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Research Article

THE ASSOCIATION BETWEEN OSTEOPOROSIS AND CHRONIC PERIODONTITIS: A CASE-CONTROL STUDY

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ABSTRACT

Background & Objectives: Periodontitis and osteoporosis affects millions of people around the world resulting in significant amount of morbidity. This cross-sectional study aims to determine the association between osteoporosis and chronic periodontitis in postmenopausal women. **Methods:** The study sample consisted of 100 post menopausal women of whom 50 were cases (Chronic periodontitis) and the remaining 50 were controls (non-chronic periodontitis). Bone mineral density was measured with an ultrasonometer and periodontal examination included gingival bleeding index (GBI), plaque index (PI),probing pocket depth (PPD), clinical attachment loss (CAL) and average alveolar bone loss. **Results:** The case group showed a mean CAL value of 3.91 while the control group showed a mean CAL of 1.62 and the difference between the groups was statistically significant with a P value of 0.001. The case group showed a mean average alveolar bone loss value of 2.95 while the control group showed a mean value of 1.34 and the differences between the case and control groups was statistically significant with a P value of 0.001. **Conclusion:** This study showed an association between bone mineral density and variables of periodontal disease activity. The periodontal disease variables such as clinical attachment loss (CAL) and average alveolar bone loss worsened with decreasing bone mineral density values.

Keywords: chronic periodontitis, osteoporosis, bone mineral density, clinical attachment loss (CAL), average alveolar bone loss (ABL).

INTRODUCTION:

Periodontal disease appears to be a major global public health problem affecting majority of the adult population after the age of 35–40 years.[1] Chronic periodontitis lesions include loss of attachment and bone and are regarded as irreversible. 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[2]. According to the World Health Organization, osteoporosis is considered to be present when bone mineral density (BMD) is 2.5 standard deviations (SD) below the mean peak value in young adults. Osteopenia is defined as bone density levels between 1 SD and 2.5 SD below normal BMD[2].

Osteoporosis is most frequently caused by continuous, physiological, gender and age-related, systemic bone loss after the menopause in women above the age of 50 years. The incidence of osteoporosis in a population is dependent on gender, age, endocrine status, lifestyle and

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menopausal age. Bone loss can be slowed or even reversed if risk factors such as physical inactivity, low dietary calcium intake, and primary hyperparathyroidism are identified and reversed[3]. Bone mineral content (BMC) or density (BMD) in a person is related to bone mass at maturity (peak bone mass) and subsequent bone loss. If rate of bone resorption exceeds the rate of bone formation in older adults, it may result in "too little bone within the bones" and subsequently osteoporosis[3]. It is commonly accepted that BMC/BMD measurements provide a tool for diagnosis, assessment and monitoring of individuals with osteoporosis and BMC/BMD is the key predictor of fracture risk[3].

The risk factors for osteoporosis can be divided into non-modifiable and modifiable risk factors. The non-modifiable include sex, age, early menopause, thin or small body frame, race, and heredity[2]. Lack of calcium intake, lack of exercise, smoking, and alcohol are modifiable risk factors. Low bone mass, certain medications, propensity to fall, and systemic diseases such as hyperparathyroidism are modifiable to some extent. The risk factors for osteoporosis include many risk factors associated with advanced periodontal disease. Since both osteoporosis and periodontal diseases are bone resorptive diseases, it has been hypothesized that osteoporosis could be a risk factor for the progression of periodontal disease[2].

Periodontitis and osteoporosis affects millions of people around the world resulting in significant amount of morbidity. In periodontal disease alveolar bone loss is a well recognized result of the inflammatory and immune response to the products of bacterial plaque[3]. While periodontitis is a local disease, osteoporosis is a systemic disease with bone loss being a common feature in both the diseases. It has been established that bone loss is influenced by both systemic and local factors[3]. The combination of systemic bone loss to periodontal destruction is debatable and the answer to this question relies on good understanding of biology of both diseases[3].

This cross-sectional study aims to determine the association between osteoporosis and chronic periodontitis in postmenopausal women.

MATERIALS AND METHODS

A cross-sectional study was conducted to determine the association between osteoporosis and chronic periodontitis. The study sample consisted of 100 post menopausal women of whom 50 were allocated to the case group (chronic periodontitis) and the remaining 50 were considered as controls(non-chronic periodontitis). The subjects for the study were recruited from the outpatients reporting to St. Joseph General Hospital and Department of Periodontics, St. Joseph Dental College, Eluru. The selection of subjects included in the study was done as follows:

INCLUSION CRITERIA:

1) Postmenopausal women.

