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Review Article

Impact of osteoporosis on oral health

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ABSTRACT

Oral diseases and osteoporosis are common conditions. A bone disease called osteoporosis arises when bone mass and mineral density decline, or when the composition or quality of bone varies. This may result in a weakening of the bones, raising the possibility of fractures. As various oral diseases, particularly periodontal disease, which affects almost half of the adult population, similarly osteoporosis also affects half of the elderly population, specially above 60 years of age. As the population ages, the rise in the number of patients with osteoporosis may increase. Osteoporosis is a systemic skeletal disorder with compromised bone density and strength that leads to increased risk of bone fracture; whereas periodontitis is considered a local infection with a host immune-inflammatory response within the supporting periodontal tissues of the teeth that results in alveolar bone loss. Bone tissue is continuously absorbed by and replaced by the body. In osteoporosis the loss of old bone is not in pace with the formation of newer bone. Medications along with a proper balanced diet and weight-bearing exercises are all part of the treatment to help strengthen already weak bones or stop bone loss. This review enlightens the possible risk factors, current evidence, pathophysiology and measures that can be taken to prevent osteoporosis based on various researches.

1. Introduction

Osteoporosis is a type of bone disease that occurs when the bone mass content and mineral density decline. This may result in a weakening of the bones, hovering the possibility of fractures.[1] In 1994 World Health Organization (WHO) stated that osteoporosis is "a disease characterized by low bone mass and microarchitectural deterioration of bone tissue leading to enlarged bone fragility and a consequent increase in fracture risk."[2] Osteoporosis is a systemic skeletal disorder with compromised bone density. Osteoporosis is a slowly progressive disease that causes low bone mass in the bones, weakening of the immune system that increases the risk of fractures, deterioration of the microarchitecture of the bones, and knee and back pain. Osteoporosis occurs when the bone resorption rate is higher than the bone formation rate, bone turnover increases, and bone loss occurs. In oral cavity this disease has definite adverse effects on both tooth health and stability and also residual alveolar crest.[3] Throughout life, it affects both the sexes, but postmenopausal women are more likely to experience it. Apparently about 50% of postmenopausal women will experience problems related to osteoporosis. Bone resorption is a common feature of both periodontitis and osteoporosis.[4–6] Following an infectious breach of the alveolar cortical bone, periodontitis causes localized inflammatory bone loss and may lead to tooth loss. The association between osteoporosis and periodontitis has been confirmed by cross-sectional studies based mainly on radiological measurements and, to a lesser extent, clinical tests. Common risk factors include age, genetics, hormonal fluctuations, smoking, and inadequate calcium and vitamin D. This relationship can be explained by mechanisms such as hormonal balance, pain resolution, and the effects of bone

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remodeling homeostasis.[7,8] Furthermore, there's a chance that the two conditions will interact and become risk factors for one another, requiring concurrent care. The linkage may be explained by mechanisms including hormone balance, inflammation resolution, and bone remodeling homeostasis disruption. With intricate treatment interactions, a mutual interventional approach is beginning to take shape.[9]

2. Classification

Osteoporosis can be classified based on etiology and severity of the disease. Osteoporosis is defined based on bone mineral density (BMD). For this a standardized score, called T-score is allocated, which compares BMD to average values.[10] The categories for diagnosis according to severity are:

1. Normal (T-score -1.0 and above).
2. Low bone density, referred to as osteopenia (T-score between -1.0 and -2.5).
3. Osteoporosis (T-score -2.5 and below).
4. Severe osteoporosis (T-score -2.5 and below with history of a fracture).

The etiology of osteoporosis can also be used to categorize it into primary and secondary forms.[3] The cause of majority of cases of primary osteoporosis is still unknown, whereas secondary osteoporosis develops in response to a specific disease with a known etiology. Osteogenesis Imperfecta, Idiopathic, Juvenile Osteoporosis, and so forth are other forms of osteoporosis. Primary osteoporosis can be divided into type I postmenopausal osteoporosis (aged 50 to 70 years) and type II senile osteoporosis (over 70 years of age, affecting trabecular and cortical bones).

