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Correlation of Bone Mineral Density and Periodontal Status Of Postmenopausal Women

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Abstract

Introduction: Periodontitis and osteoporosis are the diseases with common feature of both bone loss. However, the relation and extent between these diseases is still unclear.

Aim: The purpose of present study was to evaluate the relationship between periodontal status and systemic bone mineral density in postmenopausal women.

Methods and Material: A total of 40 postmenopausal women aged between 45–60 Years (50.6±4.6 years) were randomly selected from the department of periodontics. All women were examined for periodontal status and Bone Mineral Density(BMD). Periodontal status was examined by recording plaque index(PI), gingival index(GI), pocket probing depth(PPD), clinical attachment level (CAL) and alveolar bone loss (ABL). BMD was measured by Dual Energy X-ray absorptiometry (DEXA) scan for bone mineral density score. (T-score) values. The recorded data for T-score and periodontal status were subjected to statistical analysis for correlation and regression analysis.

Results: The results showed that there was no statistically significant correlation between Probing depth (r= -0.168, P > 0.05), gingival index (r= -0.441, P>0.05), and plaque index (r= -0.345, P>0.05) with T-score; whereas CAL (r= -0.604, P>0.05) and ABL (r= -0.637, P>0.05) was significantly correlated with T-score.

Conclusions: In the present study systemic BMD was related to ABL and CAL, suggesting that postmenopausal bone loss can be a risk indicator for periodontal disease.

Keywords: post menopause, Alveolar bone loss, bone mineral density, osteoporosis, periodontal attachment loss.

Introduction

Periodontitis is defined as "an inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms or groups of specific microorganisms, resulting in progressive destruction of the periodontal ligament and alveolar bone with pocket formation, recession, or both.[1] Many systemic diseases and disorders have been implicated as risk indicators or risk factors in periodontal disease. For e.g. endocrine disorders and hormonal changes, haematological disorders and immune deficiencies, nutritional deficiencies, cardiovascular disorders, osteoporosis, pregnancy & preterm birth.[2]

Osteopenia and osteoporosis are systemic skeletal diseases characterized by low bone mass and micro-architectural deterioration with a consequent increase in bone fragility and susceptibility to fracture. According to the World Health Organization, osteoporosis is considered to be present when bone mineral density is 2.5 standard deviation (SD) or more below the mean for normal young Caucasian women, i.e. a T score of - 2.5. Osteopenia is defined as bone density levels between 1 and 2.5 SD below normal bone mineral density.[3]

Menopause is defined by the World Health Organization and the Stages of reproductive aging Workshop working group as the permanent cessation of menstrual periods that occurs naturally or is induced by surgery, chemotherapy or radiation.[4] Many women go through the menopausal transition with few or no symptoms, while some have significant or even disabling symptoms. In most of women, the bone mass reaches its peak in the third decade of life (20-30 years of age) and declines thereafter. This decline in bone mass is accelerated with the onset of menopause, and oral/periodontal symptoms are also found in addition to the systemic manifestation of menopause.[5]

Because loss of bone is a common feature of periodontitis and osteoporosis, both disease may share common etiologic agents which may either affect or modulate the process of both the diseases. The final expression of periodontitis is predicated by the complex interactions occurring within an intricate mosaic of host, microbial and environmental factors, it was felt that the contribution of BMD as a risk factor might be worthy of investigation.[6]

Various diagnostic techniques are in use for assessment of bone mineral density like conventional radiographs, Bone densitometry, DEXA and quantitative computed tomography. Conventional radiographs are not sensitive enough to diagnose osteoporosis until the total bone density has been decreased by 50%. Similarly, Single- and dual-photon absorptiometry have been used in the past but they provide poorer resolution, less accurate analysis, and more radiation exposure than X-ray absorptiometry.

Quantitative computed tomography is the most sensitive method to diagnose the osteopenic and osteoporotic conditions. Today DEXA scan is one of the most precise diagnostic measure of choice. The effect of osteoporosis in postmenopausal women is obvious, because in post menopause period, due to estrogen deficiency, bone structure is reduced and changed. Many of these changes lead to bone loss and osteopenia or in more severe mode may lead to osteoporosis.[7]

Thus aim of this study is to evaluate the relationship between periodontal status and systemic bone mineral density in postmenopausal women using DEXA scan.

Material and Methods

The present study was an observational evaluation of postmenopausal women's periodontal status and systemic bone mineral density. A total of 40 postmenopausal women were recruited from the department of periodontics. The ethical clearance was obtained from the institutional ethics committee and Informed consent was obtained by all patients. Following subjects were included in study: 1) Age Group 45- 60 Years. 2) Patients should

have at least 7 natural teeth. 3) Patients with periodontitis having clinical attachment loss ≥ 5mm.

