REVIEW ARTICLE

Periodontists' and Orthodontists' Challenge in Periodontal Health: Role of Vitamin D3 Deficiency?

*Diah Diah [1,2], Chiquita Prahasanti[3], Retno Puji Rahayu[4] and Haryono Utomo[5]

[1] Doctoral Program, Faculty of Dental Medicine, Universitas Airlangga, Surabaya 60132, Indonesia
[2] Department of Periodontics, Faculty of Dental Medicine, Universitas Brawijaya, Malang 65145, Indonesia
[3] Department of Periodontics, Faculty of Dental Medicine, Universitas Airlangga, Surabaya 60132, Indonesia
[4] Department of Oral Pathology and Maxillofacial, Faculty of Dental Medicine, Universitas Airlangga, Surabaya 60132, Indonesia
[5] Department of Dental Forensic, Faculty of Dental Medicine, Universitas Airlangga, Surabaya 60132, Indonesia

ABSTRACT

The purpose or this review is to disscuss the literature and research on associations between vitD, periodontal disease and orthodontics treatment. Article were searched from 2013 to 2022, with keyword "Vitamin D AND Periodontal diseases"; "Vitamin D AND Gingivitis"; "Vitamin D AND Periodontitis"; "Vitamin D AND orthodontic treatment". Including literature article and research article (in vitro, and in vivo studies). Vitamin D deficiency (VDD) is often caused by insufficient solar exposure and dietary intake, or both, and and the incidence of deficiency raised during the pandemic of covid 19. The importance of vitD remains unclear to shown in prevent periodontal disease. Some reviews discovered a link between 25(OH)D in serum with periodontal health, whereas others discovered no convincing evidence of vitamin D inhibits the development of periodontal inflamation. Orthodontic patients who are VDD may have teeth movement more slowly; nevertheless, vitamin D levels in orthodontic patients may not induce external root apical resorption. The significance of vitD as an adjunctive therapy during orthodontic movement is still debated, the molecular mechanism that happened during orthodontic movement when vitamin D present are mostly unknown.

Keywords: Vitamin D, Vitamin D deficiency, Periodontal health, Orthodontic treatment, Health risk

Corresponding Author:
Diah Diah, DDS
Email: diahperio.fk@ub.ac.id
Tel: +62341576161

INTRODUCTION

VitD is a fat soluble vitamin that synthesized in the skin (1). VitD is an essential steroid hormone obtained from sunlight exposure, food and supplement (2). As a hormone, vitD regulates blood Ca and P levels via instestinal absorption. VitD has functions as an paracrine and autocrine agent, modulating the differentiation and maturation of cells, the function of innate immune system. The Vitamin D receptor (VDR), a kind of receptor molecule that bonds to the active for, of vitD, mediates vitD's cellular activities (2).

VitD can improve absorption of minerals such as Ca, Fe, Mg, P and Zn. It has two forms, vitD2 /cholecalciferol and vitD3/ergocalciferol. The UK National Health suggest that an adult consume 10 µg/day (3). 25(OH) D was established as the best marker of vitD level in blood (4). Different opinions about the ideal levels vitD in the body. The IoM defines the lowest limit of vitD in the body is 20 ng/mL. The American Endocrine Society considered that level under 20 ng/mL is deficient, between 20-30 ng/mL is insufficient, and above 30 ng/mL (75 mmol/L) is important for good health (5). Although the normal range for serum 25(OH)D concentration has not been established consistenly, a level of 20-100 ng/mL is classified as normal (4).

Serum 25(OH)D values higher than 375 nmol/L reported alongside such symptoms of toxicity (6). Toxicity can developed when daily vitD dosage surpasses 10,000 IU, resulting in 25(OH)D levels of 200-240 ng/mL. To evade the negative consequence of vitamin exsess, most medical societies suggest 25(OH)D levels no higher than 125 to 150 ng/mL (5).

