

**CONNECTION BETWEEN OSTEOPOROSIS AND PERIODONTAL DISEASE:  
REVIEW OF THE LITERATURE**

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**Abstract:** Periodontal diseases and osteoporosis are characterized by significant pathological changes with a dominant metabolic and inflammatory nature. Although periodontal disease results in tooth loss, researchers are still examining the relationship between low bone density and periodontal disease. Also, additional research needs to be done to determine whether the treatment of osteoporosis can also contribute to the health of the alveolar bone. Based on the above mentioned, the main goal of this research was to do a literature review to analyze the correlation of osteoporosis and periodontal disease. An adequate search of the available internet sources for contemporary data was done to fulfill the given aim. It has been noted in the literature that osteoporosis plays a role in the development of periodontitis, since the loss of alveolar bone as a result of osteoporosis can change the development and course of the disease and contribute to greater tooth loss. However, when considering this mutual relationship between the two diseases, other factors, both environmental and from the organism, which can influence these two diseases, should always be taken into account. A strong association between clinical attachment loss and osteoporosis has been documented in the literature. At present, it is still unclear whether there is an inverse interaction of periodontitis with systemic bone remodeling. Osteoporosis and chronic periodontitis are both diseases that develop slowly and have similar characteristics. Osteoporosis is commonly seen in women after menopause, affecting about 50% of them. Women who have gone through menopause also tend to have more severe periodontal disease, with around 30% affected subjects. Fractures of bones from osteoporosis can lead to serious health issues and even death in older adults. Similarly, chronic periodontitis can also be linked to higher death rates in elderly patients, as it might show there are other serious health problems present. Although the pathogenesis and progression of periodontitis are predominantly correlated to the way how person's body interacts with dental plaque which led to gum and periodontal inflammation, affecting the health of their bones. It may be the main link between these two conditions, which can greatly impact the health and amount of bone tissue in the jaw. Healthy bone tissue is inherently susceptible to the remodeling process that occurs permanently, which allows the creation of an adequate quantum of bone tissue with which to replace old bone tissue as a physiological process, which occurs in response to numerous factors, primarily due to the mechanical load present. By fulfilling the aim of the research, we want to find out whether the identifying the initial signs of osteoporosis and conversely whether and how untreated osteoporosis affects periodontal health, by assessing the condition of the alveolar bone.

**Keywords:** periodontal disease, osteoporosis, periodontitis, bone remodeling

## **1. INTRODUCTION**

Periodontal disease and osteoporosis are two very common diseases that affect the human population. They are skeletal disorders associated with the presence of chronic inflammation. In parallel with the increase of the number of elderly people, the prevalence of these diseases is also increasing and therefore represent significant challenges for public health.

Periodontal diseases, as well as osteoporosis, are characterized by significant pathological changes with a dominant metabolic and inflammatory nature. Although periodontal disease results in tooth loss, researchers are still examining the relationship between low bone density and periodontal disease. Also, additional research needs to be done to determine whether the treatment of osteoporosis can also contribute to the health of alveolar bone.

Based on the above mentioned, the main goal of this research was to do a literature review to analyze the correlation of osteoporosis and periodontal disease. An adequate search of the available internet sources for contemporary data was done to fulfill the given aim.

## **2. CONNECTION BETWEEN OSTEOPOROSIS AND PERIODONTAL DISEASE**

The two diseases that are the field of interest for this research, both chronic periodontal disease and osteoporosis, are diseases that characterized by a decreasing of the quality and quantity of bone tissue. When it comes to diseases that are characterized by bone tissue loss, it is necessary to define the term osteopenia at the beginning. Osteopenia is defined as a condition characterized by decreasing of the bone mass due to an imbalance between bone resorption and bone apposition, with a predominance of the resorption process. Osteopenia results in demineralization of the alveolar bone and ultimately to occurrence of osteoporosis.(Varacallo, et al, 2023). Osteoporosis is the most developed form of osteopenia, and it manifests with a large loss of bone mass, which results in structural changes in the bone, among which changes can also be observed in the alveolar bone. (Porter & Varacallo, 2023).

