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# Relation Between Osteoporosis and Alveolar Bone Level in Postmenopausal Women (A Clinical and Radiographic Study)

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## Abstract

**Purpose:** This study aimed to investigate the possible association of bone mineral density with alveolar bone loss in women during postmenopause. **Patient and methods:** Totally 60 women after menopause between the ages of 45 and 65 were divided equally into the following three bands using a dual radiography absorptiometry scan (DXA): 20 participants in group I were healthy (T-score of  $-1$ ). Cluster II consisted of 20 women during postmenopause with osteopenia ( $-1 > \text{T-score} > -2.5$ ). 20 osteoporotic females with menopause form cohort III (T-score  $-2.5$  or less). The cementoenamel junction and alveolar crest distance CE-JAC were measured using cone-beam computed tomography images. **Results:** The relationship between clinical attachment loss and linear measures of bone loss at six locations surrounding the most damaged tooth in the maxilla and mandible was favorable in osteopenic and osteoporotic groups (weak to moderate), while negative association in the normal group (poor to mediate). **Conclusions:** Osteoporosis and periodontal disease were correlated, with the greatest linkage in women who were in post-menopausal stage. So the oral health promotion, including routine dental examination and oral hygiene care, is very beneficial.

**Keywords:** Alveolar bone loss, Osteoporosis, Postmenopausal women

## 1. Introduction

The most prevalent and serious dental illness, periodontitis, is one of the most significant clinical issues to receive significant attention in the public health care system [1]. Severe periodontal disease ranked as the 11th most prevalent disease globally in the 2016 Global Burden of Disease Study [2].

Alveolar bone and other supporting periodontal tissues gradually deteriorate during periodontitis. Periodontal disease frequently manifests as gum recession and alveolar bone loss. When periodontitis is severe, bleeding gums, difficulties biting, and eventually tooth loss result [3]. Additionally, there is a considerable correlation between periodontitis and systemic disorders such as osteoporosis, rheumatoid arthritis, diabetes mellitus, and atherosclerosis [4–7].

Osteoporosis is more prevalent in women, especially after menopause, and may be related to changes in the condition of their oral health [8]. It is distinct from diminished bone density, which puts a person at higher risk for fractures. Bone quality is impacted by osteoporosis' decreasing bone mineral density, which also causes oral tissues to deteriorate [9].

Osteoporosis and periodontal disease are frequent chronic illnesses, particularly in women with postmenopause. During menopause, osteoporosis in women is more severe [10,11]. The best way to identify osteoporosis and osteopenia is by measurements of bone mineral density (BMD). According to the World Health Organization [12], dual-energy radiography absorptiometry (DXA) is applied to evaluate the BMD of the spine, hip, and forearm. BMD is represented by the BMD T-score

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[13]. Osteopenia has a T-score between 1.0 and 2.5, whereas osteoporosis possesses a T-score of 2.5 or less [14,15].

The pattern of bone resorption and alterations in periodontal disease is typically revealed by radiographic observations. As in addition to clinical examination, radiographs are a critical tool for the diagnosis of bone destruction. Two-dimensional (2-D) periapical and panoramic radiographs are regularly used to assess the amount of periodontal bone loss. The evaluation of bone craters, lamina Dura, and periodontal bone level in 2-D imaging was hampered by projection geometry and superimpositions of surrounding anatomical structures. Three-dimensional (3-D) imaging techniques, like computed tomography, overcome these restrictions [16,17].

Computed tomography with such a cone beam, a technology named cone-beam computed tomography (CBCT), which is used in dentistry, produces 3-D volumetric scans. All CBCT techniques generate nonmagnified multi-planar reconstructed images in axial, coronal, and sagittal sectors for assessment of intra-bony defects, involvement of the furcation, and loss of buccal/lingual bone [16]. Hence, the purpose of that study was to evaluate alveolar bone loss by CBCT radiographs and discover whether systemic bone loss by DXA scan and clinical evaluation of periodontal disease were interrelated.

## 2. Patients and methods

### 2.1. Study design

This study comprised 60 women in postmenopause aged between 45 and 65. Three clusters of patients created: 20 participants in a band I healthy contributors. Group II 20 patients with osteopenia (T-score between 1.0 and 2.5). Group III contained 20 patients with osteoporosis.

These patients were selected from the Out-Patient Clinic of Oral Medicine, Periodontology, Diagnosis, and Radiology Department at the Faculty of Dental Medicine for Girls, Al-Azhar University. With the approval of Research Ethics Committee (REC-ME-23-01) of the Faculty of Dental Medicine, Al-Azhar University. All procedures were discussed with every patient, and informed consent was made.