3. Diagnosis

For a more accurate diagnosis, there must be some history of bone loss or low bone density formation. In the absence of bone, low bone mass can occur. Postnatal osteoporosis-BMD deficit in Caucasian adults was 2.5 standard deviations below the reference mean in youth. In osteopenia- Inadequate BMD, 1.25 standard deviations below the youth mean.[11]

4. Bone Mineral Density

A decline in BMD with one standard deviation increases the risk of fracture by two times. Breaks caused by osteoporosis:

1. 1:2 Female
2. 1:3 Male
3. >60 years old;
4. Cascade effect of vertebral fractures

5. Risk Factors

In general, there are two types of osteoporosis risk factors: modifiable and non-modifiable. Preventing osteoporosis can lessen the chance of crippling fractures and slow the rate of bone loss. There are many ideas to consider on this topic. Modifiable factors include quitting smoking and living a sedentary lifestyle, maintaining a healthy, balanced diet, and having few intestinal or renal disorders, which can increase the risk of inadequate calcium and phosphorus absorption and vitamin D deficiency.[12] On the other hand, risk factors that cannot be changed include age, gender, menopause status, ethnicity, family history, low birth weight, anorexia nervosa, hyperthyroidism, and low testosterone levels.

6. Pathophysiology of Osteoporosis

According to the literature, there are two types of osteoporosis: primary and secondary. It is stated that primary osteoporosis is an ailment with no known cause. It is also referred to as senile osteoporosis and can develop with ageing, accelerating at menopause.[13] Conversely, secondary osteoporosis results from known causes, such as dietary habits, lifestyle choices, or a patient's underlying medical condition. The patient's medical history may be linked to osteoporosis; these conditions include parkinsonism, autoimmune disorders, hematological disorders such as multiple myeloma and leukemia, endocrine disorders, and genetic mutations resulting in hypogonadal state.

An imbalance between bone formation and resorption is the fundamental cause of osteoporosis, both primary and secondary types. This imbalance causes bones to grow inadequately or to become inadequate and lose strength during growth. Fragile bone tissue is undoubtedly the result of excessive bone resorption combined with inadequate new bone formation. Hormonal factors also play a pivotal role in adjudicating the rate of bone resorption. Osteoporosis is caused by a lack of estrogen in two ways: 1) by making more osteoclasts and reducing their apoptosis; 2) by inhibiting the production of pro-inflammatory cytokines such as interleukins 1 and 6, TNFα, and prostaglandin E2, which causes the production of more pre-osteoclasts in the bone marrow.[3,14]

7. Assessment of Oral Bone Loss

Oral indicators of osteoporosis include excessive alveolar ridge resorption, tooth loss, insistently disparaging periodontal disease, referred maxillary sinus pain and frequent fractures. In the mandibular region the cortical bone is more disposed to overall bone loss than the trabecular portion or the remaining height of the alveolar process. Associated to the lingual cortex, the buccal cortex which is situated distal to the mental foramen shows a greater correspondence with skeletal mineral

density values.[3] Alveolar bone resorption is subjective by the severity of underlying periodontal disease and, if the patient wears a denture, the denture's quality. Dental diseases are frequently screened for with dental panoramic radiographs. The unintentional discoveries found on panoramic radiographs may be used to identify women who have no awareness of their low BMD. By looking for evidence of resorption on panoramic radiographs, a number of mandibular cortical indices have been developed to determine osteopenia and evaluate the quality of mandibular bone mass. Among these are the Panoramic Mandibular Index (PMI) and the Mandibular Cortical Index (MCI).[3,15]

