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Review Article

OSTEOPOROSIS: A RISK FACTOR IN PERIODONTAL DISEASE

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Abstract

Osteoporosis and periodontitis are the diseases that affect a large number of men and women worldwide with incidence increasing with advancing age. Both these diseases present bone loss as a common hallmark. Periodontitis has long been defined as an infection mediated destruction of the alveolar bone and soft tissue attachment to the tooth, responsible for most tooth loss in adult populations. Current evidences including several studies support an association of osteoporosis with the onset and progression of periodontal disease in humans. Systemic loss of bone density in osteoporosis including that of the oral cavity may provide a host system that is increasingly susceptible to infectious destruction of periodontal tissue. Understanding the association between these common diseases and the mechanisms underlying these associations will aid health professionals to provide improved means to prevent, diagnose and treat these very common diseases.
The paper reviews the current evidence on the association between periodontal disease and osteoporosis.

Key words
Bone Loss, Osteoporosis, And Periodontal Disease

INTRODUCTION

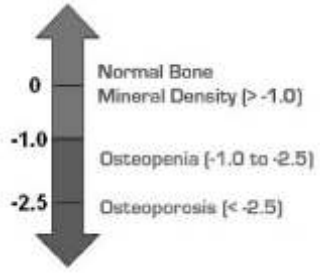
Osteoporosis (too little bone in the bones) is a medical disorder characterized by a generalized low bone mass and fragility with a consequent increase in fracture risk, particularly of vertebrae, hip and wrist1. It is a physiological, gender and age related condition resulting from bone mineral content loss and structural changes in bones.

Periodontal disease is a chronic inflammatory disease that leads eventually to loss of the supporting structures of the teeth, including resorption of the alveolar bone of the jaw.

The primary etiology of periodontal disease as a bacterial infection has been established. Although bacterial insult is the primary factor responsible, the reaction of the host's immuno-inflammatory system is also responsible for most of the destruction seen in periodontal disease. Since loss of alveolar bone is a prominent feature of periodontal disease, severe osteoporosis could be suspected of being an aggravating factor in the case of periodontal disease. A number of studies investigated a possible relationship between periodontitis and osteoporosis. Adequate health of the bone is maintained by the precise balance between bone apposition by osteoblasts and bone resorption by osteoclasts. When the activity of osteoclasts increases over the osteoblasts, osteopenia or osteoporosis occurs2.

Osteoporosis was once thought as a natural process of ageing in women, much the same way as tooth loss was thought to be related to age rather than chronic periodontal infection3. Women at peak attainment achieve less bone mineral content (BMC) and bone mineral density (BMD) than males and the rate of bone mineral loss with ageing is approximately twice as high in women than men. Osteoporosis has been categorized into primary osteoporosis and secondary osteoporosis. Primary osteoporosis is associated with menopause, advancing age, and idiopathic osteoporosis that may be seen in premenopausal and middle aged men. Secondary osteoporosis is caused by certain medical conditions or treatment that prevents either attainment of peak bone mass or enhances bone loss. It is commonly associated with endocrine disorders (Cushing syndrome, hyperparathyroidism, IDDM, adrenal insufficiency), rheumatoid arthritis, hematologic disorders and malignancies (leukemia, lymphoma), immobilization, pregnancy, lactation, environmental factors including cigarette smoking, sedentary life style and probably alcoholism.

WHO has established four diagnostic levels of bone mineral density.



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As per WHO, osteoporosis is bone density 2.5 standard deviation below the average peak bone density achieved in young adults matched by gender and race4 (Table no.1).
In a comparison of the risk factors associated with osteoporosis and periodontal diseases, it seems clear that there are multiple similarities between the 2 disease processes. The diseases are associated in general with advancing age, with the vast majority of patients being over the age of 35, and a higher incidence in the later decades. A patient with a history of loss of alveolar bone support is at risk for future progression of periodontitis. Likewise, a patient with systemic bone loss or osteoporosis is at risk for periodontitis. Some of the common risk factors shared by both osteoporosis and periodontal disease are shown in Table no.2