### 2.2. Number of samples

According to Thompson 20's equation, the sample size was calculated to be 60 women, with a 90% confidence level and a precision rate of 0.05.  $P = 0.5$ ,  $N = \text{Total Population}$ ,  $Z = Z \text{ value } '1.96'$ ,  $D = \text{Standard Error}$ , and  $n = \text{Sample Size}$  [18].

### 2.3. Inclusion criteria

Women who were in menopause and between the ages of 45 and 65 who had been menopausal for more than a year must have T-scores on a DXA scan classed as ordinary, osteopenic, or osteoporotic patients [19].

### 2.4. Exclusion criteria

- (1) Females who had experienced early menopause.
- (2) Women had metabolic bone disorders other than osteoporosis as osteomalacia, hyperparathyroidism, and hypoparathyroidism.
- (3) Persons suffering from any underlying condition that impairs bone metabolism.
- (4) A background of drinking, abusing cigarettes or smoking.
- (5) Patients who took hormone replacement therapy or bisphosphonate medications were not allowed to participate in the trial [20].

### 2.5. Bone mineral density measurements

Lumbar spine (L1-L4), total hip, and neck of femur measurements were taken for evaluation of BMD through DXA scan.

### 2.6. Clinical parameters

The following clinical parameters were assessed and noted: Gingival index [21]: Each tooth was measured at four angles: buccal, lingual, mesial, and distal. The scale below was utilized to grade the amount of bleeding and swelling: 0- typical gum, 1- No bleeding was evident when probed despite some slight edema, redness, and swelling. 2- Light color change, considerable inflammation, congestion, glazing, and bleeding upon exploring. 3- Pronounced edema, ulceration, and severe inflammation with a propensity to bleed.

Probing depth (PD) [22]. Six sites were recorded for each tooth using William's periodontal probe. Then the representative value was the mean of the measured values for each tooth.

Level of clinical attachment (CAL) [22]. Six sites surrounded the tooth used to calculate the distance from the pocket's bottom to the junction of the cement and enamel.

### 2.7. Radiographic measurement using CBCT

Romexis, a 3-D imaging program, was applied to assess the alveolar bone level. Using the CBCT

machine's low radiation mode, radiographic assessment of the most periodontally afflicted teeth in the maxilla and mandible ( $CAL \geq 5$  mm).

The cementoenamel junction, alveolar crest distance (CEJ-AC), is a linear indicator of alveolar crest height reduction. Millimeter measurements were taken of the buccal, lingual/palatal, mesial, and distal surfaces and evaluated by a single examiner under certain circumstances (the identical monitor with no changes to the contrast or resolution, the identical quantity of ambient light, and a similar distance from the monitor), and then calculated as the amount of bone resorption in each area. The digital measuring tool to the nearest hundredth of a millimeter is included in the CBCT software.

Linear measurements of CEJ-AC were taken at six sites surrounding the teeth with the highest attachment loss as follows: In a horizontal defect, Then from the CEJ to the alveolar crest AC, draw a vertical line, and in the vertical defects on both sides, from the CEJ to the bottom of the fault (to be in a perpendicular plane to a straight line joining the 'cementoenamel junctions' of two adjacent teeth in a horizontal plane). The line's length was then estimated. The six locations on the cross-sectional view were Mesiobuccal, Mid Buccal, Disto Buccal, Disto Lingual, Mid Lingual, and Mesio Lingual (Fig. 1).

### 2.8. Statistical analysis

The conclusions of the analysis were statistically examined by using one-way ANOVA and then the Tukey post hoc analysis. The association between clinical and radiographic data was examined by the Pearson Correlation Coefficient test (using the SPSS statistical package, version 25, IBM Co. USA).

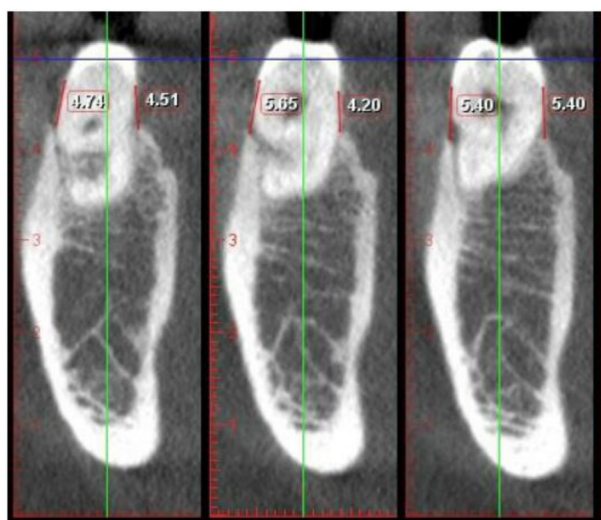


Fig. 1. Linear measurements of the affected tooth.