Many people believe that vitD has potential extra-skeletal health benefits, such as altering energy balance and potentially decreasing inflammation. VitD appears to be a key modulator of inflammation in cell studies. The active metabolite of vitD has anti-inflammatory effect on the inflammatory profile of monocytes, reducing the expression and production of several pro-inflammatory

cytokines such TNF- α, IL-1β, IL-6, and IL-8 (7).

VitD has several effects on the immune system along with boardening regulatory T cells (Tregs), suppress Th1 and Th17 cells differentiation, decrease B cells improvement and function, and decrease monocyte activation. Because of its immunosuppressive characteristic, VitD may has therapeutic benefit. Indeed, many preclinical research in colitis and multiple sclerosis model have indicated that oral or intraperitoneal vitD treatment is beneficial (but fewer in lupus and arthritis). However, no clear effect has been seen in clinical trial, showing that the interaction between vitD and autoimmune is more complex than previously thought. It is unknown if vitD influences autoimmunity via mechanisms other than immunosuppression (8). Although much research (2)(3) has been done on the connection between vitamin D and periodontal disease, its impact on periodontal health and periodontal tissue recovery is still unknown. Several studies (9)(10) have shown that vitD also affects orthodontic treatment outcome, but there is also evidence that is no relationship between vitD and orthodontic treatment. The purpose of this review was to disscuss the relationships between vitD, periodontal disease and orthodontics treatment.

Vitamin D sources and metabolism

Sunlight, diet, and supplements are the primary sources of vitD (11). The largest part (80-100%) of vitD in the body is produced in the skin through sunlight-induced biosynthesis (ultraviolet B) (12,13).

When exposed to sunlight, 7-dehydrocholesterol transform to previtD3, and then to vitD3 (cholecalciferol) by ultraviolet B radiation and heat stimulation. Only about thirty percent of vitD can be gained trough food (12). The daily intake of vitD from food high in eggs, meat, fish and cream can be predicted using data in food composition tables. Some foods, such as meat, contain high level of 25(OH)D. When taken orally, this vitD metabolite has been shown to be approximately five times more strong than vitD supplement in increasing of 25(OH)D in the blood (6)

Ultraviolet (UV) irradiation

UV rays are electromagnetic waves which shorter wavelength than visible light and are classified as UVA (320-400 nm), UVB (280-320nm), UVC (200-280nm), depending on the wavelength (14). Ultraviolet B irradiation convert provitD3 in the skin to previtD3, which is heat-dependent into vitD3 (15). VitD production occurs at wavelength less than 315 nm for both humans and animals, with a peak at around 295–300 nm. Because of the negative feedback system, when previtD3 continuously exposed to UVB light converts to lumisterol and tachysterol, so UVB-induced vitD production cannot reach toxic amounts (16).

After UV exposure to the skin, the vitD takes at least 3 days to leave the skin, and persist in the circulation seven days later. Similary, the 25(OH)D concentration in the blood rise gradually, peaking 7–14 days after a single exposure to UV radiation (6).

Vitamin D supplementation and toxicity

Therefore, vitD supplementation necessary for the most risk factor groups, including adults over the age of 65, people with heavily pigmented skin, and thosevsuffering from osteoporosis. There are two forms of vitD supplements available (D2 and D3), and most experts suggest that vitD3 should be used in practice. VitD3 is more effective than vitD2 at increasing and maintaining vitD levels, and vitD2 does not attach to the VDR as well in human tissues (17).

Still, vitD can be toxic, but only if large quantities are consumed orally (6). Toxicity can develop quickly in patients who consume large amounts of vitD, either deliberately or incidentally. The literature suggests that taking more than 10.000 IU of vitD3 per day for several months can cause toxicity (> 200 nmol/L of 25-hydroxyvitamin D3) (18).

