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Osteoporosis and periodontitis

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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. 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.

INTRODUCTION

Osteoporosis is a skeletal disease characterized by reduction in bone mass and micro architectural changes in the bone, which leads to an increased bone fragility and an increased risk

of fracture [1]. Osteoporosis results from an imbalance between the rate of bone formation and resorption that leads to loss of bone mineral mass. Loss of the mineral component of the bone leads to a greater tendency of the bone to be broken. The consequences of fracture in elderly people include an increased risk of death, long-term nursing home care or permanent limitations in mobility and performance of daily living activities. Many of the risk factors for osteoporosis are environmental and therefore, are preventable. Established risk factors include older age; female gender; post menopause; Caucasian or Asian race; a low body mass index; cigarette use; alcoholism; inadequate calcium and vitamin D intakes; physical inactivity; taking medications such as glucocorticoids and anticonvulsants; and anorexia nervosa [2,3]. Although osteoporosis and osteopenia can affect people of all ages, they occur most often in middle aged and elderly people [4]. Osteoporosis is categorized into primary or secondary. Primary osteoporosis is associated with increased age and/or decreased sex hormones. Secondary osteoporosis implies an underlying cause such as usage of glucocorticoids, systemic diseases affecting bone turnover, or low calcium intake [5, 6]. Periodontal disease is a chronic destructive disease that may occur in adults, young people and children. Periodontal pathogens which are found in the dental biofilm result in inflammation of the gingiva which is called gingivitis. When periodontal tissue destruction and alveolar bone loss happen, it is called periodontitis [7,8]. Periodontal disease and periodontal pathogen have been linked to several systemic diseases [9]. There are many factors mentioned as periodontal risk factors such as gender, [7] tobacco use, diabetes and nutrition [10], body mass index [BMI] [11], socioeconomic status and access to dental care [12]. By the way, it seems that some systemic conditions such as cardiovascular disease, diabetes mellitus, preterm birth, osteoporosis, respiratory disease and systemic infections are related to the periodontal status [13-20]. Recently, some studies have reported an association between osteoporosis and

bone loss in periodontal diseases. Discussions about the association between these two bone-damaging diseases began in 1960. [21] Since both osteoporosis and periodontal diseases are bone destructive diseases, it has been hypothesized that osteoporosis could be a risk factor for the progression of periodontal disease. But some of the literature concluded that osteoporosis in human organs has no effect on the maxilla and mandible density. Clinical features associated with osteoporotic fractures include increased morbidity (pain, physical impairment, decreased quality of life), increased risk for new fractures (even within short-term) and increased mortality. Readily recognizable clinical features that indicate a high risk for fracture include age, gender, low body weight, history of fracture, familial history of fracture, severe immobilization, smoking, rheumatoid arthritis, use of glucocorticoids and clinical risks for falls. In addition, many patients with fractures and osteoporosis have pre-existing contributors to secondary osteoporosis, many of which are correctable[22]. The primary clinical features of periodontitis include clinical attachment loss (CAL), alveolar bone loss (BL), periodontal pocketing, and gingival inflammation. In addition, enlargement or recession of the gingiva; bleeding of the gingiva following application of pressure; and increased mobility, drifting, and/or tooth exfoliation may occur(23). With few exceptions, most forms of periodontitis are chronic inflammations that may progress continuously or by bursts of activity(24-26)Both osteoporosis and periodontal diseases are bone resorptive diseases. Osteoporosis and osteopenia are characterized by reductions in bone mass and may lead to skeletal fragility and fracture. In most women, bone mass reaches its peak in the third decade of life (age 20 to 30) and declines thereafter. This decline in bone mass is accelerated with the onset of menopause, and oral symptoms are also found in addition to the systemic manifestations of menopause. An increased

incidence is observed of oral discomfort, including pain, a burning sensation, dryness, and altered taste perception, as well as a debated rise in the prevalence of periodontal disease.

DISCUSSION

Basically, interpretation of results from these studies is complicated by the variety of methods used to assess osteoporosis and periodontitis, as well as varying definitions of outcomes of interest. If osteoporosis is a predisposing factor for periodontal tissue destruction, then a relationship should exist between measures of systemic bone mineral density and periodontal tissue destruction. However, previous studies have failed to establish a strong relationship. Possible explanations for this could be lack of precise methods for assessment of bone density and confounding of the result by other factors such as age, gender, smoking, remaining natural teeth, hormone intake, exercise of jaw bone, and most importantly the host susceptibility to dental plaque and oral hygiene status. Moreover, the cross-sectional studies have their own limitations, since little information is available about the pattern of disease progression during the short period of the study, nevertheless, most osteoporosis and periodontal disease progress in a chronic pattern.

Although findings of these studies regarding the association between osteoporosis and periodontal disease are still controversial, with increases in the number of aged patients in Taiwan society, the dialogue among medical and dental professionals in this field provides a unique viewpoint in achieving and maintaining patients' optimal health. Clearer understanding of this relationship may aid health care providers in their efforts to detect and prevent osteoporosis and periodontal disease.(27).

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 proposed(28)

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 et al (1968)(29) 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)(30) 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)(31) were able to find an association between the periodontal disease index and alveolar bone loss, but no relation between metacarpal index and periodontal index was found.

Elders et al (1992)(32) 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)(31,32) 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 1990(33), 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)(34) have 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 .

LITERATURE REVIEW

The clinical importance of systemic bone loss as a risk factor to alveolar bone loss and tooth

loss requires to be studied extensively. Moreover, osteoporosis and periodontal diseases could be related because they share common etiological agents, which could affect or modulate their natural history and should be looked into [35]. The following section will re-view 17 Studies on the association between periodontal disease and osteoporosis.

