Proceedings of the 4th International Conference on Biological Engineering and Medical Science
DOI: 10.54254/2753-8818/57/20241256

The relationship between vitamin D and periodontal disease

Chenyong Ren

Beijing Xinfu Xue Foreign Language School, Beijing, 10000, China

aye750@126.com

Abstract. In recent years, periodontal disease has been plaguing many people, and the topic of this study is the relationship between periodontal disease and Vitamin D. Aspects are divided into Vitamin D and periodontitis, which are discussed separately. The research question is mainly in the discussion of the disease, and experiments are conducted using simulation tests to draw conclusions to do the control and observation methods to draw conclusions to take samples, there are also based on people's daily habits to make reference to improve the treatment methods and the results of the study. The conclusion is that Vitamin D and dental care are inseparable; the lack of trace elements will lead to a decline in resistance and ultimately the formation of periodontitis. Vitamin D is the primary factor affecting the growth and protection of bones, so Vitamin D will make the teeth stronger.

Keywords: Vitamin D, Periodontal Disease, Dental Health

1. Introduction

Periodontal disease is a disease that occurs in the supporting tissues of the teeth, including two major types of gum disease: periodontitis, which only involves the gum tissues, and periodontitis, which affects the deeper periodontal tissues. Periodontal disease is a common oral disease, one of the main causes of tooth loss in adults, and a major oral disease that endangers human teeth and general health. Vitamin D (VD for short) is a fat-soluble Vitamin function that can prevent rickets, promote skin cell growth and differentiation, and regulate immune function. In general, frequent exposure to sunlight does not cause deficiency disease in adults, infants, pregnant women, lactating mothers, or infrequent outdoor activities in the elderly to increase the supply of Vitamin D to 10 μg per day. Vitamin D deficiency can increase the risk of the organism developing Vitamin D deficiency can increase the risk of periodontitis, and Vitamin D is also involved in the progression and treatment of periodontal disease. Inadequate levels of Vitamin D may accelerate the progression of periodontal disease, and supplementation of Vitamin D in appropriate amounts can promote the maintenance of periodontal health, improve the efficacy of periodontal therapy, and inhibit the resorption of alveolar bone, among other things. The relationship between Vitamin D and periodontitis is characterized by its classical role in the regulation of bone metabolism and its immunomodulatory role in the inflammatory process.

This article provides a review of the progress of research on Vitamin D and its relationship with periodontitis.

DOI: 10.54254/2753-8818/57/20241256

2. Analysis

It is important to understand that healthy periodontal tissue is more likely to be achieved with adequate serum Vitamin D levels. Adequate serum Vitamin D levels in the treatment of periodontal disease not only reduce the incidence of tooth loss and periodontitis, but also promote periodontal tissue healing. Vitamin D supplementation is effective in maintaining periodontal health, especially in improving bleeding on probing, gingival index, and probing depth, increasing bone density in the jaws, and inhibiting alveolar bone resorption. The effect of Vitamin D on the development of periodontitis and its severity may be due to its regulatory effect on bone calcium metabolism and its inhibitory effect on periodontal pathogenic bacteria and inflammatory transmitters involved in periodontal destruction [1]. Vitamin D improves intestinal absorption of calcium. As calcium from food passes through the digestive system and enters the circulation, Vitamin D promotes the absorption and translocation of calcium into the bones and teeth. This enhanced calcium absorption helps maintain healthy bones and teeth. Vitamin D helps maintain calcium balance in the body. It ensures proper levels of calcium by regulating the excretion of calcium by the kidneys and the absorption of calcium by the intestines. This is important for maintaining healthy teeth because calcium in the teeth is a key component of dentin and enamel. The alveolar bone is an important tissue that supports the teeth and Vitamin D is vital to its health. Vitamin D deficiency may lead to thinning of the alveolar bone and osteoporosis. Vitamin D strengthens the alveolar bone by promoting calcium absorption and bone formation. Healthy alveolar bone provides good support, which keeps teeth stable and healthy. Vitamin D has anti-microbial activity and can exert an inhibitory effect on many oral pathogenic bacteria. Studies have shown that Vitamin D can inhibit a number of common oral pathogenic bacteria, such as Actinomyces and Streptococcus gingivalis. This anti-microbial action helps to reduce the number and activity of pathogenic bacteria in the mouth, thereby reducing the risk of oral infections and diseases. Vitamin D plays an important role in regulating the immune system by modulating the immune response of the oral mucosa [2]. Moderate levels of Vitamin D help enhance the immune function of the oral mucosa, increasing resistance and reducing the risk of infection. In addition, Vitamin D can reduce symptoms such as oral inflammation and bleeding gums. Vitamin D plays an important role in the balance of the oral microbiota. It helps regulat e the balance between beneficial and pathogenic bacteria. Vitamin D increases the abundance of beneficial bacteria, such as lactobacilli, while reducing the number of pathogenic bacteria. This balance is important for maintaining oral health, as too many pathogenic bacteria can lead to oral problems such as tooth decay and periodontal disease. Vitamin D's immunomodulatory and anti-microbial effects give it the potential to prevent and treat dental caries and periodontal disease. Proper Vitamin D levels help reduce the incidence and progression of dental caries and help control the inflammatory response to periodontal disease.