Daily vitD needs vary between age, and various medical societies have different suggestion on the levels needed. The Food and Nutrition Board (FNB) have recommendations for dietary allowances (RDAs) for healthy vitD concentrations.The RDAs for vitD are as follows: 400 IU between the ages of 0-12 months, 600 IU between the ages 1-70 years, and 800 IU after the age 70 years. The American Endocrine Society on other hand advises between 400-1000 IU/d in the 1st year of life and 600 to 1000 IU/d beyond that. These figures are the same for men and women (5) (19).

Vitamin D receptor (VDR)

The VDR is a receptor in the nucleus that acts as a transcription factor, which its ligand, 1,25(OH)2D, controlling the majority of its actions. VDR is a member of steroid receptor family, which includes the sex hormone, adrenal steroid, thyroid hormone, and retinoic acid receptors, and it is extensively distributed across cell lineages. VDR functions are affected by 1,25(OH)2D (20).

Most of vitD's biological activities are mediated by gene expression. The active metabolite of vitamin D (1,25(OH)2D3) has a high affinity and specificity for its nuclear receptor (nVDR). The vitamin D-nVDR forms a heterodimer with the retinoid X receptor and this complex either increases or decreases transcription of the target genes by binding to vitamin D responsive region on DNA. The nVDR is present in a variety of immune system cells, including dendritic cells, Treg cells, B cells, macrophages and neutrophils (7).

Vitamin D deficiency (VDD)

VitD is important for many bodily activities, and vitD deficiency (VDD) can lead to serious problem with

bone mineralization and metabolic function, including osteoporosis, rickets, muscular weakness, CVD, and immunological debilitated (13). VDD is widespread in many regions of the world and has been linked to obesity and other chronic disease (7). Hypovitaminosis D is often caused by insufficient solar exposure and dietary intake, or both (21).

Because contact with infected persons and contaminated surfaces is the primary mode transmission for the COVID-19 (WHO, 2021), most countries have opted to limit social interaction. This prompted calls for COVID-19 prevention measures such as school from home, work from home, gathering regulation and restriction public events that all reduce outdoor activities and less exposre to sunlight (22).

Studies on the pandemic COVID-19's effects on habits have revealed an impact on socialization, increased screen time, physical inactivity, weight gain, increased of alcohol comsumption, smoking, and bad eating habits, such as lot of high sugar and calories food and beverages (23). Due to limited access to regular grocery shopping, vital nutricious foods, such as fresh vegetables, fresh fruits, and protein-high components, people change to highly processed meals, such as junk foods and ready-to-eat foods that are high in fat and sugar (24).

Excessive antibiotic use, the Western diet which is often less fiber and heavy in saturated fat, pollutans, drugs, and vitD insufficiency are all factors that can lead to several diseases. Furthermore, VDD and VDR function have been linked to disruptions in gut homeostasis and as a result immunological tolerance. All of these variables can result to intestinal dysbiosis, increased susceptibility to infections and increased intestinal permeability, all of which predispose to lipopolysaccharides translocation and activate inflammatory immune responses such as TNF-α and IFN-γ. Loss of immunological homeostasis can result to food intolerances and allergies, which can contribute to development of autoimmune diseases (25).

Vitamin D and periodontal health

Gingivitis is the most common disease of periodontal tissue. If it is not treated properly, it may eventually lead to serious conditions such as periodontitis, which will result in tooth loss in vulnerable people. It has been observed that its frequency among adults is around 55.7 percent. It causes swollen, bulging, receding, tender and sensitive gums. Diabetes mellitus, smoking and certain drugs, including as hormonal contraceptives, hereditary factors, and VDD, are all risk factors for this condition (26).

The other types of periodontal disease is periodontitis. Periodontitis is a complicated microbial illness caused by bacterial and characterized by longterm chronic inflammation. Periodontitis is one of the most common diseases in the world and its influenced by economical and systemic consequences. It has important influence on quality of life and is regained with periodontal treatment. Diabetes, ischemic stroke, rheumatoid arthritis, cardiovascular disease, inflammatory bowel disease, solid-organ transplanted person, stress, or premature delivery have all been linked to periodontitis on a systemic level. Influence of diet on periodonta health, particularary VDD, has been extensively researched. European consensus stating that insufficient vitD status has an impact on periodontal health and oral functioning (2).