It has been noted in the literature that osteoporosis plays a role in the development of periodontitis, since the loss of alveolar bone as a result of osteoporosis can change the development and course of the disease and contribute to greater tooth loss. However, when considering this mutual relationship between the two diseases, other factors, both environmental and from the organism, which can influence these two diseases, should always be taken into account. According to the recommendations of the World Health Organization, the diagnosis of osteoporosis is made if bone density falls more than 2.5 standard deviations below the mean value in healthy and young individuals. (Sozen et al, 2017)

In the advanced stages of periodontal disease, there is permanent damage and loss of the bone that supports teeth, which can lead to teeth mobility and tooth loss. The current understanding of the disease is that it comes from a mix of different factors, including oral bacteria, how the body's immune system responds, lifestyle, and risk factors like genetics, aging, poor nutrition, hormonal changes, and smoking. (Genco, 1996)

Periodontal disease is defined as a chronic inflammatory disease of the supporting structures of the teeth that has clinical presentation with clinical loss of attachment, the appearance of periodontal pockets, and loss of alveolar bone. Clinical attachment loss is considered as gold standard in the diagnostics of periodontal disease. Clinical attachment loss is a more reliable sign of long-lasting chronic periodontal disease than other signs like the number of missing teeth, the depth of periodontal pockets, and the quality and quantity of the bone tissue of the jawbone. However, it's important to remember that the depth of periodontal pockets is the most commonly used way for diagnosis if someone has periodontal disease.

The determination of alveolar ridge height is measured using various types of oral radiographs. However, it must be noted that such an assessment of an X-ray can vary based on how clear it is and the angle it's taken from. The loss of attachment seen in dental examinations happens much sooner than what X-rays show. Additionally, a decrease of bone strength from osteoporosis can impact the bone tissue on the jaw.

A strong association between clinical attachment loss and osteoporosis has been documented in the literature. However, further research is needed to prove the existence of this association. More scientific data are needed to demonstrate improvements in clinical attachment loss, as well as other clinical signs and laboratory tests for chronic periodontal disease show better bone strength when treated correctly. However, it can be hard to prove this because noticeable improvements in bone strength take several years to observe with proper treatment.

Although a causal relationship has yet to be determined, there are a number of common risk factors between osteoporosis and periodontitis. These established or potential risk factors may also provide important information regarding the aetiology and contributing factors that will help clinicians prevent or manage these two diseases simultaneously.

Although the pathogenesis and progression of periodontitis are predominantly directly correlated with the interaction of the host with the dental biofilm, inflammation of the periodontal tissues and its impact on bone tissue homeostasis play a crucial role in both periodontitis and osteoporosis and this fact may represent the main link between these disorders that significantly affect the quality and quantity of alveolar bone.

Healthy bone tissue is inherently susceptible to the remodeling process that occurs permanently, which allows the creation of an adequate quantum of bone tissue with which old bone tissue is replaced as a physiological process, which occurs in response to numerous factors, primarily due to the mechanical load. The equilibrium of bone tissue is based on a kind of orchestrated balance between the process of (1) bone resorption by osteoclasts and (2) bone tissue formation by osteoblasts. These two processes are very important for keeping a healthy balance of bone mass and minerals in the body (Chen et al., 2018)

In periodontal disease, harmful inflammatory substances from bacteria called exotoxins attract white blood cells called neutrophils from the blood to the infection site. Neutrophils are the body's first defence against bacteria. The

recruitment of these cells is affected by many substances, especially products from bacteria, immune system signals, and lipid messengers. (Szczepanik et al, 2020) Such immunological processes cause resorption of alveolar bone, and similar processes are responsible for the loss of quality and quantity of bone tissue in osteoporosis.

According to the basic pathogenetic events, osteoporosis can be:

Primary osteoporosis, which is dominant and occurs in 90-95% of cases and it can be:

- idiopathic, with an unknown cause in young people.
- postmenopausal, which occurs between the ages of 51 and 75. This type of osteoporosis is more common in women and is characterized by a significant loss of trabecular bone and a tendency to fractures. It is believed that this form of osteoporosis is due to the loss of ovarian function in menopause.
- senile, which occurs in people over 70 years of age, is characterized by the loss of both trabecular and cortical bone. There is a tendency to fractures of the femoral neck, vertebral bodies, proximal part of the humerus or tibia. It is most likely due to the loss of vitamin D in older age.

