

# Periodontal Status of Postmenopausal Women with Osteoporosis

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## ABSTRACT

**Introduction:** Osteoporosis a common metabolic disorder in postmenopausal women, with characteristic loss of bone mass, is associated with periodontitis and tooth loss according to the vast accumulating evidence. This association needs further perusal which was addressed in the following study.

**Materials and methods:** The study subjects were postmenopausal women (No:104) in the age group of 35 to 60 years. Diagnosis of osteoporosis was by standard tests like clinical, radiographic tests and or bone densitometry. Case history of subjects (i.e. dental, personal, medical and menopausal) was elicited verbally and periodontal examination was carried out. Estrogen (17- $\beta$  estradiol) and calcium assays were measured in 20 of these patients.

**Results:** All subjects completed their periodontal and radiographic examination. Indices to measure local factors were accompanied by increase in clinical parameters for periodontitis. Alveolar bone loss visible radiographically correlated with clinical indices and clinical attachment loss. Hormonal assays, i.e. serum 17- $\beta$ . Estradiol and calcium were found to be below normal for examined cases. Majority of patients had periodontitis, half being localized and the remaining generalized.

**Conclusion:** Mandibular cortex showed osteoporosis in most of the cases. Tooth loss was not an apparent finding. Osteoporosis did not show an association with periodontitis as much as the local environment. Thus, it could be concluded that osteoporosis may not be an important risk factor for periodontitis and oral bone loss.

**Keywords:** Postmenopausal women, Bone mass, Oral bone loss, Mandibular cortex, Clinical attachment loss, Local factors, Tooth loss, Risk factor.

## INTRODUCTION

Periodontitis characterized by loss of attachment and tooth loss is related to various systemic diseases, like diabetes, respiratory diseases, cardiovascular diseases, adverse pregnancy outcome and osteoporosis.

Osteoporosis is a disease in which the density and quality of bone are reduced, leading to weakness of the skeleton and increased risk of fracture, particularly of the spine, wrist and hip.<sup>1</sup> Worldwide, lifetime risk for osteoporotic fractures in women is 30 to 50% and, in men, risk is 15 to 30%.<sup>2</sup> One out of eight males and one out of three females in India suffers from osteoporosis, making India one of the largest affected countries in the world.<sup>3</sup> Expert groups peg the number of osteoporosis patients at approximately 26 million (2003 figures) with the numbers projected to increase to 36 million by 2013.<sup>4</sup>

Thus, it becomes imperative to examine the association between osteoporosis and periodontitis as they involve a large strata of population.

## MATERIALS AND METHODS

### The Study Population

Postmenopausal women were recruited for the study from the Outpatient Orthopedic Departments of Bowring and Lady

Curzon's Hospital and Santosh Hospital, Bengaluru, private orthopedic clinics and from bone densitometry camps conducted by these hospitals.

### Selection of Subjects

Criteria for inclusion were as follows:

- Postmenopausal women of age group 35 to 60 years
- Presence of at least seven natural teeth in each quadrant
- Diagnosed as osteoporotic by standard tests of diagnosis like clinical with radiographic aids and/or use of bone densitometer.

Exclusion criteria were as follows:

- Patients with diabetes and cancer
- Subjects on hormone replacement therapy for over 6 months
- Patients on long-term steroids and antibiotics over 6 months.

### Data Collection

Upon enrollment of subjects, data regarding the age of attainment of menopause and any problems or surgical intervention associated with it were recorded.

### Clinical Examination

In the hard tissue examination, the number of teeth present, missing teeth and the reasons for loss of teeth were elicited. In

soft tissue examination, the gingiva was assessed for signs of clinical inflammation.

Debris component of oral hygiene index (Green and Vermillion),<sup>5</sup> calculus index (NIDR),<sup>6</sup> gingival index (Loe and Silness)<sup>7</sup> and bleeding index (Dichotomous)<sup>7</sup> was recorded.

### Periodontal Status

Parameters such as probing pocket depth, clinical attachment loss, mobility, furcation and pathologic tooth migration were recorded. The periodontal pocket and the clinical attachment were recorded using a William's periodontal probe; furcation was assessed using a Naber's probe.

### Osteoporosis Diagnosis

All 30 of the cases were diagnosed by orthopedician using clinical examination and radiographic aids. Clinical signs included backache, fracture of the fore arm (Colle's fracture) and fracture on routine activities. Radiographs of the lumbar spine both anteroposterior, lateral and additional radiographs of the fractured sites were obtained.

