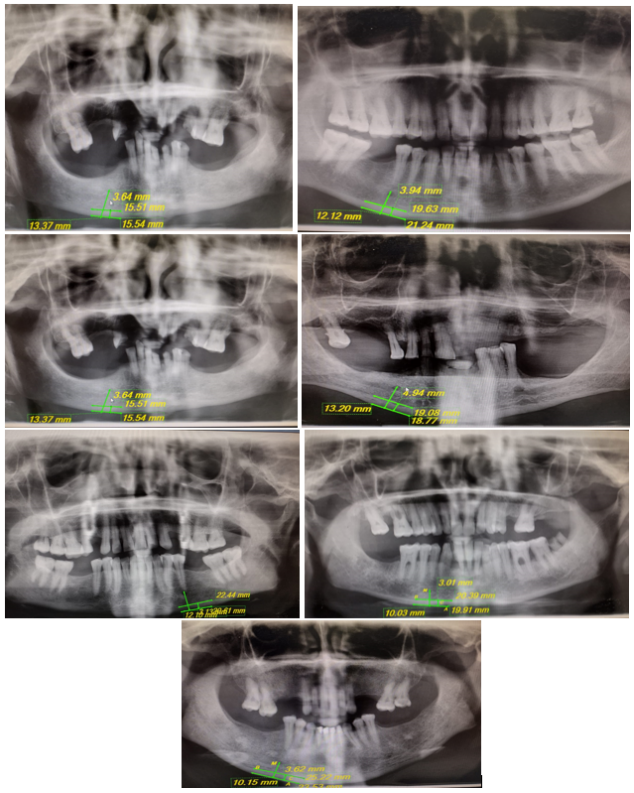

Fig. 2: Mild to moderate eroded cortex

Table 3: Distribution of study population according to gender and groups

Gender	Group		Total
	Group 1	Group 2	
Male	26 (60.5%)	24 (42.1%)	50 (100.0%)
Female	17 (39.5%)	33 (57.9%)	50 (100.0%)
Total	43 (100.0%)	57 (100.0%)	100 (100.0%)
Chi-square test	0.71 (not significant)		

Table 4: Distribution of study population according to age group and C types

Age	C1	C2	C3	Total
21-30	2 (100.0%)	0 (0.0%)	0 (0.0%)	2 (100.0%)
31-40	10 (76.9%)	3 (23.1%)	0 (0.0%)	13 (100.0%)
41-50	12 (50.0%)	12 (50.0%)	0 (0.0%)	24 (100.0%)
51-60	16 (47.1%)	18 (52.9%)	0 (0.0%)	34 (100.0%)
61-70	3 (15.8%)	9 (47.4%)	7 (36.8%)	19 (100.0%)
71-80	0 (0.0%)	0 (0.0%)	7 (100.0%)	7 (100.0%)
81-90	0 (0.0%)	0 (0.0%)	1 (100.0%)	1 (100.0%)
Total	43 (43.0%)	42 (42.0%)	15 (15.0%)	100 (100.0%)
Chi-square test	0.001(highly significant)			

Table 5: Distribution of study population according to gender and C types

Gender	C1	C2	C3	Total
Male	26 (52.0%)	24 (48.0%)	0 (0.0%)	50 (100.0%)
Female	17 (34.0%)	18 (36.0%)	15 (30.0%)	50 (100.0%)
Total	43 (43.0%)	42 (42.0%)	15 (15.0%)	100 (100.0%)
Chi-square test	0.001(highly significant)			

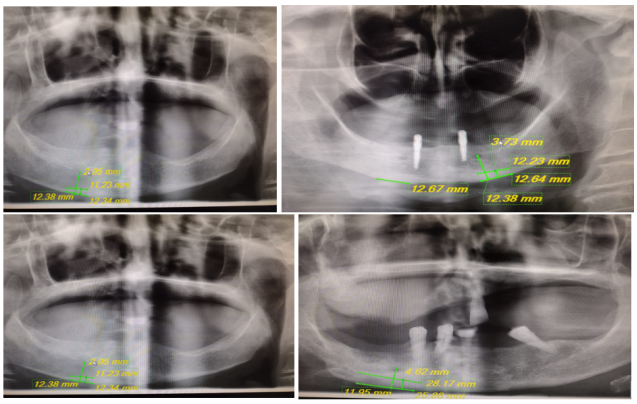

Fig. 3: Severely eroded cortex

is a systemic disease characterized by decreased bone mineral density (BMD), deterioration of bone structure, and increased bone fragility. In India, one in eight men and one in three women suffer from osteoporosis, making India one of the most affected countries in the world. According to the World Health Organization (WHO), 33% of women over the age of 65 suffer from osteoporosis.[1] Osteoporosis is defined by the World Health Organization (WHO) as a young adult woman whose BMD is less than or equal to 2.5 standard deviations of hers.[3]

Skeletal bones have different anatomical structures due to the different distribution of cortical and cancellous bone. Cancellous bone has a larger surface area and responds more quickly to metabolic changes than cortical bone. In addition, different factors cause bone mineral density (BMD) to decline at different rates in different bones at different times.[4]

Diagnosis of osteoporosis allows for preventive and therapeutic intervention and is usually accomplished with bone densitometry techniques.[5] Recent studies have shown that x-rays of the mandible are an effective method for early detection of osteoporosis. It has been suggested that it is possible.[6] DEXA scans are performed on the spine and hip joints, as the main problems of osteoporosis affect these areas. DEXA scans are not routinely used for jawbone. DEXA scans are not routinely performed and calibration studies on the range of BMD values representing optimal values have not yet been performed. DEXA was not commonly used for mandibular BMD assessment. Thus, orthopantomography technique more used than DEXA.[26] A study published in 2009 by E Calciolari et al comparing DEXA scans of the jaw and hip showed no correlation between the two areas.[27] DXA scans also have their own limitations as they are static measurements and expensive tests with limited availability in many parts of India.[28]

