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# Osteoporosis: A Risk Factor in Periodontitis

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**ABSTRACT**

**Periodontal Diseases are diseases, which are related with particular pathogenic microscopic organisms that colonize the subgingival zone. Initiation & progression of periodontal contaminations are distinctly altered by local and fundamental conditions called risk factors. The local factors incorporate prior problem as confirm by deep probing depths and plaque retention ranges related with defective restorations. Fundamental risk factors as of late have been distinguished by substantial epidemiologic investigations utilizing multifactorial statistical analysis to correct for perplexing or related co-risk variables. Recent Studies likewise point to a few conceivably critical periodontal risk factors. These incorporate anxiety and adapting practices, and osteopenia related with periodontal disease including sexual orientation, age and hereditary variables. The investigation of risk in periodontal disease is a quickly developing field and much is yet to be learned.**

**Keywords: Periodontal, Osteoporosis, risk factors, disease.**

## INTRODUCTION

It is of most extreme significance to give a clear investigation of the confirmation supporting the imperative part of risk factors in deciding the contrasts between people in susceptibility to periodontal disease and pick up a more profound understanding of the part of risk factors with a specific end goal to consolidate risk-factor modification in the management of periodontal disease. Concentrate will be particularly on systemic risk variables which are powerless for periodontal disease that are moderately basic in the populace and are probably going to have a generous population-attributable risk.

### Periodontal Risk Factors

Risk is defined as the probability that an individual will get a specific disease in a given period. However , the risk of developing the disease will vary from individual to individual. Risk factors may be environmental, behavioural, or biologic factors that, when present, increase the likelihood that an individual will get the disease. For a risk factor to be identified, the exposure must occur prior to disease onset. Risk indicators are probable or putative risk factors that have been identified in cross-sectional studies but not confirmed through longitudinal studies. Risk predictors/markers, although associated with increased risk for disease, do not cause the disease.

The concept that rate of progression, age at onset, and severity of periodontal disease in an individual are often determined by systemic risk factors in the host is a recent concept, made by understanding of the epidemiology of periodontal disease and the role of risk factors. The mechanisms involved in the initiation and progression of periodontitis has developed from a simplistic view of microbes directly causing clinical signs and symptoms of periodontitis, through understanding the importance of the immune system and the inflammatory response of the host which further describes periodontal disease ,as a multifactorial disease that also is influenced by genetic and environmental risk factors.

Periodontitis is a chronic bacterial infection characterised by destruction of tissues around the tooth and loss of alveolar bone. However, very few studies were conducted to examine the prevalence of periodontitis among children and adults in Saudi Arabia. In 1987, the prevalence of periodontitis was reported to be 18% among children 15–19 years old, whereas the prevalence among adults 35–44 years old was 36% [1]. In 2006, the prevalence of periodontitis was reported to be 68%

(≥20% bone loss) among adults ≥18 years old. Among adults who had periodontitis, 28% had localised periodontitis and 40% had generalised periodontitis [2]. Also, the prevalence of localised juvenile periodontitis among Saudi adults 17–23 years old was 0.42% and the ratio of women to men was 1.88:1. Osteoporosis is a progressive bone disease. It is one of the most prevalent diseases of bone. Osteoporosis was reported to be common among Saudi postmenopausal women [4]. A high prevalence of osteoporosis was revealed in the eastern and central regions of Saudi Arabia [5, 6]. A study in Dammam indicated that women with >6 children had a lower chance to develop osteoporosis and a lower risk of fracture compared with women who had Large numbers of studies have reported a relationship between periodontal diseases and osteoporosis.

Tanriover et al. [9] studied the relationship between low bone mineral density (BMD) and periodontal status in young individuals. The study concluded that young individuals with osteoporosis had greater gingival inflammation and recession than those with normal BMD. Others have found that low BMD was significantly associated with periodontitis. In addition, studies conducted on postmenopausal women showed that they have a higher chance of developing periodontal disease compared with women with normal BMD. A few studies found a lack of association between periodontal disease and low BMD. In a longitudinal study, there was no difference in periodontal status among men with osteoporosis and men with normal bone density.

Hildebolt et al. [10] investigated the relationship between osteoporosis and periodontal disease by assessing clinical attachment loss (CAL) and BMD among 135 postmenopausal women aged 41–70 years. Results showed no moderate to severe periodontal disease and reported that attachment loss was not correlated with BMD; however, it was associated with tooth loss. Several other studies also showed a negative association between osteoporosis and periodontal disease [19-25]. The majority of studies conducted to assess the association between osteoporosis and periodontal disease focused on postmenopausal women and had limitations including small sample size, limited control of confounding variables, and inadequate study design. In Saudi Arabia, few studies have investigated the prevalence of osteoporosis and periodontal disease or the relationship between them. Therefore, the present study was conducted to evaluate the relationship between osteoporosis and periodontal diseases in men as well as to assess the prevalence of periodontitis and osteoporosis among men in Saudi Arabia.