The remaining 74 of the cases were diagnosed by bone densitometer (Heel Densitometer, Wipro-GE) which measures the density based on ultrasound principle by placing the heel of the foot or pedal region of the patient and comparing the density against the standard bone density of a white German female.

It consists of stiffness index with a T-score and Z-score.

A T-score is as follows:

- 0 to -1 is normal
- -1 to -2.5 is osteopenia
- -2.5 and below is osteoporosis.

### Serum Estrogen and Calcium Assays

Twenty cases with a T-score below -2.5 were investigated for the estrogen and calcium values.

### Radiographic Data

Panoramic radiographs were obtained for all the 104 participants.

Mandibular cortex was examined distally from the mental foramen by oral radiologist and classified into three groups by method of Klemetti<sup>8</sup> as follows:

- C1—normal cortex with even endosteal margin on both the sides
- C2—moderately eroded cortex with endosteal margin showing semilunar defects (lacunar resorption) or endosteal cortical residues (1 to 3 layers) on one or both the sides
- C3—severely eroded cortex with heavy endosteal cortical residues and clearly porous.

The alveolar resorption index was measured by a method described by Wical and Swope.<sup>9</sup> The measurements were made unilaterally depending on the presence of teeth.

The inferior edge of the mental foramen was traced and a line parallel to the long axis of the mandible and tangential to the inferior border of the mandible was drawn. A line perpendicular to this tangent, intersecting the inferior border of the mental foramen, was constructed.

The following measurements were made along this line using a digital vernier calipers: From the lower border of the mandible to the top of the alveolar crest (mandibular height). The distance from the lower border of the mandible to the inferior edge of the mental foramen (basal height).

Alveolar resorption index = Mandibular height/basal height.

### Statistical Methods<sup>10,11</sup>

Chi-square and Fisher's exact test were used to find the significance association of 17- $\beta$  estradiol with mandibular cortex. Student's t-test (two tailed, independent) was used to find the significance of study parameters between the classes of mandibular cortex. Pearson's correlation coefficient was used to find the relationship of alveolar resorption index (ARI) with study parameters. Analysis of variance was used to find the association of 17- $\beta$  estradiol with ARI.

## RESULTS

### Recruitment

Over 150 postmenopausal women were interviewed and briefed about this study, but only 104 patients complied to be included in the study for all the examinations.

### Osteoporosis Parameters

#### General Demography

The mean age of the participants ranged was  $51.99 \pm 6.83$  years. But 36.5% of patients were in the age group of 56 to 60 years.

#### Medical Status

Hypertension was found in a fraction of the population and most of these women were on medication.

#### Age of Attainment of Menopause

The mean age of attainment of menopause was  $46.47 \pm 4.45$  years. A total of 46.2% of patients were between 46 and 50 years of age.

## PERIODONTAL PARAMETERS

### Debris Index

The mean debris index score of the participants for the Ramfjord teeth was  $1.19 \pm 0.44$ . Debris index strongly correlated with mandibular cortex C2 and alveolar resorption index. A positive correlation was found of debris index and mean clinical attachment loss.

### Calculus Index

The calculus index score of the participants was  $1.21 \pm 0.38$ . Calculus index correlated with the mandibular cortex C2. Calculus index positively correlated with alveolar resorption index and mean clinical attachment loss.

## Gingival Index

The mean gingival index score was  $0.86 \pm 0.34$ . Gingival index strongly correlated with mandibular cortex C2. There was a strong positive correlation of gingival index with mean clinical loss of attachment.

## Number of Teeth Present

A total of 38.3% of the patients had 26 to 30 teeth remaining, with only 4.7% of the cases having up to 15 teeth remaining. A total of 19.6% of the participants had more than 30 remaining teeth of the dentition (Table 1).