Secondary osteoporosis, which is less common and occurs in about 5% of cases. Its occurrence is associated with:

- endocrine diseases (hyperparathyroidism, hypogonadism, thyrotoxicosis, Cushing's syndrome),
- metabolic disorders with vitamin D deficiency (malabsorption, steatorrhea),
- genetic disorders,
- long-term therapy with glucocorticoids,
- malnutrition, alcohol and nicotine abuse,
- long-term immobilization of bones,
- malignant blood diseases (multiple myeloma, lymphoma, leukaemia),
- chronic diseases (rheumatoid arthritis, renal failure)

Local bone loss around teeth is thought to be partly caused by immune cells that are activated by bacteria (activated T lymphocytes). These immune cells send signals that encourage the formation of cells that break down bone. (Kawai et al, 2006) Additionally, increased inflammation can prevent bone-building cells from working properly, leading to more bone loss. (Pacios et al, 2015) In conditions like rheumatoid arthritis and osteoporosis, there are not enough bone-building cells to keep up with the increased activity of bone-breaking cells. Inflammation can also make it harder for bone-building cells to develop by blocking important proteins that help their growth. (Kenaki et al, 2006)

At present, it is still unclear whether there is an inverse interaction of periodontitis with systemic bone remodeling. (Guiglia et al, 2013) A large prospective cohort study done by Persson et al (2011) indicated that osteoporotic patients with periodontitis have an increased risk of hip or hand fracture. More recently, experimentally induced periodontitis exacerbates bone loss due to systemic oophorectomy. (Anbinder et al, 2016). Wowern, Klausen and Kollerup in 1994 published that the stages of the periodontal disease are different in examined groups- osteoporotic patients and subjects without osteoporosis. Furthermore, the connection between lumbar vertebral bone density and periodontal attachment loss was noted by Mohammad et al (2003). In another study by Takahashi et al. (2012) done on total number of 347 postmenopausal women, was concluded that periodontal disease and truncal bone density had a significant negative correlation.

In a literature review done by Penoni et al (2017) at postmenopausal women with osteoporosis or osteopenia was noted that they are more common to have gum or periodontal symptoms compared to women with healthy bones. In another study published by Al Habashneh from 2010 was found that women with osteoporosis have more than twice the risk of developing gum disease (periodontitis). While it is clear that osteoporosis raises the chance of getting periodontitis, we still don't fully understand why this happens. Learning more about how these two conditions are related could help doctors prevent, find, and treat them more effectively. (Al Habashneh et al., 2010).

People with certain genetic factors can predispose to systemic bone loss due to certain health issues. Additionally, habits like smoking and not getting enough calcium can lead to weaker bones and a higher chance of periodontal disease. (Hildebolt et al, 1997) Because of this, osteoporosis is thought to be one of the factors that can increase the risk of gum disease

Osteoporosis in postmenopausal women is characterized by maximal bone loss occurring within the first 5 years after menopause. (Ahlborg et al, 2001) Osteoporosis and chronic periodontitis are both slow progression diseases that share some similarities. Osteoporosis is commonly seen in women after menopause, affecting up to 50% of them. (Kanis et al, 2008) After menopause, women also tend to have more severe periodontal disease, with rates reaching as high as 30%. (Albandar & Rams, 2002). Fractures from osteoporosis can lead to serious health problems and increase the risk of dying in older people. (WHO, 2004) Similarly, chronic periodontitis is linked to a higher risk of death in older adults as it can signal other long-term health issues. (Linden et al, 2012)

Yu & Wang (2022) noted that prove unequivocally supports a relationship between systemic and alveolar bone loss whereas moderate relationship was noted between systemic BMD and periodontal attachment loss. Chronic periodontitis is multifactorial infection showing high levels of inflammatory factors causing systemic bone loss which will lead to osteoporosis. Performing standard oral hygiene and examinations of bone mineral quality are preventing factors for avoiding osteoporosis and periodontitis. (Hong et al, 2021)