POTENTIAL MECHANISM OF ASSOCIATION
Several potential mechanisms Mechanism by which osteoporosis or systemic bone loss may be associated with periodontal attachment loss, loss of alveolar bone height and tooth loss have been proposed5:

1) Low bone density in the oral bone associated with low systemic bone: This low bone density or loss of bone density may lead to more rapid resorption of alveolar bone following insult by periodontal bacteria.
2) Modification of local tissue response to periodontal infections due to systemic factors affecting the bone remodeling: Persons with systemic bone loss are known to have increased systemic production of cytokines (IL 1 and 6) that may have effect on the bone throughout the body including bone of oral cavity. Periodontal infections have been shown to increase local cytokine production that in turn increases local osteoclasts activity resulting in increased bone resorption.
3) Genetic factors that predispose a person to systemic bone loss: These also influence or predispose an individual to periodontal destruction.
4) Environmental factors such as cigarette smoking and sub optimal calcium intake, among others, may put individuals at risk for development of both osteopenia and periodontal disease.

However, most of the studies consider low systemic bone density as the primary factor for the rapid resorption of alveolar bone.

Studies have attempted to define the relationship between osteoporosis and periodontitis. Most studies support a positive association between these common diseases and inspite of the various limitations, recent investigations have been designed to provide more specific information.

Groen etal (1968)6, assessed the relationship between osteoporosis or low bone density and clinical attachment levels. Toothlessness and severe periodontal disease were found among 38 patients, aged 43 to 73, who exhibited clinical and radiographic signs of advanced osteoporosis.

Philips and Ashley (1973)7 found that bone density assessed by the metacarpal index (MI) was associated with mesial probing depth (Russell's periodontal index) and was significantly associated when limiting the assessment to posterior teeth, in 113 females, aged 30-40 years.

Ward and Manson (1973)8 were able to find an association between the periodontal disease index and alveo1ar bone loss, but no relation between metacarpal index and periodontal index was found.

Elders et al (1992)9 assessed the association between alveolar bone height and, spinal BMD and Metacarpal Cortical Thickness (MCT) in 286 women, aged 46-55 years, 21% of whom were edentulous. The dentate subjects, mean alveolar bone height was significantly correlated with spinal BMD, MCT, age and years since menopause. However, lumbar BMD and MCT were not found to significantly correlated with alveolar bone height. The fact that no association was detected, may be due to the selection of subjects, given their relatively young age (46-55 years) when prevalence of osteoporosis may be low, limiting the association that may be observed.

Ward and Manson (1973)8,9 were unable to show a significant relationship between alveolar bone loss and bone density of hand using metacarpal bone index. However, rapidity (a measure of alveolar bone loss divided by age) was found to be associated with metacarpal bone index in females but not males, potentially suggesting some role of osteoporosis in loss of oral bone by gender and with ageing.

In a cross sectional study of mandibular bone density by Kribs P.J 199010, in osteoporotic women, tooth loss and edentulism were found to be significantly more common in osteoporotic group. On average, osteoporotic women had lost 6.9 mandibular teeth compared to 4.5 teeth in women with normal bone density.

Taguchi et al (1995)11have studied the relation between tooth loss and oral bone density, the first study included 269 subjects, 99 men and 170 women aged, 3-88 years. No relationship was seen between mandibular cortical width and tooth loss in males, however, in female subjects, a decrease in mandibular cortical bone width was positively correlated with tooth loss. The association was most apparent in women past their 7th decade of life.

In a cross sectional study of 64 women aged, 50-70 years, tooth loss was found to be highly correlated with prevalence of spinal fracture. A later study reported a positive relationship between loss of posterior teeth and alveolar and spinal bone density, however, no association was found between number of anterior teeth and density of the spine or oral cavity.

MANAGEMENT
Combination of lack of exercise, decreased nutritional intake of calcium and a lack of hormone replacement after menopause may explain upto 50 % of loss of bone mineral density attributed to osteoporosis. Certainly one clinical implication is to advise patients on diet, exercise, the risks and benefits of HRT.

Several longitudinal cohort studies have examined the effects of hormonal replacement therapy on tooth loss. Each of the studies demonstrated that with long term estrogen replacement as a part of post menopausal replacement therapy, a protective effect limiting tooth loss was observed after correcting the data for confounding variables such as age smoking and education. Estrogen repletion is associated with less bleeding on probing and a tendency for less frequent clinical attachment loss.