Kribbs et al. [36] were the first to address the association between periodontal disease and osteoporosis. They compared the mandibular bone mass of 85 osteoporotic women and 27 normal women and reported the osteoporotic group had less mandibular bone mass and density and a thinner cortex at the gonion than the normal group. No differences in clinical periodontal measurements were found between osteoporotic and normal groups [Odds ratio (OR): 2.7 (95% CI: 1.1-6.5)]. Von Wöern et al. [37] measured mandibular bone mineral content by dual photon absorptiometry in 52 women with a history of osteoporotic fracture and concluded that osteoporotic subjects did not have less bone mineral content in their jaw bones [OR: 1.00 (95% CI: 0.98-1.02)]. Jacobs et al. [38] designed a longitudinal study which assessed lumbar spine BMD of 69 women receiving hormone replacement therapy, up to 5 years with dual photon absorptiometry of the lumbar spine.

After 5 years, a positive effect of estrogen replacement therapy on the bone mass of the mandible and the lumbar spine was observed and they suggested that mandibular bone mass correlated with bone mass in the spine and the wrist. No OR was calculated.

Streckfus et al. [39] designed a quantitative factor for measurement on vertical dimension and hand radiographs in 28 healthy women aged 60-70 and 23 women with periodontitis. Based on the results, they concluded that postmenopausal women on estrogen therapy had more alveolar bone loss (ABL), more missing teeth, and reduced alveolar and second metacarpal bone density than

premenopausal women [OR: 2.47 (95% CI: 1.23-6.12)]. Southard et al. [40] used quantitative intraoral radiography and systemic bone densities determined by dual-energy X-ray absorptiometry (DXA) in 61 Caucasian women. They found significant correlation between the density of maxillary and mandibular alveolar process, lumbar spine, hip and radius in healthy women [OR: 5.3 (95% CI: 2.5-11.3)]. Shroot et al. [41] selected 65 postmenopausal women who had no or only mild periodontal disease (no probing depths > 5 mm) and compared the complexity of the trabecular pattern of their digital bitewings with the lumbar spine and femoral BMD. They found weak relation between the complexity of the trabecular pattern of lumbar spine and femoral BMD [OR: 1.16 (95% CI: 0.90-1.49)]

.Leffcoat et al. [42] in a preliminary report of the study of the Women's Health Initiative, evaluated 158 postmenopausal women. The women's hipbone mineral density was confirmed by DXA and the mandibular bone density was measured by quantitative digital radiography. After data adjustment, a significant correlation was found between mandibular basal bone and hipbone mineral density (OR: 5.23). Elders et al. [43] compared the clinical parameters of periodontitis and alveolar bone height with BMD of the lumbar and metacarpal bone. No statistically significant differences were observed in gingival bleeding, probing pocket depths, gingival recession and marginal bone level of the subjects with low BMD compared to subjects with high BMD [OR: 1.46 (95% CI: 0.97-2.21)].

Hildebolt et al. [44] designed a study to answer the question, "is clinical attachment loss related to BMD?". They assessed BMD of 135 postmenopausal women aged 41-70 years, with no moderate to severe periodontitis and reported that attachment loss was correlated with tooth loss, but not with BMD [OR: 1.4 (95% CI: 0.6-3.1)].

When Weyant et al. [45] compared the number of attachment loss sites with systemic BMD in 292 women, no statistically significant association was found between periodontal disease and systemic BMD [OR: 1.56 (95% CI: 0.98-2.02)]. Lundstrom et al. [46] compared 15 women with osteoporosis to 41 subjects with normal BMD. No statistically significant differences were found in gingival bleeding, probing pocket depths, gingival recession, or the marginal bone level between the women with osteoporosis and the women with normal BMD [OR: 1.3 (95% CI: 0.98-1.02)]

Von Wowerm et al. [47] assessed 112 women with osteoporotic fractures and found greater amounts of loss of attachment in osteoporotic women with a mean age of 68 [OR: 2.7 (95% CI: 1.1-6.5)].

Tezal et al. [48], in a study assessed 70 post-menopausal Caucasian women's skeletal systemic BMD by DXA and reported that the mean alveolar bone level significantly correlated with systemic BMD and a correlation between clinical attachment levels and BMD was found (OR: 2.89).

Payne [49] evaluated 58 menopause periodontal patients which were in maintenance program. Forty-one of the patients had normal BMD and 17 women were osteoporotic. They reported greater alveolar bone loss, crestal and 260subcrestal density loss in the osteoporotic and estrogen-deficient women [OR: 1.73 (95% CI: 1.23-2.43)]. Reinhardt et al. [50] assessed bleeding on probing and clinical attachment levels in 59 women with periodontitis and 16 non-periodontitis women, all within 5 years of menopause and reported osteoporotic periodontitis patients with estrogen deficiency had more bleeding on probing and clinical attachment levels (OR: 1.68). Taguchi et al. [51] evaluated 64 women between the ages of 50 and 70 years.

Osteoporotic signs consisted of thoracic spine fracture and periodontal disease signs were the number of teeth present, mandibular cortical width and alveolar bone re-sorption. According to these study results, they concluded that the mean alveolar bone level significantly correlated with systemic BMD (OR: 2.10).

Grodstein et al. [52] examined the risk of tooth loss in relation to hormone use in a prospective study of 42,171 post-menopausal women and reported the risk of tooth loss was lower in women who currently used hormones [OR: 1.35 (95% CI: 1.14-1.59)].

According to the above validation criteria, the level of evidence of the articles we reviewed regarding the association of periodontal disease and osteoporosis resulted in 3 prospective and 14 cross-sectional studies, is placed in the Clinically Well Documented (CWD) category.

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