2) Presence of atleast 5 natural teeth.

3) No history of systemic diseases.

4) No medication or surgery which alter the course of the diseases under study.

EXCLUSION CRITERIA:

i. Individuals who are on-long term steroid medication and hormone replacement therapy

ii. Early onset menopause

iii. Endocrine or metabolic bone diseases.

iv. Individuals suffering from osteoporotic fractures.

v. Smokers

vi. Any type of periodontal treatment within one year prior to examination.

All the subjects had undergone a thorough clinical oral examination followed by a radiographic interpretation to determine their periodontal status. Periodontal examination included gingival bleeding index, plaque index, probing pocket depth, clinical attachment level (CAL) and average alveolar bone loss.

Alveolar Bone Loss in the interproximal regions was determined by using panoramic radiographs (OPG). The radiographs were taken with orthophos-XG3™ panoramic radiographic device and processed digitally to be viewed with the proprietary software (Sidexis™). Using the calibration tool, the alveolar crestal height was measured as the distance from the cemento-enamel junction to the most coronal point of the alveolar crest immediately adjacent to the root

surface. It is the absolute distance between these two points measured along the long axis of the tooth. In the case of vertical defect, alveolar crestal height was measured as the distance from the CEJ to the point immediately adjacent to the root surface at the base of the defect. Alveolar crestal height was recorded for the each individual site measured.

Considering the normal distance from the cemento-enamel junction to the alveolar crest, which equals to approximately 2mm (Hausmann's Criteria)[4], the interproximal bone loss is calculated by subtracting the normal distance from the alveolar crestal height measured. The mean interproximal bone loss for a particular individual is then calculated.

Bone mineral density (BMD) test at the os calcis (heel) was done by using an ultrasound bone densitometer device (Lunar Achilles™).Ultrasound bone densitometry measures the physical properties of bone, specifically BMD. The ultrasound measurement contains two criteria; the velocity (SOS) and frequency attenuation (BUA) of a sound wave, as it travels through a bone. The stiffness index which is a combination of velocity and frequency attenuation of sound wave gives the bone mineral density (BMD) which can be calculated by the following formula.

BMD = (BUA-50) × 0.67 + (SOS-1380) × 0.28

Based on the clinical oral examination, bone mineral density test and aided by medical history, subjects were divided into two groups; a test group (periodontitis group) which consisted of 50 postmenopausal women diagnosed with periodontitis and a control Group (Non-periodontitis group) which consisted of 50 subjects who did not have periodontitis. After obtaining consent from the subjects, they were evaluated for age, age at menopause, time since menopause, body mass index (BMI), medical history, drug history, dental history and various periodontal parameters**.**

RESULTS

TABLE: 1

DESCRIPTIVE STATISTICS in CASE GROUP					
PARAMETERS	MEAN	SD	MIN	MAX	RANGE
Age	56.42	8.17	40.00	76.00	36.00
Age at menopause	44.54	4.35	35.00	53.00	18.00
time since menopause	11.36	5.79	3.00	25.00	22.00
Teeth present	19.82	7.92	4.00	32.00	28.00
BMI	25.73	4.57	16.80	37.80	21.00
Gingival bleeding index	63.86	19.82	41.00	100.00	59.00
plaque index	2.12	0.40	1.34	3.00	1.66
probing pocket	3.51	0.45	2.09	4.33	2.24
CAL	3.91	1.03	2.65	7.25	4.60
Average alveolar bone loss	2.95	1.11	1.86	7.28	5.42

TABLE: 2

DESCRIPTIVE STATISTICS in CONTROL GROUP					
PARAMETERS	MEAN	SD	MIN	MAX	RANGE
Age	54.8	8.32	38.00	75.00	37.00
Age at menopause	43.28	6.39	30.00	55.00	25.00
time since menopause	10.04	5.55	3.00	30.00	27.00
Teeth present	28.64	3.23	21.00	32.00	11.00
BMI	25.93	4.23	18.40	35.90	17.50
Gingival bleeding index (%)	34.34	10.54	10.00	53.00	43.00
plaque index	1.45	0.37	1.00	2.28	1.28
probing pocket	2.00	0.86	1.00	3.65	2.65
CAL	1.62	0.72	1.00	2.96	1.96
Average alveolar bone loss	1.34	0.39	1.00	2.25	1.25