At the end of this literature review, it must be noted that the relationship between osteoporosis and periodontitis is still unknown. Osteoporosis might be linked to periodontal disease is through the loss of bone in the mouth. When someone has osteoporosis, their bone density lowers, which happens in both the upper and lower jaw. (Takaishi et al., 2005). This loss of bone density can be influenced by bacteria in the mouth, which can lead to a faster resorption of alveolar bone, leading to the rapid development of periodontal destruction (Estrugo-Devesa et al, 2013). On the other hand, the alteration of local tissue reactions can be caused by systemic inflammatory mediators that affect bone remodeling. In addition, an increase in osteoclast activity may stimulate local activity of osteoclasts causes attachment loss and bone loss, speeding up the progression of periodontal disease. (Lerner, 2006)

## 5. CONCLUSIONS

By fulfilling the aim of the research, we find out identifying the initial signs of osteoporosis and how untreated osteoporosis affects periodontal health, by the influence of the condition of the alveolar bone. As a conclusion we must note that the relationship between osteoporosis and periodontitis is still questionable and numerous theories and hypotheses exist. Therefore, additional research is needed.

## REFERENCES

- Ahlborg, H. G., Johnell, O., Nilsson, B. E., Jeppsson, S., Rannevik, G., & Karlsson, M. K. (2001). Bone loss in relation to menopause: a prospective study during 16 years. *Bone*, 28(3), 327-331.
- Al Habashneh, R., Alchalabi, H. A., Khader, Y. S., Hazza'a, A. M., Odat, Z., & Johnson, G. K. (2010). Association between periodontal disease and osteoporosis in postmenopausal women in Jordan. *Journal of periodontology*, 81(11), 1613-1621.
- Albandar, J. M., & Rams, T. E. (2002). Global epidemiology of periodontal diseases: an overview. *Periodontology* 2000, 29(1), 7-10.
- Anbinder, A. L., Moraes, R. M., Lima, G. M., Oliveira, F. E., Campos, D. R., Rossoni, R. D., ... & Elefteriou, F. (2016). Periodontal disease exacerbates systemic ovariectomy-induced bone loss in mice. *Bone*, 83, 241-247.
- Chen, X., Wang, Z., Duan, N., Zhu, G., Schwarz, E. M., & Xie, C. (2018). Osteoblast-osteoclast interactions. *Connective tissue research*, 59(2), 99-107. <https://doi.org/10.1080/03008207.2017.1290085>
- Estrugo-Devesa, A., Gómez-Vaquero, C., & Lopez-Lopez, J. (2012). Osteoporosis and oral diseases. *Medicina Clinica*, 140(4), 169-174.
- Genco, R. J. (1996). Current view of risk factors for periodontal diseases. *Journal of periodontology*, 67, 1041-1049.
- Guiglia, R., Di-Fede, O., Lo-Russo, L., Sprini, D., Rini, G. B., & Campisi, G. (2013). Osteoporosis, jawbones and periodontal disease. *Medicina oral, patología oral y cirugía bucal*, 18(1), e93.
- Hildebolt, C. F., Pilgram, T. K., Dotson, M., Yokoyama-Crothers, N., Muckerman, J., Mauser, J., ... & Civitelli, R. (1997). Attachment loss with postmenopausal age and smoking. *Journal of periodontal research*, 32(7), 619-625.
- Hong, S. J., Yang, B. E., Yoo, D. M., Kim, S. J., Choi, H. G., & Byun, S. H. (2021). Analysis of the relationship between periodontitis and osteoporosis/fractures: a cross-sectional study. *BMC oral health*, 21(1), 125. <https://doi.org/10.1186/s12903-021-01496-1>
- Horner, K., & Devlin, H. (1998). The relationships between two indices of mandibular bone quality and bone mineral density measured by dual energy X-ray absorptiometry. *Dentomaxillofacial Radiology*, 27(1), 17-21.
- Kaneki, H., Guo, R., Chen, D., Yao, Z., Schwarz, E. M., Zhang, Y. E., ... & Xing, L. (2006). Tumor necrosis factor promotes Runx2 degradation through up-regulation of Smurf1 and Smurf2 in osteoblasts. *Journal of Biological Chemistry*, 281(7), 4326-4333.
- Kanis, J. A., Burlet, N., Cooper, C., Delmas, P. D., Reginster, J. Y., Borgstrom, F., ... & European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO). (2008). European guidance for the diagnosis and management of osteoporosis in postmenopausal women. *Osteoporosis international*, 19, 399-428.
- Kawai, T., Matsuyama, T., Hosokawa, Y., Makihiro, S., Seki, M., Karimbux, N. Y., ... & Taubman, M. A. (2006). B and T lymphocytes are the primary sources of RANKL in the bone resorptive lesion of periodontal disease. *The American journal of pathology*, 169(3), 987-998.