Several clinical investigations have found a link between an inadequacy of vitD in the diet and periodontal diseases. Other research, however, have indicated that there is no connection between serum vitD levels and periodontal tissue health. The relationship between vitD and periodontal disorders is yet unknown and has to be researched further (3).

The immunomodulatory effect of vitD, as mediated by 25(OH)D and 1α,25(OH)2D has already been exensively examined. Active vitD has multiple effects on the immune system, including: stimulating macrophage, T cells, and activated B cells function, dendritic cells maturation, TNF expression modulation, production of neutral antibacterial proteins and peptides (eg, cathelicidins and β-defensin) (27) and ROS; and expression of inducible nitric oxide synthase. Antibacterial proteins and peptides are produced by neutrophils, natural killer (NK) cells, antigen presenting (AP) cells, and various epithelial cells in airway, urinary bladder, gingiva and gastrointestinal system cells. Pathogen are in direct touch with all of these cells. VitD also inhibits of IFN-γ and rise the expression of the NK toxicity receptors NKp30 and NKp44 in NK cells. IL-10 and proinflammatory cytokines are blocked, as is the expression of CD40 (needed for B-cell activation) and CD80/86 (needed for T-cell activation). MHC II is also reduced. To increase barrier fuction, 1α,25(OH)2D upregulates gene expression for gap junction, adhesion, and tight junction proteins in epithelial cells. Vitamin D regulates cathelicidin- encoding gene production, although it is also boosted by bacterial infections and powerful pro-inflammatory cytokines (especially IL-1,TNF-α, IFN-γ, IL-6). Cathelicidins also play an important role in the recruitment of leukocytes, the chemotaxis of immunocompetent cells to the infection site, and the suppression of LPS-dependent endothelial activation and vasodilation (17).

Periodontal disease has been linked with VDD in a variety of group, although the mechanism is unclear. VitD influence the gingival epithelium against periodontal pathogens in order to maintain microbial equilibrium and suppress proinflammatory cytokines (28).
During P. gingivalis invasion, vitD inhibits synthesis of proinflammatory cytokines while increasing the

production of the HBD-3. To further assess the immunomodulatory effects of vitD triggered by P. gingivalis primed HGE and HPL cells, the IL-8, IL-12 and TNF-α by HGE and HPL cells were measured. IL-8 is neutrophil chemoattractant and activator that promotes neutrophil recruitment and infiltration; it is important in inflammation and one of the most important cytokines in inflammatory response to infections (29).

VDD may raise the risk of infectious illness. This implies that vitD may be useful for periodontitis treatment. Beside its direct effects on bone metabolism, it may have antibacterial effects on periodontopathogens and reduce inflammatory mediators that lead to the periodontal deterioration (30). The plasma concentration should be 90–100 nmol/L to have effect on periodontium (31).
VDR in gingival and junctional epithelium improve host protection against microbial by increasing the function of epithelial barrier, hence boosting innate barrier immunity. Topical vitD administration inhibited IL-1a, a key cytokine implicated periodontal tissue deterioration in animal model (32).

Vitamin D and periodontal healing
1,25(OH)2D/VDR signaling aids wound healing in several ways. During the inflammatory phase of tissue repair, it mediates keratinocyte proliferation and differentiation as well as monocyte/macrophage recruitment, and VDR-deficient animals show deterioration in the development of granulation tissue with low vascular formation and extracellular matrix content. As a result, VDD cause impede periodontal tissue recovery (27).

