Periodontal health status for post-menopausal women with and without osteoporosis (clinical and radiographical study)

Hadeel Mazin Akram, Areej Ahmed Najm, Suzan Ali

College of Dentistry University of Baghdad

Abstract

Osteoporosis is a natural part of aging in women, it's considered as risk indicator for a periodontal diseases. Many investigators have demonstrated a significant association between BMD of the mandible and periodontal disease in postmenopausal women. Panoramic morphometric indices such as Panoramic Mandibular Index (PMI) and Antigonial Index (AI) are effective indices to diagnose osteoporosis in postmenopausal women. The aims of this study were first :to measure the periodontal parameters , PMI and AI by panoramic radiograph in osteoporotic women compared to normal healthy groups, and second to assess the accuracy of these parameters and indices to diagnose reduced bone mineral density which diagnosed by DEXA scan. Seventy two women were enrolled in this study; classified into three groups according to T score of DEXA, Group (1) G1 24 healthy premenopausal women, Group (2) G2, 24 non osteoporotic postmenopausal women and Group (3) G3, 24 osteoporotic postmenopausal women. Clinical examination involved measuring of periodontal parameters; Plaque Index(PLI), Gingival Index (GI), Probing Pocket Depth(PPD), Clinical Attachment loss (CAL). Radiographic examination involved panoramic radiograph for each women with measuring two panoramic indices (PMI) and (AI). After DEXA scan for all patients to measure the bone mineral density. Highest mean of periodontal parameters were belong to G 3 they were (1.75 ± 0.48, 1.73 ± 0.35, 5.44 + 0.91, 5.28 ± 1.28) for PLI, GI,PPD, and CAL respectively while lowest mean for radiographic parameters were belong to G3, they were (1.27 ± 0.37, 0.15 ± 0.03) for AI and PMI respectively. Analyses of variance were applied to show the intragroup comparison. Regarding the radiographical parameters (AI, PMI) highly significant differences were found between the three groups. Postmenopausal women with osteoporosis are more apron to periodontal diseases, PMI and AI considered as important Panoramic indices and sensitive indicator for diagnosis of osteoporosis.

Keywords: Postmenopausal, periodontal disease, PMI, AI , DEXA, osteoporosis.

INTRODUCTION

Osteoporosis and periodontitis are common diseases affecting elderly population. They are bone destructive diseases. Osteoporosis considered as risk indicator for periodontitis, it is silent skeletal disease characterized by reduction in bone mass and micro architectural changes in the bone, which leads to increased bone fragility it's frequently not detected until a fracture occurs [1]. These disorders may be related. More than one-third of the female above age 65 suffers from osteoporosis, Estrogen deficiency is the dominant pathogenic factor for osteoporosis in women.[2] Both osteoporosis and periodontitis may be related, to define chronic periodontitis it's an inflammatory disease of the tooth supporting structure associated with bacteria. It's may be localized or generalized destruction of the supporting tissues of the teeth that involved alveolar bone, periodontal ligament and soft tissues if left untreated can lead to teeth loss. [3] The gold standard for osteoporosis diagnosis is measurement the bone mineral density (BMD) by dual-energy X ray absorptiometry (DEXA). BMD values expressed as a T- score are divided according the World Health Organization (WHO) into: 1.normal (T–score > -1.0), 2. Osteopenia (T-score between -1.0 and-2.5), 3. Osteoporosis (T-score < -2.5) BMD decreased gradually after the age of thirty five in men and women. Women loss BMD more rapidly than men especially in menopausal age. [4,5]

Many studies also linked between low BMD of the mandible and the peripheral skeleton with alveolar bone loss of the mandible and tooth loss in menopause women.

Dental panoramic radiology (OPG) is a useful imaging modality by which the dentist can evaluate the jaw bone and the whole dentition, also its play a role in identifying post-menopausal women with undetected osteoporosis. Clinicians have started to measure important mandibular panoramic indices, such as panoramic mandibular index (PMI) defined as the ratio of the mandibular cortical width (MCW) to the distance between the superior or inferior margin of the mental foramen and the inferior margin of the mandibular cortex, was introduced by Benson in 1991 to compensate for the vertical magnification of panoramic radiography. It has been shown to decrease significantly with increased age in women.[6] and the antegonial index (AI) for diagnosis osteoporosis in menopausal women. The aims of this

study were firstly to examine the periodontal health status for pre and post-menopausal women with and without osteoporosis and measuring PMI and AI indices, secondly to compare the periodontal and panoramic parameters among the three study groups.