- Lerner, U. H. (2006). Inflammation-induced bone remodeling in periodontal disease and the influence of post-menopausal osteoporosis. *Journal of dental research*, 85(7), 596-607.
- Lin, T. H., Lung, C. C., Su, H. P., Huang, J. Y., Ko, P. C., Jan, S. R., ... & Liaw, Y. P. (2015). Association between periodontal disease and osteoporosis by gender: a nationwide population-based cohort study. *Medicine*, 94(7).
- Linden, G. J., Linden, K., Yarnell, J., Evans, A., Kee, F., & Patterson, C. C. (2012). All-cause mortality and periodontitis in 60–70-year-old men: a prospective cohort study. *Journal of clinical periodontology*, 39(10), 940-946.
- Mohammad, A. R., Hooper, D. A., Vermilyea, S. G., Mariotti, A., & Preshaw, P. M. (2003). An investigation of the relationship between systemic bone density and clinical periodontal status in post-menopausal Asian-American women. *International Dental Journal*, 53(3), 121-125.
- Pacios, S., Xiao, W., Mattos, M., Lim, J., Tarapore, R. S., Alsadun, S., ... & Graves, D. T. (2015). Osteoblast lineage cells play an essential role in periodontal bone loss through activation of nuclear factor-kappa B. *Scientific reports*, 5(1), 16694.
- Penoni, D. C., Fidalgo, T. K. S., Torres, S. R., Varela, V. M., Masterson, D., Leão, A. T. T., & Maia, L. C. (2017). Bone density and clinical periodontal attachment in postmenopausal women: a systematic review and meta-analysis. *Journal of dental research*, 96(3), 261-269.
- Persson, G. R., Berglund, J., Persson, R. E., & Renvert, S. (2011). Prediction of hip and hand fractures in older persons with or without a diagnosis of periodontitis. *Bone*, 48(3), 552-556.
- Porter, J. L., & Varacallo, M. (2023). Osteoporosis. In *StatPearls*. StatPearls Publishing.
- Richa, Puranik, M. P., & Shrivastava, A. (2017). Association between osteoporosis and periodontal disease among postmenopausal Indian women. *Journal of investigative and clinical dentistry*, 8(3), e12223.
- Sczepanik, F. S. C., Grossi, M. L., Casati, M., Goldberg, M., Glogauer, M., Fine, N., & Tenenbaum, H. C. (2020). Periodontitis is an inflammatory disease of oxidative stress: We should treat it that way. *Periodontology 2000*, 84(1), 45-68.
- Sözen, T., Özışık, L., & Başaran, N. Ç. (2017). An overview and management of osteoporosis. *European journal of rheumatology*, 4(1), 46–56. <https://doi.org/10.5152/eurjrheum.2016.048>
- Takahashi, O., Yoshihara, A., Nakamura, K., & Miyazaki, H. (2012). Association between periodontitis and systemic bone mineral density in Japanese community-dwelling postmenopausal women. *Journal of dentistry*, 40(4), 304-311.
- Takaishi, Y., Okamoto, Y., Ikeo, T., Morii, H., Takeda, M., Hide, K., ... & Nonaka, K. (2005). Correlations between periodontitis and loss of mandibular bone in relation to systemic bone changes in postmenopausal Japanese women. *Osteoporosis international*, 16, 1875-1882.
- Varacallo, M., Seaman, T. J., Jandu, J. S., & Pizzutillo, P. (2023). Osteopenia. In *StatPearls*. StatPearls Publishing.
- Von Wowern, N., Klausen, B., & Kollerup, G. (1994). Osteoporosis: a risk factor in periodontal disease. *Journal of periodontology*, 65(12), 1134-1138.
- World Health Organization. (2004, May). WHO scientific group on the assessment of osteoporosis at primary health care level. In *Summary meeting report* (Vol. 5, pp. 5-7).
- Yu & Wang (2022) noted that prove unequivocally supports a relationship between systemic and alveolar bone loss whereas moderate relationship was noted between systemic BMD and periodontal attachment loss