8. Oral Considerations in Osteoporosis

In various studies it has been stated that osteopenia may be a risk factor for periodontal disease along with other systemic risk factors like smoking, diabetes and obesity. Many studies have experimentally concluded that interproximal bone loss is concomitant to BMD in postmenopausal women. Women with low BMD and high calculus apposition had a advanced clinical attachment loss than women with normal BMD and analogous calculus apposition.[3] Gingival inflammation in osteoporotic early menopausal women and attachment loss are the cause of early tooth loss. These factors are reduced by serum estroidal supplementation. It is also well known that the alveolar BMD and alveolar bone height may both decline in conjunction with the loss of posterior teeth. Enduring ridge resorption in patients with complete dentures is a biological phenomenon brought on by a diminution in biomechanical loading on bone, which let down the stresses on the periosteal surface and inside the bone itself, sooner or later consequential in resorption. A survey of the last fifteen years' literature reveals the relationship between BMC and residual ridge resorption. Osteoporosis ominously marks the reduction of residual ridge in edentulous patients, according to Hirai T et al.[16] Significant mandibular ridge height was also found to be associated with either localized or systemic bone loss in quite a few further researches.

9. Relationship between Periodontitis and Osteoporosis

Osteoporosis and periodontitis are common inflammatory skeletal disorders that present serious public health issues to our aging population. Clinical study accomplices and measurement procedures used in clinical studies determine the relationship between osteoporosis and periodontitis.[10] Osteoporosis affects more in women than in men, whereas periodontitis primarily affects men. Furthermost cross-sectional association studies among older post-menopausal women revealed a general positive relationship, suggesting that this type of connotation might exist in this specific subgroup of the population.[17] In addition, contingent on the clinical and radiographic parameters used for both diseases, the degree of association may vary pointedly.[18] These days, quantitative computer tomography (QCT), dual-photon absorptiometry (DPA), and dual-energy absorptiometry (DXA) are the approaches accustomed to evaluate osteoporosis.[19] Osteoporosis is defined by the World Health Organization (WHO) as a bone mineral density (BMD) T-score 2.5 as standard deviations below the average peak in young adults. The hip, femur, and spine are the preferred sites for osteoporosis diagnosis using bone mineral density (BMD). Variability may also arise from different studies that use continuous BMD for statistical assessment versus dichotomous diagnosis approaches. Conversely, radiographic measures for alveolar crest height (ACH), tooth loss, absolute bone density (DXA, DPA, QCT), and computer-assisted densitometry image analysis (CADIA) are amongst the techniques used to assess periodontal conditions and oral bone loss. Periodontal disease parameters can be divided into two categories: radiographic considerations (ACH, DXA, DPA, QCT) and clinical examinations (PD, CAL, tooth loss). Although there is a strong correlation with tooth loss, the precise relationship between osteoporosis and the clinical characteristics of periodontitis is still unknown, as per a recent systematic review. But when determining radiographic findings (osteoporotic change of the jaw or alveolar bone), there is, nevertheless, a very strong association. These results point toward a unique molecular relationship between the two bone resorbing circumstances.[10,20] Interdisciplinary approaches are necessary for the prevention and treatment of both conditions, as well as the need for additional carefully monitored longitudinal and interventional research to bolster evidence-based clinical recommendations. Both conditions require expensive, continuous dental and medical care.

10. Prevention of Osteoporosis

1. Smoking should be stopped
2. Calcium supplement
3. Vitamin-D Supplement.
4. Medication
5. Weight bearing Exercise
6. Check your risk factors
7. Reduce Alcohol

11. Conclusion

Comprehending the molecular mechanisms that underpin their association illuminates prospective therapeutic approaches that could aid in the co-management of both systemic and skeletal loss. The pro-inflammatory tissue microenvironment in both diseases is driven by age-related

oxidative stress and senescence, which in turn causes an uncoupling of the bone remodeling process. Smoking and a lack of vitamin D are two of their common risk factors, and these mechanistic connections are at work. Better patient care can be achieved when interdisciplinary management and possible therapies to treat both diseases are appropriately put into practice.

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13. Conflict of Interest

None.

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