MATERIALS AND METHODS

Seventy two women were enrolled in the study, 48 postmenopausal women of an age ranged between (50-70) years old. And 24 premenopausal healthy women. The consent form for each patient was obtained to explain the aim of study. The study sample classified according to DEXA scan into three groups
1. Group1(G1): 24 premenopausal healthy women of an age 20-30 years old.
2. Group 2(G2): 24 non osteoporotic post-menopausal women
3. Group 3(G3) : 24 post-menopausal women with osteoporosis

Exclusion Criteria include:
1. Diabetes mellitus patients
2. Smoking
3. Pregnancy
4. Patient with a history of malignancy
5. Patients with a systemic disease that affect bone metabolism like hyperthyroidism, hypothyroidism, hyperparathyroidism , patients with renal impairment and those with anticonvulsant , corticosteroid and blood thinners drug
6. Female that previously diagnosed osteoporosis and using bone active medications such as calcium, Vitamin D.

BMD Assessment

BMD was measured by using DEXA (Dual Energy X-ray Absorptiometry). Measurement of T-score in lumber spine is done by osteosys Dexxum 3 machine, At the X-Ray Institute in the Medical City in Baghdad. The BMD scores were given as the 'T' score according to WHO classification of osteoporosis [5].
* Normal BMD was defined as T- score of -1.0 or more
* Osteoporosis was defined as a BMD T- score of -2.5 or less.

Radiographical examination by digital panoramic radiograph.
Panoramic radiographic examination (PLANMECA, Helsinki, Finland) was taken for each selected participant for the evaluation

of dental status for each female at the radiology clinic/College of Dentistry/ University of Baghdad.

Measurement of Mandibular Cortical Width

(MCW) Cortical width at the mental foramen was measured by drowning a line tangential to the lower border of inferior cortex of the mandible, another line was drawn parallel to the first line from the upper border of inferior cortex. [6] The distance between the two lines at the mental foramen, when perpendicular line is drawn passing through the center of mental foramen (distance between most outer point of right and left side mental foramen) was considered as MCW.

Measurement of Panoramic Mandibular Index (PMI) and Antegonial Index (AI)

PMI is defined as the ratio of the thickness of the inferior cortex in the mental region (MCW) over the distance between the lower border of the mandible and the superior border of the mental foramen. The PMI was measured bilaterally and the mean PMI was calculated.[7]

Antegonial Index (AI) is the measurement of the cortical width in the region anterior to the gonion at a highest point by extending a "best fit" line along the anterior border from the ascending ramus down to the lower border of the mandible measurement were made on both sides and their mean was calculated.[8](Figure 1)

Periodontal examination:

Measurement of clinical periodontal parameters were performed by using Michigan O periodontal Probe at the four sides (buccal or labial, lingual or palatal, mesial and distal) of all teeth excluding the third molar tooth; participants should have at least (20) teeth. The data collected included:-

Measurement the Plaque Index system (PLI) [9], Gingival Index system (GI) [10]. Bleeding on Probing (BOP) [11]. Probing Pocket Depth (PPD)[12]. And Clinical Attachment Level (CAL)[12]. Statistical analysis was evaluated by employing t-test, Analysis of variance (ANOVA) test, and Pearson's coefficient of correlation (r).

Significant (S) = $0.05 \geq p > 0.01$
Highly significant (HS) = $P \leq 0.01$
Non-significant (NS) = $P > 0.05$

This study implicating human subjects is in accordance with the Helsinki declaration of 1975 as revised in 2000 and that it has been approved by the relevant Institutional Ethical Committee.

RESULTS AND DISCUSSION

Table (1) revealed descriptive analysis mean and standard deviation of the periodontal parameters (PLI, GI, PPD, CAL) and the radiographical parameters (AI, PMI) of the three groups. Highest mean of periodontal parameters were belong to G3, they were (1.75±0.48, 1.73 ± 0.35, 5.44 ± 0.91, 5.28 ± 1.28) for PLI, GI, PPD, and CAL respectively. The lowest mean for radiographical parameters were belong to G3, they were (1.27 ± 0.37,0.15 ± 0.03) for AI and PMI respectively. Table (2) showed intergroup comparison regarding the radiographical parameters, T- test was applied. For AI none significant differences were found between G1 & G2, while highly significant differences were found between G1&G3, G2 &G3. For PMI Highly significant difference was found between G1&G3, and significant differences were found between G2& G3, and between G1&G2. Table (3)T- test was applied to show the intergroup comparison regarding periodontal parameters, Highly significant differences were found between each group pairs. Analyses of variance were applied in table (4) to show the intragroup comparison regarding the radiographical parameters (AI, PMI) highly significant differences were found between the three groups