Table: 3

Pearson Correlation between the study variables in Case group (Chronic Periodontitis)

Correlations						
Clinical parameters	**Cases**	BMD	PI	PPD	CAL	ABL
BMD	Pearson Correlation	1.000	0.017	-0.101	-0.361*	-0.326*
	P-value		0.906	0.486	0.010	0.021
PI (Plaque index)	Pearson Correlation	0.017	1.000	0.290*	0.339*	0.285*
	P-value	0.906		0.041	0.016	0.045
PPD (probing pocket depth)	Pearson Correlation	-0.101	.290*	1.000	0.213	0.261
	P-value	0.486	0.041		0.137	0.068
CAL (clinical attachment loss)	Pearson Correlation	-0.361*	0.339*	0.213	1.000	0.916*
	P-value	0.010	0.016	0.137		0.000
ABL (average alveolar bone loss)	Pearson Correlation	-0.326*	0.285*	0.261	0.916*	1.000
	P-value	0.021	0.045	0.068	0.000	

*Correlation is significant at the 0.05 level (2-tailed).

Table: 4

Pearson Correlations between the study variables in Control group (Non-Chronic Periodontitis)

Correlations in control group						
		BMD	PI	PPD	CAL	ABL
BMD	Pearson Correlation	1.000	-0.197	-0.246	-0.172	-0.125
	P-value		0.170	0.085	0.233	0.389
PI	Pearson Correlation	-0.197	1.000	0.333*	0.280*	0.294*
	P-value	0.170		0.018	0.049	0.038
PPD	Pearson Correlation	-0.246	0.333*	1.000	0.901*	0.854*
	P-value	0.085	0.018		0.000	0.000
CAL	Pearson Correlation	-0.172	0.280*	0.901*	1.000	0.945*
	P-value	0.233	0.049	0.000		0.000
ABL	Pearson Correlation	-0.125	0.294*	0.854*	0.945*	1.000
	P-value	0.389	0.038	0.000	0.000	

*Correlation is significant at the 0.05 level (2-tailed).

DISCUSSION

Osteoporosis and osteopenia are systemic skeletal diseases characterized by low bone mass and micro-architectural deterioration of bone, with a consequent increase in bone fragility and susceptibility to fracture (Geurs, 2003)[5]. Since osteoporosis and periodontal disease were bone resorptive diseases, it has been hypothesized that osteoporosis could be a risk factor for the progression of periodontal disease (Geurs, 2003)[5].

This study was undertaken to evaluate the association between osteoporosis and chronic periodontitis. The study was conducted in a total of 100 post-menopausal women subjects, who were randomly segregated into two groups, a chronic generalized periodontitis group (cases) and a non-periodontitis group (controls). The parameters that were recorded included gingival bleeding index, plaque index, probing pocket depth, clinical attachment loss (CAL) and average alveolar bone loss. The bone mineral density was measured at the os calcaneus with an ultrasonometer and a diagnosis of osteoporosis or osteopenia or healthy bone mineral density was made. The study included variables such as age, age at menopause, time since menopause and body mass index (BMI) apart from clinical and radiographic parameters.

The present study showed that the study subjects were evenly matched for age between the case group (56.42± 8.17) and the control group (54.8±8.32). The similar age distribution between the study groups was reflected by a non-significant p-value. As the significant effect of systemic bone loss on localized periodontal disease may not become apparent until a certain amount of bone is lost at older ages (Tezal et al 2005)[3], this particular age range was selected for the present study.

This study showed a statistical difference between the study groups for the number of teeth present. The case group showed a lesser mean for the number of teeth present indicating pronounced periodontal disease activity. This argument was further supported when the variables indicating periodontal disease severity were compared with the number of teeth present. This study showed that patients with periodontitis had lesser number of teeth than their healthier counterparts. These findings were in accordance with Yoshihara et al (2005)[6] who reported that subjects with osteopenia had a low number of remaining teeth that the subjects without osteopenia.