Paganini-Hill (1995)12 examined the relationship between post menopausal estrogen replacement and number of missing teeth in 3921 women. They found that age adjusted risk of edentulism was approximately half that of non users.

However, HRT is not acceptable to, nor is it appropriate for all human. Therefore some attention has been focused on identifying nutritional factors that will reduce bone loss, either alone or in combination with osteoporosis medications.

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Medications and strategies for prevention and treatment of osteoporosis also includes anti resorptive drugs. It includes selective estrogen receptor modulators and bisphosphonates. Bisphosphonates binds avidly to apatite crystals, mainly on remodeling surfaces and inhibits their growth, aggregation and dissolution. The more potent nitrogen containing member of this drugs class includes alendronate, risedronate, ibandronate and zoledronic acid. Alendronate has been shown to reduce active bone resorption significantly without interfering with bone mineralization and quality. Clinical trials have shown that bisphosphonates also decrease bone turnover and increased bone mass and bone strength 13.

Weinreb et al (1994)14 tested the efficacy of alendronate in reducing alveolar bone loss caused by experimental periodontitis in cynolomolgus monkeys. Alendronate was found to be significantly effective in reducing bone loss associated with experimental periodontitis. Reddy et al (1995)15 also evaluated alendronate for inhibition of alveolar bone loss in naturally occurring periodontitis in beagle dogs. They concluded that alendronate received group exhibited statistically significant differences in bone mass and density.

There have been few human studies to date on the oral effect of medications for osteoporosis and therefore carefully designed studies and randomized controlled trials with adequate statistical power are required to determine the clinical significance of osteoporosis therapies on periodontal diseases, risk of tooth loss, and other oral health outcomes. These measures are not likely to replace established periodontal treatment protocol; more research is needed to determine if they may be used to augment treatment in appropriate patients.

SUMMARY

A number of studies have been presented and have generally suggested that osteopenia does play a role in the establishment of periodontal disease. Periodontal disease is characterized by resorption of the alveolar bone as well as loss of the soft tissue attachment to the tooth. The etiology of periodontal disease as a bacterial infection is well established, however, loss of oral bone as a result of osteopenia is probably important in the creation of a susceptible host. In addition, osteopenia and periodontal disease may share common etiologic agents which may either directly influence or modulate both disease processes. Many of the studies conducted to date suggest there is a relationship between these diseases, but these studies have been plagued by relatively small sample sizes and lack of adequate control of potential confounding variables such as gender, hormone intake, smoking, race, age, stress and distress, diet, body mass and exercise. Further study of the relationship between osteoporosis, oral bone loss and periodontal disease is needed. Understanding the association between these common diseases and the mechanisms underlying those associations will aid health professionals to provide improved means to prevent, diagnose and treat these very common diseases.

Table No.1;

FOUR DIAGNOSTIC LEVELS OF BONE MINERAL DENSITY ESTABLISHED BY WHO.

1.	NORMAL BONE	t-score better than -1
		(>833 mg/cm2)
2.	OSTEOPENIA	T-score between⩾1 and 2.5
		(between 833 and 648 mg/cm2).
3.	OSTEOPOROSIS	T-score less than -2.5 (lower than 648mg/cm2).
4.	ESTABLISHED OSTEOPOROSIS	Includes the presence of a non-traumatic fracture.

Table No. 2; COMMON RISK FACTORS FOR OSTEOPOROSIS AND PERIODONTAL DISEASE

OSTEOPOROSIS	COMMON RISK FACTORS	PERIODONTITIS
Female gender	Cigarette smoking	Plaque
Causacian or Asian race	Nutritional deficiency	Stress
Heredity	Increasing age	Diabetes
Menopause, Amenorrhoea	Corticosteroid use	Hormone changes
High intake caffeine, protein, salt, phosphate phosphate	Immune dysfunction	Medical disorders
Low intake calcium, vitamin D		Osteoporosis
Excessive alcohol		
Physical inactivity		
Low skeletal mass		
Medical disorder		

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