

Periodontal Status in Post-menopausal Osteoporosis: A Preliminary Clinical Study in Taiwanese Women

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Key Words

osteoporosis;
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Background. Osteoporosis and periodontitis are common diseases affecting post-menopausal women; however, the exact relationship between the diseases is still uncertain. The purposes of this study were to examine the periodontal status in a group of type I post-menopausal women with and without osteoporosis and to elucidate the possible role of the osteoporosis in the pathogenesis of periodontal disease.

Methods. Thirty-four patients (18 in the osteoporotic and 16 in the non-osteoporotic group) were selected from 329 post-menopausal Taiwanese women who had completed radiographic measurements of spinal bone mineral density and received full-mouth periodontal examination. Periodontal measurements, including O'Leary plaque index, probing depths, clinical attachment level, and gingival recession, on 6 sites of each tooth of full mouth were examined and recorded by 1 examiner.

Results. Significantly greater probing depth was noted at the interproximal, but not at the facio-lingual, osteoporotic sites if compared to those non-osteoporotic sites. The depth was also significantly influenced by the examining factors of plaque accumulation, tooth location, and jaws. By individual jaw, increased attachment loss accompanied by greater probing depth and gingival recession was found at the osteoporotic sites on mandible if compared to non-osteoporotic sites. On maxilla, however, less gingival recession and attachment loss were observed at the osteoporotic sites.

Conclusions. In the present study, increased attachment loss accompanied by greater probing depth and gingival recession was found at the osteoporotic sites on mandible. However, the parameters were also influenced by the examining factors of plaque accumulation, tooth location, and jaws. Therefore, we suggest that post-menopausal osteoporosis may play a role in the pathogenesis of periodontal disease, especially on the mandible, although the etiology of periodontal disease is still multi-factorial.

Osteoporosis is a very common metabolic disease characterized by low bone mass and micro-architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture.¹ Periodontal disease is a microbial infection, but the exact etiology of the disease may be multi-factorial. Risk factors associated with periodontal disease include accumulation of dental plaque and host-response abnormalities, involving smoking and many systemic diseases.² Osteoporosis has long been suggested as a contributing etiologic factor of periodontal disease because of the characteristic generalized skeletal bone decrease.³ De-

creased osseous density in oral and facial bones has been demonstrated in patients with osteoporosis; however, the correlation between systemic osteoporosis and periodontal disease is still controversial.⁴ Patients with osteoporosis show a greater incidence of edentulous condition and retain fewer natural teeth.⁵ On the other hand, functional occlusal stimuli from natural teeth may also be an important aspect of maintaining the oral and facial skeleton.⁶ It has been shown that the hip joint fracture, a common clinical complication of osteoporosis, presents higher incidence rates in white population than in black, Asian, or Hispanic populations.⁷ However, there are lim-

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ited data on periodontal status in post-menopausal osteoporosis women, especially from Asia. Therefore, the purposes of this study were to examine the periodontal status in a group of post-menopausal Taiwanese women who retained more than 20 natural teeth and who were either osteoporosis or non-osteoporosis, and further to understand the relationship between generalized bone density and periodontal status.

METHODS

From 329 Taiwanese women patients who had received spinal bone mineral density screening (Hologic QDR 4500 Fan Beam X-ray Bone Densitometer, Bedford, MA, USA) in the Radiography Department of the Armed Forces Tao-Yuan General Hospital, 81 patients (aged 50-59 years) with either normal (control) or degree II or III bone mineral density value (osteoporosis) were selected (Table 1). However, only 34 patients, who fitted the requirements of post-menopausal conditions, completed the periodontal examinations. There were 18 women in the osteoporotic and 16 in the control group. All selected patients presented more than 20 teeth, had no systemic disorder, and had received no periodontal therapy or antibiotic treatments in the past 6 months. The periodontal examinations included measurements of O'Leary plaque index, probing depths, attachment level, and gingival recession^{8,12,16} on 6 sites of each examined tooth from full mouth with William's marker Michican

"O" probe. A single blinded examiner completed all measurements.

Statistical analysis

Six sites (including the mesio-buccal, mid-buccal, dist-buccal, mesio-lingual, mid-lingual, and dist-lingual sites) from each every tooth were recorded; however, the interproximal (the mesial and distal sites) and facio-lingual sites (the mid-buccal or mid-lingual sites) were grouped and analyzed independently. ANOVA analysis, with $p < 0.05$ defining significance, was selected to compare whether the means of periodontal parameters (dependent variables) were related to osteoporosis, tooth location, jaws, or plaque accumulation (independent variables).