## PERIODONTAL DISEASE AND OSTEOPOROSIS

The relationship of tooth loss and BMD has been studied. Several reports find a correlation while others do not. The use of tooth loss as a surrogate for periodontal disease extent, has several limitations because of other factors which could contribute to it. Therefore several cross-sectional reports have used a variety of parameters to evaluate the periodontal disease severity in subjects with decreased BMD.

In a report by Elders et al., [13] lumbar BMD and metacarpal cortical thickness were compared to alveolar bone height on bitewing radiographs and clinical parameters of periodontitis. No significant relation was observed between the bone mass measurements and alveolar bone height and periodontal parameters. The mean age in this group was relatively young between 46-55 years of age which could have contributed to the lack of correlation.

In another study of 70 year old women 15 subjects with osteoporosis were compared to 21 subjects with normal BMD. No statistically significant differences were found in gingival bleeding, probing pocket depths, gingival recession or marginal bone level between the women with osteoporosis and the women with normal BMD [14].

Von Wowern et al., [15] found greater amounts of loss of attachment in osteoporotic women with a mean age of 68. Osteoporosis was assessed using bone mineral content of the mandible and forearm determined by dual photon scanning.

In a study population of 70 post-menopausal Caucasian women aged 51-78, skeletal systemic BMD was assessed by DXA. Clinical attachment loss and interproximal alveolar bone loss represented periodontal disease severity. Mean alveolar bone loss significantly correlated with systemic BMD. A trend for a correlation between clinical attachment levels and BMD was found [16].

The cross sectional studies have limitations. No information about the diseases studied prior to the exam is available. Although both osteoporosis and periodontiits are chronic diseases it is incorrect to presume that these diseases would have been present prior to the examination, therefore to better evaluate this relationship, prospective longitudinal studies have been performed.

In a two-year longitudinal study, the alveolar bone height and density changes in 21 osteoporotic/osteopenic women, compared with 17 women with normal lumbar spine BMD were studied. The osteoporotic/osteopenic women exhibited a higher frequency of alveolar bone height loss and crestal and subcrestal density loss relative to women with normal BMD. Estrogen deficiency was associated with increased frequency of alveolar bone crestal density loss in the osteoporotic/osteopenic women. The authors concluded that osteoporosis/osteopenia and estrogen deficiency are risk factors for alveolar bone density loss in post-menopausal women with a history of periodontitis [17].

In another study 59 moderate/advanced adult periodontitis patients and 16 non-periodontitis subjects all within five years after menopause at baseline were stratified based on serum estradiol levels. Attachment loss was assessed over a two year period and correlated to BMD and serum estradiol levels. Serum estradiol levels did not influence the percentage of sites losing attachment for either periodontitis or non periodontitis groups. The estradiol deficient group had a trend towards a higher frequency of sites with attachment loss Greater than or equal to 2 mm. [18]

The oral ancillary study of the Women's Health Initiative at the University of Alabama at Birmingham was designed to determine if there is an association between systemic osteoporosis and oral bone loss. All subjects enrolled in the study were post-menopausal females. Hipbone mineral density was confirmed with DXA. Comprehensive medical histories and examinations were linked with the results of oral examinations and quantitative digital intraoral radiography.

The intraoral techniques used in this study have been validated and are over 90% sensitive and specific in detecting small changes in bone mass and density. Standardized vertical bitewing radiographs were taken at baseline and the three-year follow-up visit. Subtraction radiography was used for the enhancement of the standardized radiographs.

Alveolar bone height was measured using Periovision software. Measurements were made on the mesial and distal aspects of posterior teeth. The patients were recalled and a similar examination including the radiographic surveys was performed every three years.

The amount of Alveolar bone loss (ABL) along the root surface over the three-year period was calculated for 58 subjects using digital subtraction radiography.

The subjects were divided into two groups, based on BMD at the hip measured at baseline. The osteoporosis group was defined as hipbone mineral density 2.5 SD below the normal as confirmed by DXA. Subjects with BMD above this level were considered the non-osteoporosis group. The subjects were also stratified based on ABL as a measure of the periodontal disease status at baseline. A subject was considered to have periodontitis when 3 mm or greater of alveolar bone height was measured at baseline. Subjects with osteoporosis presented with greater progression of ABL than subjects with no osteoporosis over the 3-year period [19].