This study showed a negative correlation between age and number of teeth present in the case group. The age of the study subjects increased as the degree of edentulousness increased. This finding is in accordance with the study done by Yoshihara et al (2005)[6] and Nicolopoulou-Karayianni (2009)[7].

The number of years after menopause was not statistically significant between both the study groups in the present study. Similar results were reported by Hildebolt et al (2002)[8] and Tezal et al (2005)[3].

The present study showed a similar value for BMI between the study groups. In other words, the present study did not find a significant association between BMI and periodontitis. The findings were in accordance with the study done by Gomes-Filho et al,(2007)[9]. The present study showed a significant association between gingival bleeding index and periodontitis. Similar results were reported by Gomes –Filho et al (2007)[9]. The positive association of gingival bleeding index to periodontitis could be attributed to more number of diseased sites in active state indicating periodontal disease activity. The present study showed statistically significant mean probing depths between the study groups. This is in accordance with the studies done by Tezal et al (2005)[3] and Gomes-Filho et al (2007)[9].

Clinical attachment loss was used as the most dependant variable to represent periodontal disease. This study showed a pronounced CAL in the case group with a statistically significant association between the study groups. Furthermore, a positive correlation was seen between osteoporosis and CAL. The findings of this study are in accordance with Von Wovern et al (1994)[2] who stated that osteoporotic subjects had more loss of attachment than normal subjects. A positive association between BMD which is a measure of osteoporosis and periodontal disease variables was reported by Mohammad et al (1997)[10], Inagaki et al (2001)[11], Persson et al (2002)[12] and Gomes-Filho et al (2007)[9].

The present study showed a statistical significant association in the average alveolar bone loss between the groups and between BMD and average alveolar bone loss. It was hypothesized that an association between systemic bone loss and alveolar crestal bone loss exists, since menopause is associated with estrogen depletion resulting in systemic and oral bone loss. These findings were in accordance with studies done by Payne et al (1997)[13] ,Wactawski –wende et al (2001)[14], and Tezal et al (2005)[3] who found a similar association.

The results of the present study showed a significant association between the bone mineral density (BMD) which is a measure of osteoporosis/osteopenia and periodontitis. The association could be explained by the fact that osteoporosis could affect the severity of pre-existing periodontal disease in a host with suppressed immune system and poor bone density. The results of the present study were in accordance with studies done by Payne et al (1997)[13], Von Wovern et al (1994)[2], Mohammad AR et al (1997)[10], Persson et al (2002)[12] and Tezal et al (2005)[3] who reported a positive association between BMD and periodontal disease.

In this study age, age at menopause, time since menopause and BMI were identified as possible confounding factors. Prior to establishing an association between osteoporosis and chronic periodontitis, the role of these confounding factors was considered and negated by selecting evenly matched cases and controls.

This study employed a cross-sectional study design to study the association between chronic periodontitis and osteoporosis. However, cross-sectional studies have some inherent limitations (Yoshihara et al 2005)[6]. Therefore the ability to establish a causal relation between osteoporosis and periodontitis is limited.

CONCLUSION

This cross-sectional study was conducted to determine the association between osteoporosis and chronic periodontitis in post-menopausal women. The study sample was segregated into two groups, a chronic periodontitis group (cases) and a non-periodontitis group (controls). The data was collected for various parameters like age, age at menopause, time since menopause, body mass index (BMI), bone mineral density (BMD), gingival bleeding index, plaque index, probing pocket depth, clinical attachment loss (CAL) and average alveolar bone loss.

The study showed that the subjects were evenly matched for age between the case and control groups. A statistical significance was seen between the study groups for the number of teeth present. Additionally, the case group showed a lesser mean for the number of teeth present. The study showed a significant association between gingival bleeding index and periodontitis which could be attributed to more number of diseased sites in the case group. The study showed statistically significant mean probing depths between the study groups. The study showed a pronounced CAL in the case group with a statistically significant association between the study groups. Furthermore, a statistically significant association was also seen between BMD and CAL. The present study showed a statistical significance in the average alveolar bone loss between the groups. Moreover, this study found a statistically significant association between BMD and average alveolar bone loss.

It can be concluded that a statistically significant association exists between osteoporosis/osteopenia and chronic generalized periodontitis. This study employed a relatively smaller sample size and a cross-sectional design. However, longitudinal studies with larger sample sizes should be employed to establish a causal relationship between osteoporosis and periodontitis so that the findings could be generalized.

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