RESULTS

Probing depth at the interproximal osteoporotic sites showed significantly greater than that at the non-osteoporotic sites; however, the depths at the facio-lingual osteoporotic sites were similar to those at the non-osteoporotic sites (Table 2). The depth was significantly influenced by the all other examining factors (including the plaque accumulation, the tooth location, and the jaws), regardless at interproximal or at facio-lingual sites (Table 2). The gingival recession and attachment loss showed similar between the sites with and without osteoporosis, although they were significantly influenced by other examining factors, except the factor of jaws at interproximal sites (Table 2). Greater attachment loss accompanied deeper probing depth, and more gingival recession was noted at sites with positive plaque or in posterior location. However, the finding of greater probing depth but less gingival recession and attachment loss was noted on maxilla than on mandible.

In further analyzing the data by individual jaw, a significantly greater probing depth was noted either at interproximal or at facio-lingual osteoporotic sites if compared to those of non-osteoporotic sites on mandible, but not on maxilla (Table 3). On mandible, increased attachment loss accompanying greater probing depth and gingival recession was found at the osteoporotic sites (Table 3). However, an inconsistent pattern of less

Table 1. Distribution of age and severity of the bone mineral density in the initial screening of participants for this study (^a the patients were selected for periodontal evaluation in the study)

Age (yr)	Osteoporosis level				Normal	Subtotal
	I	II	III	IV		
20-29	1	1	0	0	2	4
30-39	7	4	1	0	10	22
40-49	24	14	5	1	38	82
50-59	33	25 ^a	22 ^a	7	34 ^a	121
60-69	6	11	12	20	4	53
70-79	5	8	10	12	5	40
80-89	0	2	1	3	1	7
Total	76	65	51	43	94	329

Grade I: > -1 ; Grades II & III: $-1 \sim -2.5$; Grade IV: < -2.5 .

Table 2. Effects of the osteoporosis condition, the plaque accumulation, the tooth location and the jaws on the periodontal parameters (including the probing depth, the gingival recession, and the total attachment loss) at the interproximal and facio-lingual sites (millimeters)

	Osteoporosis		Plaque		Location		Jaw	
	Control	Diseased	Negative	Positive	Anterior	Posterior	Upper	Lower
Probing depth								
Interproximal	3.19 (0.61)	a 3.24 (0.62)	3.22 (0.61)	a 3.32 (0.62)	3.06 (0.43)	a 3.35 (0.71)	3.27 (0.70)	a 3.16 (0.51)
Facio-lingual	2.26 (0.54)	2.29 (0.57)	2.22 (0.52)	a 2.31 (0.57)	2.15 (0.42)	a 2.38 (0.63)	2.32 (0.61)	a 2.23 (0.48)
Gingival recession								
Interproximal	0.35 (0.86)	0.29 (0.64)	0.16 (0.50)	a 0.36 (0.80)	0.27 (0.61)	a 0.36 (0.86)	0.26 (0.77)	a 0.38 (0.72)
Facio-lingual	0.67 (1.08)	0.59 (0.87)	0.41 (0.76)	a 0.78 (1.18)	0.62 (0.89)	0.63 (1.03)	0.50 (0.99)	a 0.75 (0.92)
Attachment loss								
Interproximal	3.54 (1.15)	3.53 (0.90)	3.39 (0.76)	a 3.58 (1.08)	3.33 (0.76)	a 3.71 (1.17)	3.53 (1.13)	3.54 (0.89)
Facio-lingual	2.91 (1.32)	2.87 (1.03)	2.63 (0.89)	a 3.08 (1.30)	2.77 (1.00)	a 2.99 (1.29)	2.81 (1.27)	a 2.98 (1.04)

a: significant difference at $p < 0.05$ by four-way ANOVA.

(): standard deviation.

Table 3. The periodontal parameters (including probing depth, gingival recession, and attachment loss) at inter-proximal and facio-lingual sites with the osteoporosis and non-osteoporosis condition from maxilla and mandible, respectively

	Mandible		Maxilla	
	Control	Diseased	Control	Diseased
Probing depth				
Interproximal	3.12 ± 0.48	a 3.19 ± 0.53	3.25 ± 0.71	3.28 ± 0.68
Facio-lingual	2.19 ± 0.44	a 2.26 ± 0.51	2.32 ± 0.59	2.31 ± 0.62
Gingival recession				
Interproximal	0.33 ± 0.68	a 0.42 ± 0.75	0.37 ± 1.01	a 0.17 ± 0.50
Facio-lingual	0.71 ± 0.88	0.78 ± 0.96	0.62 ± 1.23	a 0.41 ± 0.73
Attachment loss				
Interproximal	3.45 ± 0.81	a 3.61 ± 0.94	3.62 ± 1.39	a 3.46 ± 0.86
Facio-lingual	2.90 ± 1.02	a 3.04 ± 1.06	2.91 ± 1.53	a 2.72 ± 0.97

a = significant difference at $p < 0.05$ by one-way ANOVA.

attachment loss accompanied by less gingival recession was observed on maxillary osteoporotic sites.