The subjects with periodontal disease at baseline exhibited greater amounts of ABL than subjects without periodontal disease. The greater amount of ABL was found in the group of subjects with periodontal disease and osteoporosis. When, periodontitis was present at baseline the mean ABL for patients with periodontitis and osteoporosis was 1.08 plus/minus 0.46 mm compared with 0.31 plus/minus 0.20 mm in the non-osteoporosis group. This would indicate that osteoporosis or low systemic BMD should be considered a risk factor for periodontal disease progression.

## OSTEOPOROSIS - BIOLOGICAL ASPECTS & RISK FACTORS

### Bone Remodeling

A balance process of bone resorption continuously remodels normal bone, including alveolar bone, by osteoclasts, followed by bone deposition by osteoblasts. Osteoblasts secrete bone matrix proteins, including type-I collagen, proteoglycans, osteocalcin, osteopontin and the growth factors and, later stimulate the bone mineralization. Osteoclastogenesis is also under the control of osteoblasts, since osteoblasts are affected by factors capable of promoting bone resorption, such as parathyroid hormone (PTH), 1,25 dihydroxyvitamin D3, calcitonin, and prostaglandin E2 (PGE2). Unlike osteoclasts, osteoblasts do not have a hematopoietic lineage, but are derived from mesenchymal precursors13. Precursor cells are attracted chemotactically, then bone cell mitogens, including transforming growth factor beta (TGFb), platelet-derived growth factor (PDGF), bone morphogenetic protein, fibroblast growth factor and insulin-like growth factors-I and –II, induce their proliferation and differentiation to osteoblasts. Many of these growth factors are released as osteoclasts dissolve the bone. Resorption thus automatically triggers replacement.

**Osteopenia/Osteoporosis**

Osteopenia is defined as a reduction in bone mass due to bone resorption4. The reduction in bone mass and deterioration in bone architecture that may occur after age 40, is characteristic of osteoporosis resulting in increased fragility of the bone and its susceptibility to fractures. In 50-years–old Caucasian American women, the lifetime risk for total osteoporotic fractures and hip fractures is 45% and 17.5% respectively. About 25 to 30% of all hip fractures occur in men, and male osteoporosis is increasing as men live longer, probably due to a decrease in sex steroids and age-related bone loss. Osteoporosis can be further characterized as either primary or secondary. Primary osteoporosis can occur in both sexes at all ages, but often follows menopause in women and occurs later in life in men. In contrast, secondary osteoporosis is a result of medications (e.g. glucocorticoids) or other conditions (e.g. hypogonadism). Currently there is no accurate method to measure the overall bone strength. Bone mineral density (BMD) is frequently used as a proxy measure and accounts for approximately 70% of bone strength14. The World Health Organization (WHO) operationally defines osteoporosis as bone density 2.5 SDs below the mean for young white adult women. It is not clear how to apply this diagnostic criterion to men and children, or across ethnic groups. Because of the difficulty of accurate measurement and standardization between instruments and sites, controversy exists among experts regarding the continued use of this diagnostic criterion [15].