Table (5) showed the correlation between radiographical parameters for G1 and G3. Significant strong correlation was found between AI&PMI for G1 & G3, p- value was 0.007&0.01 respectively (P <0.001). Osteoporosis is a major health problem and important risk indicator for developing periodontal diseases affecting middle aged and elderly population, especially women at postmenopausal age.[13] several techniques used to diagnose osteoporosis the most common one is BMD assessment by dual-energy X-ray absorptiometry, have been useful in identifying peoples with low BMD or at high risk for osteoporotic fracture.in this study the clinical examination involved measuring the periodontal parameters (PLI, GI, PPD, CAL) for the three groups, women at menopausal age with osteoporosis showed higher mean values, and highly significant differences were found in comparison with other two groups. These results support the studies that prove women at postmenopausal age with osteoporosis are more apron to develop periodontal diseases than non-osteoporotic women. [14,15,16] lack of estrogen after menopause is a critical risk factor in bone loss, Lower estrogen levels affect bone metabolism and also affect the oral cavity, causing inflammatory changes in the body that can lead to gingivitis.[17]

Many studies approved that the BMD in the mandible be positively correlated with that in lumbar spine, femoral neck and forearm, important sites in osteoporosis [18]. For radiographical examination, Identification of the signs of osteoporosis in dental panoramic radiographs is important in the diagnosis of this condition. [19] Many panoramic radiographic indices, have been developed to measure the cortical shape and width, either qualitatively [20, 21] or quantitatively. [22]

The present study measure the PMI and AI index values of postmenopausal female patients with and without osteoporosis and a control group using panoramic radiography. Benson et al in (1991) [6] who was the first proposed PMI as radio morphometric index of adult cortical bone mass. The studies on PMI values have been performed mostly on women. Klemetti et al[22] conducted a study on 355 femals using DEXA scan and panoramic radiograph to measure the PMI, they conclude a strong relation between the two methods and reported that PMI can be used as a sensitive indicator for low bone mineral density by detecting the slight changes in its value from the average value of the normal healthy population. In Horner and Devlin study [23], the MCI, PMI values measured in women with osteoporosis on panoramic radiographs and compared with the mandibular bone values measured with DEXA, and they found a significant relation between the two results. Studies showed that PMI value was decreased with increasing age, smaller among women compared with men. And they are smaller in women with osteoporosis than in healthy women .the present study reported lowest mean value of PMI for postmenopausal women with osteoporosis, significant differences were found between G1 & G2, and between G3 & G2 while highly significant differences between G1&G 3.In this study, the AI had good reliability, lowest mean value of AI was for G3, highly significant differences were observed among the three groups. Positive significant correlation was found between PMI& AI. Various studies have suggested positive correlation between AI and BMD. This result disagree with the Léger ton, et al study results [24], Leite FA, et al[25] and Yashoda Devi et al[13] results, these studies found a negative correlation between AI values and BMD, and this may be due to differences in measuring techniques or the study groups age, ratio and health condition but agree with the other study results of edentulous females that found AI values measured on panoramic films were lower in the group with osteoporosis, and antegonial region measurements are a useful method to identify osteoporosis risk groups[26]. Panoramic radiographs measurements are important in dental diagnosis for over forty years [27] mandibular cortical porosity and width seen

on dental panoramic radiographs are potentially useful for assessing an individual risks for systemic osteoporosis necessary drawings should be made and finally these configurations should coincide with each other. That is, as the operations that must be performed for measuring index increases, the measurement error would also increase, so it might be more effective to use simple indexes to reduce measurement error and increase agreement between. In 2003 Balcikonyte et al.[28] stated that the efficacy of panoramic based indices such as mandibular ratio index in diagnosing the osteoporosis is low to moderate. The results of the current study not confirmed with those results, and this may be due to differences in measuring the index, the previous authors measure the mandibular height by their own index which was not completely identical to the PMI. While Bajoria et al.[29] reported that Panoramic morphometric indices such as (MCI, PMI, AI, and MI) can be used as screening tools for determining osteoporosis. The results of the current study agreed with their results. Although there are problems with repeatability of panoramic radio morphometric indices [25], most authors conclude that the efficacy

of these indices in diagnosing osteoporosis is sufficient [21]. The choice of post-menopausal female for the study because most of osteoporotic radiographic changes occurs in postmenopausal population and compared with young age group as they have good bone mass.
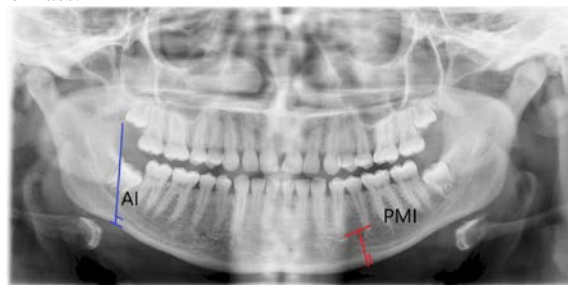