VitD has been found to promote angiogenesis by inducing endothelial migration and proliferation. This physiological mechanism is partially attributed to vitamin D-induced NO production. NO has been shown to stimulate the production of capillary-like structures in human umbilical endothelial cells (HUVEC) and the human coronary artery in a 3D matrix in in vitro and ex vivo tests. NO-mediated endothelial cell migration and proliferation is one potential mechanism explaining NO's participation in angiogenesis. VitD has been demonstrated to promote migration and proliferation endothelial cell by enhance gene expression ofMMP-2), an disintegrating agent. Furthermore, enhanced MMP-2 expression was linked to increased NO generation in HUVEC and porcine aortic endothelial cells, since eNOS suppression with n(ω)-nitro-L-arginine methyl ester prevented endothelial cell migration and proliferation (L-NAME). This data implies that vitD-induced endothelial cell angiogenic activities are mediated via eNOS-dependent NO generation. Furthermore, NO-mediated angiogenesis involves amplification of angiogenic growth factor gene expression, including VEGF and FGF, as well as reduction of angiostatin (1).

Vitamin D and orthodontic treatment
Tooth movement is dependent on the application of predefined forces that provide mechanical stimuli that result in two simultaneously processes that are bone resorption via osteoclastic activity at the pressure site, and bone formation via osteoblastic action at the tension site. When combined with mechanical, chemical, or electrical inputs, these two mechanisms may result in quicker tooth movement. In terms of chemical components, vitD has demonstrated encouraging outcomes in terms of tooth mobility during orthodontic therapy. Regardless, VDD reduces rate of tooth movement in animal models, resulting in treatment delays or problems (2).

The PDL play a role in alveolar bone remodelling, which is a critical part of orthodontic tooth movement (OTM). OTM is caused by the application of a mechanical force to a tooth using orthodontic equipment, which results of tensile and pressure zones inside the PDL. When activated mechanically, PDL fibroblasts release various pro-inflammatory mediators, resulting in a sterile inflammatory process inside the PDL that eventually causes osteoclast development and activity. Thus, PDL fibroblasts play an important role in modulating the molecular mechanisms essential for OTM (9).

VitD enhanced bone resorption in several experiments by stimulating the development of osteoclasts from their progenitors and boosting the activity of existing osteoclasts. Orthodontic patients who are VDD may have slower tooth movement. There was a significant increase in osteoclastic activity at first, and then followed by osteoblastic activity (26).

Even the relationship between vitD, VDR, and orthodontic phenotypes is not a new in the literature and has been studied by some researchers over the last three decades, the role of vitamin D as a adjuctive therapy during OTM is still debatable, and the molecular processes that occur during OTM with influence of vitamin D are mainly unclear (9). After correcting for age and gender, Tehranchi's cross-sectional study propose that vitD level is not a clinical characteristic that is a possible contributor to manifested external root apical resorption in orthodontic patients (10).

METHODS

Article were searched from Science Direct, Pubmed and internet, from 2013 to 2022, with keyword "Vitamin D AND Periodontal diseases"; "Vitamin D AND Gingivitis"; "Vitamin D AND Periodontitis"; "Vitamin D AND orthodontic treatment". Inclusion criteria were determined as follows: literature articles and research articles, in vitro and in vivo studies.

RESULTS

16 papers were finally selected, consisting of 7 literature articles on Table I and 9 research articles on Table II. Based on data in Table 1, six review papers found that vitD had a favorable association with oral disorders, including periodontal diseases and while 1 article discovered that there was no significant evidence between vitD and periodontal diseases. According to the data in Table II, eight research papers discovered that vitD had a substantial connection with periodontal disorders and can be used as a preventive or therapeutic for these diseases. One study conclude that vitD were negatively associated with periodontal diseases. All of the data in Tables I and II, show that vitD had a strong connection with oral health, particularly periodontal diseases and more study is needed.