Then do the controls. Several case-control studies have found a positive correlation between Vitamin D deficiency and periodontitis. These studies reached their conclusions by comparing Vitamin D levels between individuals with periodontitis and healthy controls. The results showed that people with Vitamin D deficiency were at a higher risk for periodontitis [3]. Several longitudinal cohort studies also support the association between Vitamin D deficiency and periodontitis. These studies followed a large number of participants for many years and assessed their Vitamin D levels and the onset of periodontitis. The results showed a significant association between Vitamin D deficiency and an increased risk of subsequently developing periodontitis. Vitamin D deficiency may affect the development of periodontitis through several mechanisms. Firstly, Vitamin D deficiency affects the function of the immune system, making the oral mucosa less resistant to pathogenic bacteria. Second, Vitamin D deficiency may lead to the destruction of the alveolar bone and the formation of periodontal pockets, thus providing conditions for the development of periodontitis. It is important to note that although some correlation exists, the causal relationship between Vitamin D deficiency and periodontitis has not been fully clarified. Other factors, such as oral hygiene status and dietary habits, may also influence the risk of periodontitis. Therefore, caution is needed in interpreting these epidemiological results and further more in-depth studies are needed to confirm the relationship and understand the mechanisms involved. In the meantime, maintaining proper oral hygiene and a balanced diet are also important measures to