Subjects excluded from the study were: 1) Patients who need antibiotic prophylaxis. 2) Early onset of menopause. 3)Parathyroid disease. 4) Metabolic bone diseases. 5) Malignancy 6) Patients on long term steroid medication, hormone replacement therapy (HRT) and Calcium. 7) The use of contrast agents or participation in nuclear medicine studies seven days prior to BMD assessment.

Recording of the periodontal parameters: All subjects underwent a complete periodontal & radiographic (full mouth IOPA & OPG) examination. The clinical measurements were performed by a single examiner who was unaware of subjects bone mineral density. The following periodontal measurements were recorded:

1) Plaque index(PI) by Silness & Loe 1964.[8] for four sites per tooth i.e. buccal, mesiobuccal, distobuccal, and lingual.

2) Gingival index(GI) - Loe & Silness 1963.[9]

3) Probing pocket depth (PPD) measured with UNC 15 probe.

4) Clinical attachment loss (CAL) on all teeth except third molars. CAL was measured with cemento-enamel junction as fixed reference point.

5) Alveolar bone loss (ABL) measured on IOPA with grid. ABL measured on mesial and distal surfaces of all teeth except third molars, and was recorded as the distance from cementoenamel junction(CEJ) to most coronal portion of alveolar crest in a plane parallel to long axis of the tooth.

Measurement of systemic T- score: The bone mineral density of all subjects were measured by DEXA scan (GE lunar prodigy advanced bone densitometer). BMD was assessed at sites like lumbar spine and femur. BMD of lumbar spine measured from anterior and posterior view of lumbar vertebrae 1-4 (L1-L4). BMD of L2 was used for all data analysis because it is the vertebrae least affected by artifacts. All DEXA scans were performed by examiner who was blinded to patient's periodontal status. Thus, the data obtained for T-score and periodontal status were subjected to statistical analysis for correlation and regression procedures.

Statistical analysis: The results were expressed as arithmetic means, considering SD. Pearson's linear correlation coefficient was used to evaluate the interdependence between examined parameters. Multiple regression analysis was applied to examine the relationship between dependent variables (T-score and CAL) with various potential predictors. Correlation was considered to be significant at the values of $P<0.05$.

Results

A total of 40 postmenopausal women aged between 45–60 Years (mean ± SD:50.6±4.6 years) were examined in this study. Based on the periodontal examination and assessment of systemic bone mineral density the descriptive statistics of measured variables are shown in Table 1.

Variables	Minimum	Maximum	Mean	D
BMD	-3.5	-0.2	-1.83	.2
Plaque index (PI)	0.7	3.0	2.1	.52
Gingival Index (GI)	0.7	2.9	2.03	.477
Pocket Depth (PPD)	1.9	3.54	2.93	.40
Clinical Attachment Loss (CAL)	3.15	5.47	3.87	.73
Alveolar Bone Loss (ABL)	3.29	6.35	4.63	.90

Table 1 - Descriptive statistics of measured variables. (N=40)

Correlation of the clinical parameters with T-score. Pearson's correlation coefficient between bone mineral density and periodontal parameters are shown in Table 2.

The results showed that Probing depth (r=-0.168, P > 0.05), gingival index (r=–0.441, P>0.05), and plaque index (r=–0.345, P>0.05) were not significantly correlated with T-score; whereas CAL and ABL showed significant correlation (P<0.05) with T-score.

Parameters	Pearson R value	Correlation - p value , Significance
Bone Mineral Density + Plaque Index	-0.354	0.141
Bone Mineral Density + Gingival Index	-0.441	0.115
Bone Mineral Density + Probing Depth	-0.168	0.145
Bone Mineral Density + Clinical Attachment Loss	-0.604	0.046* Significant correlation
Bone Mineral Density + Alveolar Bone Loss	-0.637	0.0392* significant correlation

p > 0.05 – not significant, p < 0.05 – significant, p < 0.001 – highly significant.

Table 2 - Correlation of BMD and periodontal parameters.

Results of multiple stepwise regression analysis of T-score as dependent variable: Multiple regression analysis was conducted to examine the relationship between T-score and CAL & ABL shown in Table 3. While PI, GI, PPD were not a significant predictor in this model, hence excluded from the regression model. Only significant predictor variable or combinations are included in the regression model.

Predictor variable	B	T	B	p value
1. Alveolar Bone Loss	-0.637	- 5.094	- 0.843	<0.001
2. Attachment loss	-0.556	-0.556	-0.737	<0.001
3.Alveolar Bone Loss + Attachment Loss	-0.283	-0.283	-0.698	0.028

p > 0.05 – not significant, p < 0.05 – significant, p < 0.001 – highly significant. Dependent variable: T- score, B = unstandardized regression coefficient, β= standardized regression coefficient.