## Reasons for Loss of Teeth

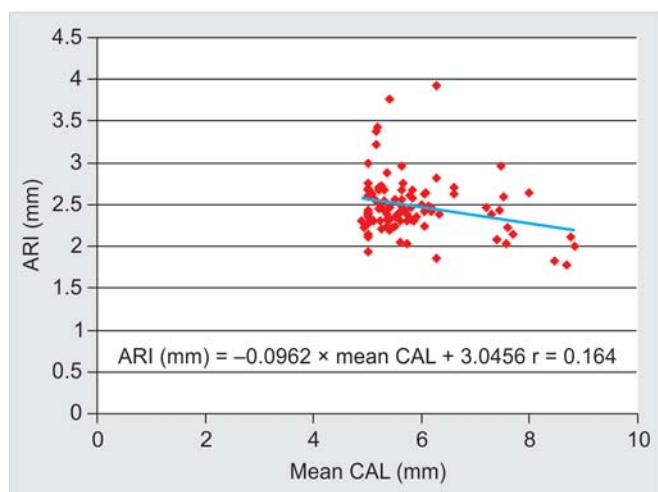
A total of 35.6% of the patients had lost teeth due to caries and 14.45% of the patients had lost teeth due to periodontitis. About 25.9% of the cases had combined history of caries and periodontitis for loss of teeth. A total of 23.1% of the study population had no tooth loss.

## Probing Depth

The mean probing depth for the 104 cases was  $3.94 \pm 1.06$  mm. There was no correlation of probing depth with alveolar resorption index.

## Clinical Attachment Loss

The mean clinical attachment loss was  $5.85 \pm 1.03$  mm. There was a strong positive correlation of mean clinical attachment loss with mandibular cortex C2. There was a negative correlation of mean clinical attachment loss with alveolar resorption index (Fig. 1). There was a strong positive correlation of mean clinical attachment loss with debris index, calculus index and gingival index.



**Fig. 1:** Scatter plot of mean clinical attachment levels and alveolar resorption index

## RADIOGRAPHIC MEASUREMENTS

### Mandibular Cortex

Mandibular cortex was only in the category of C1 (49.1%) and C2 (50.9%) with none of the cases presenting in the C3 category. The mandibular cortex C2 was strongly correlated with age, debris index, gingival index and mean clinical attachment loss.

### Alveolar Resorption Index

The alveolar resorption index was between 2.1 and 2.5 mm for 55.8% of the cases and mean alveolar resorption index being  $2.49 \pm 0.36$  mm (Table 2). There was no correlation of alveolar resorption index with mandibular cortex. Alveolar resorption index was strongly correlated with debris index and calculus index and moderately correlated with gingival index. There was a negative correlation of alveolar resorption index with mean clinical attachment loss (Fig. 1). There was a positive correlation of alveolar resorption index with  $17\text{-}\beta$  estradiol levels (Table 3).

## BIOCHEMICAL TESTS

### Serum Calcium Levels

More than 95% of the 20 subjects had serum calcium levels  $<8.5$  mg/dl. The remaining 5% of cases had serum calcium levels  $>8.5$  mg/dl.

**Table 1:** Number of teeth present

Number of teeth present	Number (n = 104)	%
Up to 15	5	4.7
16-20	14	13.1
21-25	23	21.5
26-30	41	38.3
>30	21	19.6

**Table 2:** Alveolar resorption index (ARI) mm

Alveolar resorption index (ARI) mm	Number (n = 104)	%
$\leq 2.0$	5	4.8
2.1-2.50	58	55.8
2.51-3.00	34	32.7
$>3.00$	7	6.7
Mean $\pm$ SD	$2.49 \pm 0.36$	

**Table 3:** Association of  $17\text{-}\beta$  estradiol with alveolar resorption index

$17\text{-}\beta$ estradiol pg/ml	Number of cases	ARI mean $\pm$ SD
Up to 10	13	$2.37 \pm 0.19$
11-50	5	$2.38 \pm 0.28$
$>50$	2	$2.84 \pm 0.33$
Significance	$p = 0.347$	

## Serum 17- $\beta$ Estradiol Levels

Out of the 20 cases assessed, 65% of the cases had serum 17- $\beta$  estradiol levels of up to 10 pg/ml, 25% between 11 and 50 pg/ml and the remaining 10% had > 50 pg/ml. There was a moderate positive correlation of 17- $\beta$  estradiol levels with alveolar resorption index (Table 3). Reduced 17- $\beta$  estradiol levels were significantly associated with mandibular cortex C2 (Table 4).

## Diagnosis

A total of 49% of the cases were diagnosed as chronic generalized gingivitis with localized periodontitis, 48.1% of the cases being chronic generalized periodontitis and the remaining 2.9% were chronic generalized gingivitis. Increased incidence of periodontitis both localized and generalized may be associated with reduced levels of 17- $\beta$  estradiol levels.

## DISCUSSION

Osteoporosis and periodontal disease have common risk factors, and both diseases begin to show their effects mainly after the age of 35 years. Considering that periodontal examinations along with radiographic examination are carried out routinely, if any oral signs of osteoporosis can be elicited during these examinations they would prove to be useful for further diagnostic testing.