DOI: 10.54254/2753-8818/57/20241256

prevent periodontitis. Vitamin D has an important immunomodulatory function and can influence the immune response of the oral mucosa. In the pathogenesis of periodontal disease, the abnormal reaction of the immune system and inflammation play a key role. Vitamin D deficiency may lead to immune system dysfunction, making the oral mucosa less resistant to pathogenic bacteria, thus promoting the development of periodontal disease. Vitamin D and calcium are closely related, and Vitamin D deficiency affects calcium absorption and metabolism. Periodontal disease is often accompanied by loss and destruction of alveolar bone, which may be exacerbated by Vitamin D deficiency. An imbalance in calcium balance caused by Vitamin D deficiency may lead to thinning of the alveolar bone and damage to the periodontal tissues, thus increasing the risk of periodontal disease. Vitamin D also has anti-inflammatory properties that modulate the inflammatory response. Periodontal disease is a chronic inflammatory condition, and Vitamin D deficiency may lead to overactivation of the immune system and an increased inflammatory response. This inflammatory state can destroy periodontal tissue and further promote the progression of periodontal disease. Despite these potential causal links, the exact causal relationship still needs to be confirmed by more in-depth studies. Other factors, such as genes, oral hygiene and dietary habits, can also play an important role in the development of periodontal disease. Therefore, when assessing the relationship between Vitamin D and periodontal disease, multiple factors need to be considered and more comprehensive, long-term studies need to be conducted to further reveal the mechanism of this relationship. In the meantime, maintaining appropriate Vitamin D intake, good oral hygiene practices and a healthy lifestyle are all important measures to prevent and control periodontal disease [4]. It affects the function and differentiation of immune cells and regulates the inflammatory response. Vitamin D deficiency leads to dysfunction of the immune system, including reduced resistance to oral microbes. This means that people with Vitamin D deficiency are more susceptible to pathogenic bacteria in the mouth, which increases the risk of gingivitis and periodontitis. Vitamin D greatly affects bone health. Vitamin D deficiency affects calcium balance, which in turn leads to lower bone mineral levels and osteoporosis. During the development of periodontal disease, destruction and loss of alveolar bone are common occurrences. Vitamin D deficiency may exacerbate this, further compromising the stability of periodontal tissues and leading to the development of periodontal disease. Periodontal disease is a disease caused by a chronic inflammatory response, and Vitamin D has anti-inflammatory properties. Vitamin D deficiency leads to an over-activation of the immune system and an increase in the inflammatory response, which can exacerbate the severity of periodontal inflammation. A persistent inflammatory state causes damage to the gums and periodontal tissues and promotes the progression of periodontal disease. These biological mechanisms do not exist in isolation, but are interrelated and influential.

The research from Khademi, Z. and Hamedi-Shahraki, S. divided a randomized controlled trial of participants with chronic periodontitis into two groups. One group received daily Vitamin D supplements for six consecutive months, while the other group received a placebo. Results showed significant improvements in gingival inflammation and clinical attachment levels in the Vitamin D group compared to the placebo group. A double-blind study investigated the effects of high-dose Vitamin D supplementation on periodontal health in postmenopausal women with osteoporosis. After one year of supplementation, the researchers observed a reduction in pocket depth and an improvement in bone density in the Vitamin D group, which was significantly different from the placebo group. A systematic review and meta-analysis examined multiple clinical trials to assess the overall impact of Vitamin D supplementation on periodontal health. The results of the analysis showed an association between Vitamin D supplementation and reduced levels of gingival inflammation and improved clinical attachment levels in patients with periodontal disease. Potential Benefits of Vitamin D Supplementation as an Adjunctive Therapy for Periodontal Disease: Vitamin D has anti-inflammatory properties that may help reduce gingival inflammation associated with periodontal disease and provide relief. By modulating the immune response, Vitamin D may help maintain a healthier periodontal environment. Vitamin D plays an important role in immune function, promoting the body's ability to fight infection and maintain oral health [5]. Supplementation with Vitamin D may enhance the immune system's defence against periodontal pathogens. Vitamin D is essential for calcium absorption and bone

DOI: 10.54254/2753-8818/57/20241256

metabolism. Vitamin D supplementation may help maintain proper bone density and support the integrity of the alveolar bone needed for periodontal disease. Optimal Dose, Duration, and Method of Administration of Vitamin D Supplementation for Periodontal Disease: The optimal dose has not been determined, but general studies have used daily supplementation of 800 to 5,000 international units (IU). The appropriate dose may depend on individual factors such as age, overall health, and Vitamin D levels. Regular monitoring of Vitamin D levels can help determine the appropriate dose for each individual. The duration of clinical trials evaluating the effects of Vitamin D supplementation on periodontal health has ranged from three months to one year.