Figure1: panoramic mandibular index (PMI) and Antigonial index (AI) on OPG

Table 1: describe mean and standard deviation of periodontal parameters and radiographic parameters for the three groups

Group	PLI	GI	PPD	CAL	AI	PMI
Group 1 (Normal)	0.42 + 0.16	0.7 + 0.25			2.46 + 0.42	0.25 + 0.07
Group 2 (Post-Menopause)	1.02 + 0.38	1.22 + 0.24	4.38 + 0.36	3.98 + 0.71	2.35 + 0.46	0.2 + 0.05
Group 3 (Osteoprosis)	1.75 + 0.48	1.73 + 0.35	5.44 + 0.91	5.28 + 1.28	1.27 + 0.37	0.15 + 0.03

Table 2: Inter group comparison for the radiographic parameters with significant differences using T- test

Groups	AI			PMI		
	T-TEST	P value	Sig.	T-TEST	P value	Sig.
Group 1 & Group 2	0.89	0.3	NS	3.18	0.002	S
Group 1 & Group 3	10.44	<0.001	HS	6.42	<0.001	HS
Group 3 & Group 2	8.9	<0.001	HS	3.53	0.001	S

Table (3): Intergroup comparison for the periodontal parameters with significant differences using the T- test

Groups	PLI			GI			PPD			CAL		
	T-TEST	P value	Sig.	T-TEST	P value	Sig.	T-TEST	P value	Sig.	T-TEST	P value	Sig.
Group 1 & Group 2	-7.15	<0.001	HS	-7.34	<0.001	HS						
Group 1 & Group 3	-13.01	<0.001	HS	-11.88	<0.001	HS						
Group 3 & Group 2	5.9	<0.001	HS	-5.91	<0.001	HS	5.28	<0.001	HS	4.35	<0.001	HS

(S) = 0.05≥ p > 0.01, (HS) = P ≤ 0.01 (NS) = P > 0.05

Table 4: intragroup comparison for the radiographic parameters of the three groups with significant differences using ANOVA test

Radiographic parameters	df	MS	F	P-Value	Sig.
AI	2	10.39	59.22	<0.001	HS
PMI	2	0.056	21.12	<0.001	HS

Table 5: Correlation between radiographic parameters for group 1&3 with significant differences using Pearson correlation test

Groups	Parameters	R	P-value	Sig
Group 1	AI & PMI	0.53	0.007	S
Group 3	AI & PMI	0.51	0.01	S

CONCLUSIONS

DEXA scan is a noninvasive technique that considered as the gold standard method for the diagnosis of osteoporosis. There was a strong correlation between osteoporosis , periodontal disease and decreased panoramic morphometric indices. So periodontal parameters ,PMI and AI can be used as an indicators for low bone mineral density in postmenopausal women which helpful in early diagnosis of osteoporosis.

REFERENCES

1. Esfahanian V, Shamami M, Shamami S. Relationship Between Osteoporosis and Periodontal Disease: Review of the Literature. J Dent (Tehran). 2012; 9(4): 256–264.
2. Richard A. Reinhard T. Influence of Estrogen and Osteopenia/Osteoporosis on Clinical Periodontitis in Postmenopausal Women. Journal of Periodontology 1999;70(8): 823-828
3. Kinane DF. Causation and pathogenesis of periodontal disease. Periodontol 2001; 25: 8–20.

4. Gulsahi A, Yuzugulla B, Imirazalioglu P, Genc Y, Assessment of panoramic radiomorphometric indices in Turkish patients of different age groups , gender and dental status. DentomaxillofacRadiol. 2008; 37:288-292

5. Tözüm TF , Taguchi A. Role of dental panoramic radiographs in assessment of future dental conditions in patients with osteoporosis and periodontitis. The New York State Dental Journal 2004; 70(1):32-35.

6. Benson BW, Prihoda TJ, Glass BJ. Variations in adult cortical bone mass as measured by a panoramic mandibular index. Oral Surg Oral Med Oral Pathol 1991; 71: 349-356.