The study population was homogenous with respect to age, race and socioeconomic status.

The results of the study demonstrated that while periodontitis was prevalent in all but three subjects examined, it was mild to moderate in most of the subjects. Whereas 19.6% of subjects had all their teeth remaining, 38.3% of the subjects had more than 25 teeth remaining in the dentition and only 4.7% had less than 15 teeth. This shows that osteoporosis *per se* is not a major cause for tooth loss, it was either due to dental caries or periodontitis.

An important finding in the present study was the strong correlation between the local factors and that of the clinical attachment loss and alveolar bone loss. Further, the clinical attachment loss values were strongly associated with alveolar resorption index as well. These findings demonstrated that periodontal status is more determined by local environment than the systemic bone density. These findings are in confirmation with that of study by Elders et al,<sup>12</sup> Hildebolt et al<sup>13</sup> and Tezal et al.<sup>14</sup>

In the study by Elders et al, Caucasian women between the age group of 46 and 55 years were examined for the relation between systemic bone mass and periodontitis similar to the present study, but the oral bone loss was measured using bite-wing radiographs in the molar-premolar junction. The age and number of years since menopause, did not seem to have a bearing on the number of missing teeth, mean probing depth or the occurrence of bleeding on probing which was the case in the present study. Even the correlation between the alveolar bone loss and bone mineral density could not be observed.<sup>12</sup>

The association between bone mineral density and periodontitis was studied in older patients where in addition to periodontitis, smoking history, body mass index, missing teeth and dietary calcium were recorded. Bone mineral density (BMD) was measured with dual energy X-ray absorptiometry (DEXA) and periodontal parameters were measured with advanced diagnostic aids.<sup>13</sup> Here, there was no correlation between systemic bone mineral density and clinical attachment loss similar to the present study.

According to the study by Tezal et al, BMD was found to be related to interproximal alveolar bone loss which was determined using intraoral-periapical and bite-wing radiographs. But clinical attachment loss was found to have no relation with the systemic bone similar to the present study. In contrast to the present study, there was significant correlation between skeletal BMD and interproximal alveolar bone loss.<sup>14</sup>

A large sample of osteoporotic subjects belonging to diverse racial background were studied by Persson et al for assessing the relation between BMD and oral bone loss. The results of the study demonstrated that osteoporosis and periodontitis were strongly associated unlike the present study. But this study used only radiographic assessment of periodontitis without clinical parameters, which may have led to these results.<sup>15</sup>

Studies by national health and nutrition survey have shown that maintaining calcium levels at old age by increased dietary intake, has a beneficial role in preventing periodontitis.<sup>16</sup> Keeping these data in view levels of serum calcium were estimated in every fifth patient in the present study. Around 95% of the subjects had calcium levels ranging between 7.32 and 8.58 mg/dl. Although these levels were marginally less than normal level of 8.5 mg/dl no conclusive correlation could be drawn between the serum calcium levels and periodontal status.

Similarly, serum 17- $\beta$  estradiol levels have been correlated with alveolar crestal height by Hildebolt et al,<sup>17</sup> where they have observed a strong correlation between the two. The normal levels of serum 17- $\beta$  estradiol, in postmenopausal females, are usually between 30 and 40 pg/ml.<sup>18</sup> It is significant that 18 of the 20 cases examined for this substance had levels lower than 30 pg/ml who might have required hormone replacement therapy. However, the periodontal status did not greatly vary in these patients, although statistically there was more attachment loss as well as bone loss in these patients. The poor size of the sample could perhaps explain this discrepancy.

The present study had a main limitation of lack of more sophisticated diagnostic aids like DEXA or subtraction

**Table 4:** Association of 17- $\beta$  estradiol with mandibular cortex

17- $\beta$ estradiol pg/ml (n = 20)	Mandibular cortex	
	C1	C2
Up to 10 (n = 13)	4 (20.0)	9 (45.0)
11-50 (n = 5)	5 (25.0)	–
>50 (n = 2)	2 (10.0)	–
Inference	Lower estrogen levels associated with the C2 mandibular cortex with p = 0.005**	

radiography which are more precise for alveolar bone loss. A larger sample size would have probably given more information regarding the association between these two entities.

But to find an association between these two diseases which are affected by so many variables it is essential to have a well-designed, longitudinal prospective clinical trial wherein having matched controls would probably aid in obtaining a clearer picture.

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