The current study divides patients into males and females. It is observed that the predisposition to osteoporosis is greater in women than in men. The mandibular cortex has an area between the mental foramen and the anterior horn region that is useful in identifying women at increased risk of osteoporosis. Radio morphometric indices evaluated from panoramic dental radiographs can be used to identify women with low bone density. This is 50.0% (p<0001).[16]

The current study divides patients into two groups. Group 1 has all teeth and Group 2 has few or missing teeth. In osteoporosis, the jawbone shrinks, leading to tooth loss with age. This is consistent with a study by K. HORNER et al. and H. DEVLIN et al. (2013) show 57% in the 31–90-year-old group. 31.6% he was 51–60 years old (p < 0.001).[29] Determination of jaw bone loss and classification of residual ridge resorption is often performed using panoramic radiographs. Its early diagnosis is fundamental to prevent complications of osteoporosis. Osteoporosis usually presents in the maxillofacial area, including the jawbone.[12]

In the current study, divides patients into two groups based on gender. In osteoporosis, women tend to lose teeth due to loss of bone density with age, but tooth loss is also seen in men with periodontal disease. Therefore, there is no significant correlation (p>071) between sex and tooth loss, consistent with a study by Charlene W. J et al. and Jairam Reddy et al. (2013) agrees.[30]

In this study, patients are grouped into different age groups based on mandibular cortex thickness. In osteoporosis, the thickness of the mandibular cortex is reduced and divided into three categories. C1 is normal crust, C2 is light to moderate crust, and C3 is severely eroded crust, consistent with studies by Stefka Peychev et al., Hristina Lalabonova et al. and Hristo Daskalov et al. (2012) 43.0% C1, 42.0% C2 and 15.0% C3 in age groups 21-30, 31-40, 41-50, 51-60, 61-70, 71-80 and 81-90. Year of finding indicates mild to moderate cortical erosion observed at ages 51–60 (52.9%). This shows a high significance (p < 0.001) of increasing cortical bone erosion with increasing age.[2]

The current study divides patients into males and females based on osteoporosis classification (C1, C2, C3). In osteoporosis, there was a significant association between mandibular cortex index (MCI) and osteoporosis, and the incidence of osteoporosis increased from C1 group to C2 group to C3 group. This is consistent with the work of Pankaj R. Bodade et al. and Rajendra N Mody et al. (2013) shows 34.0% in C1, 36.0% in C2 and 30.0% in C3 in females compared to 52.0% in C1, 48.0% in C2 and 0.0% in C3 in males, meaning, that there is a highly significant relationship (p< 0.001) between gender and the incidence of osteoporosis, suggesting that women have a higher incidence of developing osteoporosis with increasing age.[23]

The current study conducted on 100 orthopantomography used the panoramic mandibular index and the mandibular cortical index as radio morphometric indices to assess mandibular cortical thickness. In osteoporosis, there is a significant erosion of the endosteal edge of the cortical bone in the lower jaw, which is consistent with a study by Somayeh Nemati et al, Zahra Dalili Kajan et al, Bardia Vadiati Saberi et al, Zohre Arzin et al, Mohammad Hashem Erfani et al. al (2016) showing PMI and MCI have high diagnostic value for predicting low BMD.[3]

Horner et al in a study published in 2002 concluded that if cortical width measurements were less than 3 mm, DEXA screening should be performed to confirm BMD.[31]

Summary and ConclusionIn my study, there is a highly significant relationship between age, gender and the incidence of osteoporosis. As we age, there is a decline in oral health, including receding gums, periodontal disease, leading to decreased bone health and tooth loss, as seen in both middle-aged men and women. Also, due to the drop in oestrogen levels, women are more likely to develop osteoporosis due to a decrease in overall calcium levels and bone mineral density. Through this study, we conclude that radio morphometric indices can be used to measure cortical bone height and cortical bone thickness in relation to the location of the mental foramen on the OPG and predict the likelihood of osteoporosis in an individual. Women are more likely to have osteoporosis than men.

Because osteoporosis is a preventable and early-detected disease, diagnostic procedures are very important. Dentists are often the most frequent physician visits in the geriatric population, and dental x-rays are the most commonly used imaging modality. Panoramic X-rays are widely used for routine examinations and are available everywhere. It has been scientifically proven that bone loss due to osteoporosis also affects the mandible, and this loss of bone density can be detected during routine oral examinations or prior to dental treatment with an orthopantomogram. Scientifically proven to be detectable on both apical radiographs. There are methods that require measurement of PMI, MCI, and a simple visual inspection of the klemetti trabecular pattern makes it possible to observe that there is evidence of bone loss. Based on this study, we can recommend that orthopaedic surgeons use OPG as a screening tool. The high cost associated with advanced imaging techniques and the unavailability of this equipment in many diagnostic centres limits its usefulness. OPG is cost effective. Using it for screening with low skeletal BMD is economical and beneficial as dentists can refer patients for further examination, if necessary, should be referred for further evaluation of osteoporosis by a dentist. This helps to diagnose cases of changes in bone density that are only recognized after a fracture has occurred.

5. Conflict of Interest

No conflict of interest.

6. Acknowledgment

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