7. Leite AF, Figueiredo PT, Guia CM, Melo NS, Paula APD. Correlations between seven panoramic radiomorphometric indices and bone mineral density in postmenopausal women. Oral Surg Oral Ned Oral Pathl Oral Radiol Endod. 2010; 109:449-456

8. Ledgerton D, Horner K, Devlin H, Worthington H. Panoramic mandibular index as a radiomorphometric tool : an assessment of precision . Dentomaxillofac Radiol. 1997; 26:95-100.

9. Silness J, Löe H.. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand 1964;22: 121-135.

10. Löe H. The Gingival Index, the Plaque Index and the Retention Index Systems. J Periodontol 1967; 38(6): 610-616.

11. Newbrun E.. Indices to measure gingival bleeding. J Periodontal 1996; 67(6): 555-561.

12. American Academy of Periodontology (AAP). Severity of chronic periodontitis. Annals of Periodontology 1999;P. 38

13. Yashoda BK., Rakesh N, Ravleen N. Diagnostic efficacy of panoramic mandibular index to identify postmenopausal women with low bone mineral densities. J Clin Exp Dent. 2011;3(5):e456-461.

14. Al Habashneh R1, Alchalabi H, Khader YS, Hazza'a AM, Odat Z, Johnson GK. Association between periodontal disease and osteoporosis in postmenopausal women in Jordan. J Periodontol. 2010;81(11):1613-1621

15. Pepelassi E1, Nicopoulou-Karayianni K, Archontopoulou AD, Mitsea A, Kavadella A, Tsiklakis K, Vrotsos I, Devlin H, Horner K. The relationship between osteoporosis and periodontitis in women aged 45-70 years. Oral Dis. 2012;18(4):353-359.

16. Huang Y, Chang C, Liu C, Muo C, Tsai C, Wu C. The Impact of Oral Hygiene Maintenance on the Association between Periodontitis and Osteoporosis. Medicine (Baltimore). 2016 ; 95(6): e2348

17. Tözüm TF, Taguchi A Role of dental panoramic radiographs in assessment of future dental conditions in patients with osteoporosis and periodontitis. The New York State Dental Journal 2004, 70(1):32-35.

18. Horner K, Devlin H, Alsop CW, Hodgkinson IM, Adams JE. Mandibular bone mineral density as a predictor of skeletal osteoporosis.Br J Radiol. 1996; 69:1019-1025.

19. Dagistan S, Bilge OM. Comparison of antegonial index, mental index, panoramic mandibular index and mandibular cortical index values in the panoramic radiographs of normal males and male patients with osteoporosis. Dentomaxillofac Radiol. 2010; 39: 290-4

20. Lee K, Taguchi A, Ishii K, Suei Y, Fujita M, Nakamoto T et al. Visual assessment of the mandibular cortex on panoramic radiographs

21. to identify postmenopausal women with low bone mineral densities. Oral Surg Oral Med Oral Path Oral Radiol Endod. 2005;100:226-31.

22. Klemetti E, Kolmakov S, Kroger H. Pantomography in assessment of the osteoporosis risk group. Scand J Dent Res. 1994; 102: 68–72.

23. Klemetti E, Kolmakov S, Heiskanen P, Vainio P, Lassila V. Panoramic mandibular index and bone mineral densities in purg Oral Med Oral Pathol 1993; 75: 774-779.

24. Horner K, Devlin H. The relationship between mandibular bone mineral density and panoramic radiographic measurements. J Dent. 1998; 26: 337-343.

25. Ledgerton D, Horner K, Devlin H, Worthington H. Radiomorphometric indices of the mandible in a British female population. Dentomaxillofac Radiol. 1999; 28: 173-181.

26. Leite AF, Figueiredo PT, Guia CM, Melo NS, Paula APD. Correlations between seven panoramic radiomorphometric indices and bone mineral density in postmenopausal women. Oral Surg Oral Med Oral Pathl Oral Radiol Endod. 2010; 109:449-456.

27. Dutra V, Devlin H, Susin C, Yang J, Horner K, Fernandes A. Mandibular morphological changes in low bone mass edentulous females: evaluation of panoramic radiographs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006; 102: 663-668.

28. Yasar F, Akgunlu F. The differences in panoramic mandibular indices and fractal dimension between patients with and without spinal osteoporosis. Dentomaxillofac Radiol. 2006; 35: 1-9.

29. Balcikonyte E, Balciuniene I, Alekna V. Bone mineral density and radiographic mandibular body height. Stomatologija, Baltic Dental and Maxillofacial Journal 2003; 5(4):137-140.

30. Bajoria A, Mil A, Kamath G, Medha B, Patil P, Sukhija P. Evaluation of radiomorphometric indices in panoramic radiograph- A screening tool. The Open Dentistry Journal 2015; 9(2):303-310.