## 3. Results

According to DXA results, 18.18% of women undergoing menopause were osteoporotic, 49.09% were osteopenic, and 32.73% were controlled.

In the gingival index, none of the three groups'  $P$  values were statistically significant. PD and CAL, in total the  $P$  value were statistically significant, demonstrating that the discrepancy between the osteoporotic and the healthy persons was meaningful (the osteoporotic participants had the highest mean of PD, CAL, and bone loss among the three groups). Significant discrepancies were between the three groups ( $P \leq 0.05$ ). Pearson Correlation test between clinical attachment loss and the linear measures of bone loss (BL) at the diverse six locations surrounding the tooth with the highest damage CAL. CAL and BL in natural members clearly show a negative connection (weak to moderate). However, it was a definite significant connection between the osteoporotic and osteopenic groups (low to intermediate) Table 1.

## 4. Discussion

The most important benchmark for determining the severity of periodontitis and identifying individuals at risk of collapsing periodontal tissue is still bone damage [23]. Contributors and measurement techniques used in clinical trials determine the relationship between osteoporosis and periodontitis. In general, males are more likely to have periodontitis than women are to have osteoporosis [24,25].

In periodontics, radiographic testing aids in the identification of periodontitis by complementing clinical investigation [26]. Alveolar bone loss is measured linearly using CBCT at six locations around the tooth. It offers accurate information on the alveolar bone that can be used to identify periodontal diseases [27].

The two best approaches to diagnose osteoporosis are BMD testing, notably in the hip and lumbar spine using a technology called dual energy DXA, or the occurrence of nontraumatic hip or vertebral fractures. Another way to detect osteoporosis is the presence of osteopenia [28].

The present study's objective was to establish a link between systemic and alveolar bone loss. Although assessing alveolar bone loss using radiography is a crucial criterion, CAL represents the cumulative effects of periodontitis. When periodontitis is severe, CAL leads to the degeneration of alveolar bone support and tooth loss [29].

Results of the current investigation demonstrated a positive connection between clinical data (CAL)



Table 1. Correlation between clinical attachment loss and linear measurements of bone loss at six points around the tooth in the osteoporotic group.

	r <sup>a</sup>	P value	Correlation type
CAL Buccal versus BL maxilla Buccal	0.236	0.511 <sup>NS</sup>	Weak positive
CAL Buccal versus BL mandible Buccal	0.248	0.490 <sup>NS</sup>	Weak positive
CAL Lingual versus BL maxilla lingual	0.324	0.361 <sup>NS</sup>	Moderate positive
CAL Lingual versus BL mandible lingual	0.007	0.985 <sup>NS</sup>	Weak positive

<sup>NS</sup> Nonsignificant (P value < 0.05).

<sup>a</sup> Pearson Correlation value.

and linear assessments of radiographic BL at six sites around the most severely damaged tooth in each of the three groups. Correspond to a study by Mashalkar et al. 2018, on 94 women in post menopause aged 45–60 with affected teeth (CAL > 5 mm on 30% of the site) [30].

Osteoporosis and periodontitis are both bone conditions that are directly linked to inflammation and ageing. There has been ongoing interest in determining if the systemic skeletal disorder like osteoporosis may exacerbate the alveolar BL in periodontitis due to the numerous overlapping risk factors and connections in pathogenic pathways. Although the early clinical findings until the early 2000s were at best debatable, more recent research has offered stronger evidence to support a link between these two illnesses [10].

According to Yu *et al.* [31], there was a link between systemic BMD and alveolar bone resorption. However, some research, including Singh *et al.* [32] and Marjanovic *et al.* [33], found no connection between CEJ-AC and BMD. There are disparities between these studies and the present investigation, even though the discrepancy present in the results.

A general positive correlation was discovered in the large portion of cross-sectional association studies undertaken in older women with menopause, showing that such an association may exist in a part of the populace. The degree of the relationship may also differ noticeably depending on the clinical and radiographic measures employed for both disorders [34].

#### 4.1. Conclusion

Although osteoporosis is not the primary cause of periodontitis, the findings of this study indicate that it may indirectly affect it by boosting to the alveolar BL. The severity of periodontitis and osteoporosis in postmenopausal women has observed to be correlated.

#### 4.2. Recommendation

There is a need for longer-term investigations.

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#### Conflicts of interest

There was no conflict of interest.

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