DISCUSSION

In the present study, periodontal parameters including probing depth, attachment level, and gingival recession were examined at 6 tooth sites in post-menopausal

Taiwanese women with or without osteoporosis. A significantly greater attachment loss was noted at the osteoporotic site than that at the non-osteoporosis; however, it was only found at the mandibular sites, but not at the maxillary sites (Table 3). A similar finding of greater attachment loss on the mandible has also been observed in the 6 Ramfjörd teeth by examining the 3 probing sites from each tooth.⁸ In the present study, the recording of 6 probing sites from a full dentition might include rather

more comprehensive information than that 3 sites in Ramfjörd teeth. The variation in bone density from each individual jaw, lower in maxilla and higher in mandible, might be related to our findings at the mandible sites with or without the osteoporosis. Nevertheless, that severe osteoporosis which significantly reduces the bone content of the jaws may be associated with less favorable attachment levels in cases of periodontal disease has been suggested based on the observations on a group of osteoporotic Caucasian women in the study by Von Wöern and colleagues.⁸

Osteoporosis can generally be classified into primary and secondary patterns. Postmenopausal or senile osteoporosis is catalogued as the primary pattern, with a further division into types I and II. Type I is associated with early postmenopausal bone loss caused by a drop in estrogen levels.⁹ In the early postmenopausal period, about 25% of women may lose 5% to 8% per year of their bone mineral content in the skeleton (including the jaws), while the remaining 75% may lose 1% to 2%.¹⁰ The participants in this study were age-matched (50-59 years old), but osteoporotic patients within this narrow age range might principally fall into primary type I. Thus, our data may only represent the condition in type I osteoporosis (a moderate rather than a more severe status) which may partly explain inconsistencies with the study by Mohammad and colleagues.¹¹ Their cross-sectional study examined 40 selected women, 20 in the bottom textile of spinal bone density and 22 in the top. Because of significantly greater gingival recession components of periodontal attachment level in the bottom textile group; systemic osteoporosis was possibly suggested to contribute to periodontal attachment loss in the form of gingival recession. In the present study, greater recession and attachment loss was also observed at the mandibular sites with osteoporosis when compared with non-osteoporosis, but opposite findings that less recession and attachment loss were noted at the maxillary sites with osteoporosis. Nevertheless, the condition of type II osteoporosis is not examined in the present study.

In 227 healthy post-menopausal Finnish women, an inconsistent finding that individuals with high mineral values in the skeleton seemed to retain their teeth with deep periodontal probing more readily than those with low mineral values was observed.¹² The authors advo-

cated that their findings should especially motivate treatment of persons suffering from advanced periodontal disease but having good mineral status. In the present study, other factors (especially plaque) were significantly inferential to the periodontal parameters. Osteoporosis does not seem to be the only major etiological factor in the pathogenesis or progression of periodontal disease. Because greater probing depth, recession, and attachment loss were noted at sites with poor plaque control in the present study (Table 2), we agreed that the dental bacterial plaque still plays a very important role in the progression of periodontal disease.^{13,14} At the interproximal sites, a significantly deeper probing depth was found in the osteoporotic condition than that without the condition. In addition, greater plaque retention was also observed at the interproximal sites than at the facial or lingual sites (data not shown), which might, in part, explain the significant difference observed only at the interproximal sites.

It has been shown that the severity of osteoporosis or hip joint fracture (a common clinical complication of the disease) is significantly related to racial distribution. Asian Americans appear to have less cortical bone mass than whites of similar age.⁷ Incidence of osteoporotic fracture rates in blacks is about one-third that of whites.¹⁵ Nevertheless, we preliminarily evaluated the periodontal status for a group of post-menopausal women with or without osteoporosis in Taiwan. In addition, patients with a restricted range of moderate osteoporosis, the bone mineral density degree II or III, were selected in the present study, while those with a rather higher severity or wider range of osteoporosis were used in the study of Mohammad and colleagues.¹¹ Although greater bone loss in dental alveoli has been shown in patients with osteoporosis,¹⁶ functional stimuli of occlusion from natural teeth might still be important in maintaining the oral or facial skeleton.⁶ But, patients with osteoporosis showed greater edentulous incidence and retained fewer natural teeth.¹⁷ Thus, the differences in the present study from previous studies might be related to racial characteristics, the severity of osteoporosis, and the functional stimuli from natural teeth.⁸

In conclusion, periodontal status was recorded on the 6 examining sites of each tooth from 18 osteoporotic or 16 non-osteoporotic Taiwanese women. Significantly

greater probing depth was noted at the interproximal osteoporotic sites if compared to those non-osteoporotic sites. In further evaluation, increased attachment loss accompanied by greater probing depth and gingival recession was found at the osteoporotic sites on mandible but not on maxillae. Nevertheless, the periodontal parameters were also significantly influenced by the examining factors of plaque accumulation, tooth location, and jaws. Therefore, we suggest that osteoporosis may play a role in the pathogenesis of periodontal disease, especially on the mandible, although the etiology of periodontal disease is still multi-factorial.

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