Table 3 - Significant variable of multiple stepwise regression analysis of T-score as dependent variable (N=40)

Discussion

Although the plaque is the initiating etiologic factor in periodontal disease, the nature of the host response determines the disease progression. Systemic conditions, including osteoporosis may be an important contributing factor in progression of periodontitis. The risk factors for osteoporosis can be divided into non-modifiable e.g. age, sex, race, family history of osteoporosis or fracture, Early menopause and modifiable e.g. sex hormone insufficiency, Calcium and Vitamin D intake, Weight, Physical activity, Cigarette smoking, Chronic glucocorticoid use.[3] As the risk factors for both osteoporosis and advanced periodontal disease are associated with each other, and since both are bone resorptive diseases, it has been hypothesized that osteoporosis could be a risk factor for progression of periodontal disease.[10] A number of studies have investigated a possible relationship between periodontitis and osteoporosis, and although the literature supports such relationship, its extent remains unclear due to small sample sizes, non-comparable study populations and different study methods used to assess periodontitis and osteoporosis. Moreover, the evaluation of the relationship between osteoporosis and periodontitis is a complicated issue. It can be understood by the fact that both diseases are multifactorial in aetiology.[5]

The bone compromise seen in osteoporosis is characterized by low bone density, which increases the risk of fractures in postmenopausal women. Menopause usually takes place between 45 and 55 years of age[11] & it is associated with destructive periodontal disease in older women. The detrimental effect of menopause on periodontal health has been associated with hormonal

changes observed in postmenopausal women. Estrogen deficiency was shown to decrease bone metabolism and to affect immune response and inflammation.[12]

The present study was aimed to evaluate the Relationship between various periodontal clinical parameters and systemic BMD in postmenopausal women. In this study 40 postmenopausal women were examined for periodontal parameters and bone mineral density, with a range of periodontal disease severity.

The results were expressed as arithmetic means, considering the standard deviation. Pearson's linear correlation coefficient was used to evaluate the interdependence between examined parameters. Multiple regression analysis was applied to examine the relationship between dependent variables (T-score, CAL and ABL). In this study, ABL, CAL was used as dependent variables to represent periodontal disease severity. In the literature, the majority of earlier studies used ABL and PPD as periodontal disease variables[13-17] and recently CAL[18,19] was also added, as PPD readings do not offer a good measurement of the periodontal disease history.[20]

In this study DEXA was used to measure the systemic bone mineral density. Previous studies have utilized QUS (Qualitative Ultrasound Technique), and some studies measured oral bone mineral density to obtain T score. However, studies have reported significant correlation between the systemic bone mineral density and oral bone mineral density. In a cross sectional study, Jeffcoat et al examined 158 postmenopausal women's age between 62-76 years shows a significant correlation between hip BMD and mandibular basal BMD. [21] In another study by streckfus et al[22] studied 28 women between 23-78 age and found that there is strong correlation between alveolar density and second metacarpal density, both are reduced in postmenopausal women.

In a study of 227 postmenopausal women, Kelmetti et al found that women with higher BMDs in the skeleton seems to retain teeth with deeper periodontal pockets more easily than with those of low BMD or osteoporosis.[23] Also studies done by Kribbs et al[18, 24-26] and Von wowern et al[25] showed significant relationship between systemic and oral bone mineral density.

Results of this study revealed that there was a statistically significant correlation between periodontal parameters like CAL and ABL and T-score, and no significant correlation with PI, GI, and PPD. In a cross sectional study, Tezal M et al[27] examined 70 postmenopausal women in which the mean ABL was significantly correlated with BMD. The present study also shows a significant correlation between CAL and ABL with T-score. Greater alveolar bone loss, crestal and subcrestal bone density loss in osteoporotic women and estrogen deficiency women was noted in a 2-year longitudinal study done by Payne et al.[28] In a study of 292 women, Weyant et al[29] found no statistically significant association between periodontal parameters and systemic BMD. Elders et al[30] studied 216 women between age of 46 - 55 years and found no significant correlation between probing depth, bleeding on probing, missing teeth, alveolar bone height and bone loss. These findings are in good agreement with the present study where the results showed no significant co relation of PPD, PI, & GI with T-score.

Thus osteoporosis though not being the initial cause of periodontitis in postmenopausal women, it may be a risk indicator that may contribute to the progression of periodontal disease. Although few studies that attempted to correlate osteoporosis with periodontal disease with a significant result, some studies not show any significant results. These findings may suggest that osteoporotic patients should be advised to give more awareness

towards their oral health to prevent periodontal problems. Further longitudinal studies with larger sample size are required for better understanding of the relationship between the two disease.

Conclusion

Positive correlation between BMD with CAL & ABL may suggest postmenopausal bone loss can be a risk indicator for periodontal disease in postmenopausal women. Although large-scale, multicentre prospective studies are needed to identify the role of osteoporosis on the prevalence and severity of periodontal disease and to determine whether osteoporosis is also associated with the incidence and progression of periodontal disease in post-menopausal woman.

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