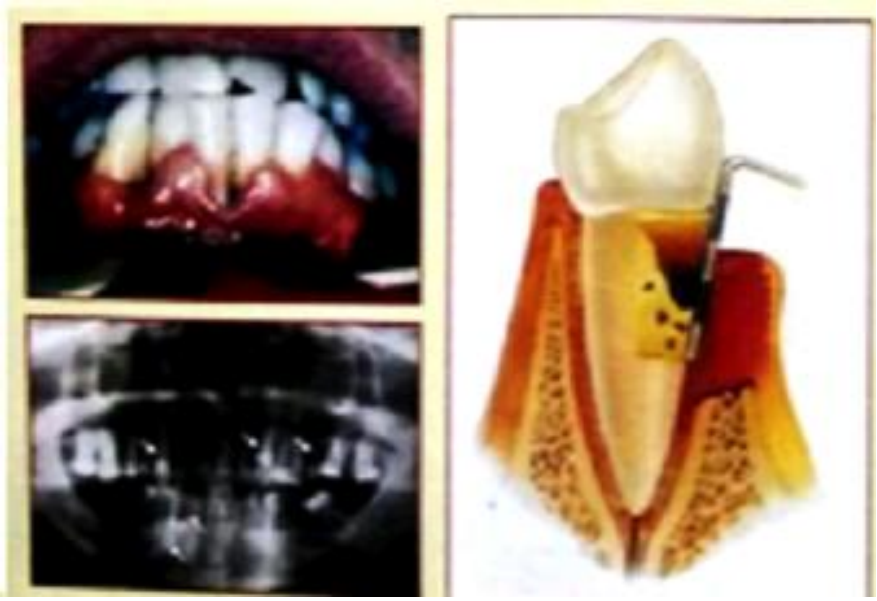

**Figure 1: Bacterial Damage in Dental Supportive Structure**

**Risk factors for osteoporosis**

The prevalence of osteoporosis and the incidence of fracture vary by sex and race/ethnicity. Both men and women experience an age-related decline in BMD starting in midlife. Women experience more rapid bone loss in the early years following menopause, which places them at earlier risk for fractures5,18. Risks associated with low BMD are supported by evidence that includes large prospective studies. Predictors of low bone mass include female sex, increased age, white race, low weight and body mass index (BMI), family history of osteoporosis, smoking, and history of prior fracture. Use of alcohol and caffeine-containing beverages is inconsistently associated with decreased bone mass15. The most common cause of osteoporosis in women is the decrease in estrogen that accompanies menopause. Estrogen loss is associated with elevated bone resorption caused by an rise crease in the cytokines that regulate osteoclast generation, as follows:

RANK–ligand;
TNF-a (tumor necrosis factor-a); interleukin-1 (IL-1), IL-2, IL-6;
M-CSF (macrophage-colony stimulating factor), and
prostaglandin E11.

Production of all of these cytokines is either directly or indirectly suppressed or regulated by estrogen4. Glucocorticoid use causes the most common form of drugrelated osteoporosis, and the long-term administration of glucocorticoids for

disorders such as rheumatoid arthritis and chronic obstructive pulmonary disease is associated with a high rate of bone fracture. People who have undergone organ transplantation are at high risk for osteoporosis due to a variety of factors. Hyperthyroidism is also a well-described risk factor for osteoporosis5.

A number of studies have investigated a possible relationship between periodontitis and osteoporosis, and although the literature supports such relationship, its extent remains unclear, due to small sample sizes, noncomparable study populations and different study methods used to assess periodontitis and osteoporosis. In spite of these limitations, recent investigations have been designed to provide more specific information. Periodontal disease is a chronic inflammatory disease that leads eventually to loss of the supporting structures of the teeth, including resorption of alveolar bone of the jaw. Periodontitis are the most prevalent of the diseases of the bone in humans, being severe enough to lead to tooth loss in 10 to 15% of adults19,20 and can be exacerbated by certain systemic factors, such as estrogen-deficiency21. Estrogen-deficiency enhances the rate of breakdown of connective tissue components of the gingiva by stimulating synthesis of matrix metalloproteinases (MMP-8, and MMP- 13)22, nitric oxide23 and several cytokines implicated in bone resorption [20].

Estrogen deficiency increases IL-6 concentrations in bone marrow, serum and gingival, cooperatively stimulating osteoclast bone resorption. A cross-sectional study of pre and postmenopausal women report significant correlation between alveolar and metacarpal BMD and elevated salivary IL-6 concentrations in postmenopausal women. Preliminary data from the oral ancillary study of the Women's Health Initiative which was designed to determine a possible association between systemic osteoporosis and oral bone loss, suggested a significant correlation between the mandibular basal bone mineral density and hip bone mineral density.

Krall et al 2011 have correlated calcium and vitamin D supplements with a lower risk of tooth loss in elderly men and women. Others have reported diminished tooth loss in estrogen users, gingival plaque and body mass index, the authors demonstrated that loss of skeletal bone mineral density was related substantially to alveolar bone loss. To a lesser extent, skeletal bone mass was also related to CAL (clinical attachment loss) [18].

These data implicate postmenopausal osteoporosis as risk indicator for periodontal disease in postmenopausal white women. The relationship between skeletal loss of mineral density and increased periodontal bone loss may be due to several factors. It may be that more periodontal bone loss occurs simply because the bone surrounding the teeth is less dense and therefore less resistant to resorption. Genetic predisposition to systemic and periodontal bone loss also may be factor, as well as environmental or lifestyle factors that predispose some people to both diseases. Many possible factors contribute to the development of osteoporosis and periodontal diseases being difficult to establish the direct correlation between tooth loss, bone loss, and loss of attachment resulting from periodontitis and decreased BMD associated with osteoporosis, but studies are ongoing. 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.

## CONCLUSION

Periodontitis and osteopenia are common among men aged 50 years and above in many countries and should be considered a public health concern. In addition, there was no evidence of an association between osteoporosis and periodontitis. This suggests that systemic bone mass does not play a significant role in the development of periodontitis; however, further analysis to adjust for other risk factors is required.

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