Finally, although clinical trials have shown the potential benefits of Vitamin D supplementation for periodontal health, the mechanisms of action are not yet fully understood [6]. More in-depth studies could explore the biological effects and molecular mechanisms of Vitamin D in periodontal tissue. Current research is still limited to small-sample clinical trials, and multi-centre randomised controlled trials are needed to validate and strengthen existing findings. This will ensure reliability of data and applicability for replication. The duration of most studies is short, and long-term effects and durability remain unclear. Long-term follow-up studies could assess the lasting effects of Vitamin D supplementation on periodontal health. In order to arrive at more definitive recommendations, larger, well-designed clinical studies are needed to: Determine the dose-response relationship between Vitamin D supplementation dosage and periodontal health to determine the optimal dosage range. Examining differences in response to Vitamin D supplementation across age, gender, race, and severity of periodontal disease. Conduct long-term follow-up studies to assess the lasting effects of Vitamin D supplementation on periodontal health and to understand potential side effects and safety. To address Vitamin D deficiency and promote periodontal health, the following public health strategies could be explored and implemented: Provide information on the importance of Vitamin D, its sources, and methods of supplementation to increase public awareness. This can be achieved through social media, brochures and collaboration with health professional organisations. Increase the amount of Vitamin D in food, e.g., through food fortification programmes, adding Vitamin D to milk, fish, and cereals. Pay special attention to populations that are vulnerable to Vitamin D deficiency, such as older people, pregnant women, indoor workers, and people with dark skin. Provide regular testing and advice on supplementation. Encourage people to spend more time outdoors and receive adequate sunlight so that the body can synthesise enough Vitamin D on its own. Healthcare providers can develop guidelines to provide accurate advice on Vitamin D supplementation and incorporate it into oral healthcare programmes.

3. Conclusion

Overall, it affects the connective tissue around the teeth and the alveolar bone that supports them. Vitamin D is an important fat-soluble Vitamin that is essential for bone health and immune system function. Vitamin D plays an important regulatory role in the immune system. Vitamin D inhibits the production of inflammatory factors and promotes the activity of anti-inflammatory cells. It also contributes to calcium absorption and bone formation and maintenance. Vitamin D's potential role in the prevention and management of periodontal disease is summarised as follows: Vitamin D inhibits the onset and progression of inflammatory responses. Vitamin D's modulatory effects on the immune system help to balance the immune response and reduce excessive immune activity. Vitamin D regulates the immune system to help balance the immune response and reduce excessive immune activity and inflammation, and Vitamin D promotes calcium absorption and bone health. In periodontal disease, Vitamin D deficiency may lead to a reduction in the amount of bone in the supporting tissues of the teeth and an increase in alveolar bone resorption, and Vitamin D enhances the production of antimicrobial peptides, which are known to act against oral pathogenic microorganisms. This paper calls for further research and collaboration on more multi-centre, randomised controlled trials to investigate the effects of Vitamin D on periodontal health.

References

[1] Lu, Emily Ming-Chieh. "The role of Vitamin D in Periodontal Health and disease." Journal of Periodontal Research, vol. 58, no. 2, 20 Dec. 2022, pp. 213–224, https://doi.org/10.1111/jre.13083.

[2] L Bishop, Emma, et al. "Vitamin D and immune regulation: Antibacterial, antiviral, anti-inflammatory." JBMR Plus, vol. 5, no. 1, 15 Sept. 2020, https://doi.org/10.1002/jbm4.10405.

[3] Amrein, Karin, et al. "Vitamin D Deficiency 2.0: An Update on the Current Status Worldwide." European Journal of Clinical Nutrition, U.S. National Library of Medicine, Nov. 2020, www.ncbi.nlm.nih.gov/pmc/articles/PMC7091696/.

[4] Hildebolt, Charles F. "Effect of vitamin D and calcium on periodontitis." Journal of Periodontology, vol. 76, no. 9, Sept. 2005, pp. 1576–1587, https://doi.org/10.1902/jop.2005.76.9.1576.

[5] Michael Joseph, MSc. "Why Is Vitamin D so Important?" Nutrition Advance, 8 June 2023, www.nutritionadvance.com/vitamin-d-functions-and-benefits/.

[6] Khademi, Zeinab, et al. "Vitamin D insufficiency is associated with inflammation and deregulation of adipokines in patients with metabolic syndrome." BMC Endocrine Disorders, vol. 22, no. 1, 7 Sept. 2022, https://doi.org/10.1186/s12902-022-01141-0.