Table I: Summary of the related available literature articles for vitamin D and periodontal tissue

No.	Author (y)	Literature title	Literature source	Topic in this article	Findings
1	Botelho et al. (2020) (2)	Vitamin D Deficiency and Oral Health: A Comprehensive Review	Journal article	Effect of vitamin D deficiency in oral health	VDD is highly implicated with oral diseases and has been linked with a higher risk of tooth defects, caries, periodontitis and oral treatments failure.
2	Martinon et al. (2021) (3)	Nutrition as a Key Modifiable Factor for Periodontitis and Main Chronic Diseases	Journal article	Relationship between nutrition-periodontal disease, nutrition-chronic diseases, and periodontal disease-chronic diseases	Unhealthy diet will be at risk of periodontal disease, bad eating habits remain unchanged and the PD untreated, then will be at risk of other chronic diseases, such as neuro and cardiovascular diseases, cancers and diabetes. Periodontal diseases could be considered as an early risk factor of the other chronic diseases.
3	Lee & Won (2019) (19)	Relationship between Clinical Indicators of Periodontal Disease and Serum Level of Vitamin D	Journal article	Relationship between serum level of vitamin D and clinical parameter, bacterial species and biochemical parameters	Positive associations between the serum 25(OH)D level and periodontal health, and the clinical parameters of periodontal disease were reduced by vitamin D oral supplementation
4	Khan & Ahad (2021) (32)	Application of adjunct vitamin D supplementation in the management of periodontal disease: A three-pronged approach	Perspective	Adjunct vitamin D supplementation is a three-pronged approach in tack-ling periodontal disease progression by anti-inflammatory, host modulatory, and antimicrobial effects.	Vitamin D could be an agent in the prevention and management of periodontal disease.
5	George et al. (2019) (33)	Vitamin D: A “Sun Shine” on the periodontium	Journal article	Effect of Vitamin D on periodontium	Significant association between Vitamin D and periodontal health, disease, and/or therapy. Can be explained by its actions on alveolar bone metabolism, host response to microbial challenge and polymorphisms in the Vitamin D receptor.
6	Machado et al. (2020) (34)	Vitamin D and Periodontitis: A Systematic Review and Meta-Analysis	Journal article	Effect of Vitamin D on periodontium	Periodontitis is associated with 25(OH)D serum levels. The effect of vitamin D supplementation as an adjunct of nonsurgical periodontal treatment remains unclear. Future studies are needed regarding the effect of vitamin D supplementation and the biological mechanisms linking vitamin D to the periodontium
7	Millen & Pavlesen (2020) (35)	Could Vitamin D influence risk for Periodontal Disease - to “D” or not to “D”?	Journal article	Association between vitamin D and periodontal disease, stregths and weakness	No strong evidence suggest that vitamin D protects against development of periodontal disease.

Table II: Summary of the related available research articles for vitamin D and periodontal tissue

No.	Author (y)	Literature title	Literature source	Topic in this article	Findings
1	Kim et al. (2020) (4)	Low serum 25-hydroxyvitamin D levels, tooth loss, and the prevalence of severe periodontitis in Koreans aged 50 years and older	Journal article	Relationship between serum vitamin D and periodontal clinical marker (PPD, CAL and BOP)	Serum vitamin D levels were negatively associated with tooth loss and severe periodontitis in a sample of Korean adults over 50 years old
2	Menzel et al. (2018) (28)	Activation of vitamin D in the gingival epithelium and its role in gingival inflammation and alveolar bone loss	Journal article	1. In vitro study of effect VDD on alveolar bone loss and inflammation In vivo study of topical application administration of vitamin D	VDD in mice contributes to periodontal diseases. Vitamin D increases the activity of GEC against the invasion of periodontal pathogens and inhibits the inflammatory response, both in vitro and in vivo.Topical application of both vitamin D3 and 1,25(OH)2D3 to the gingiva of mice led to rapid inhibition of IL- 1α expression
3	De Filippis et al. (2016) (29)	Vitamin D reduces the inflammatory response by Porphyromonas gingivalis infection by modulating human β-defensin-3 in human gingival epithelium and periodontal ligament cells	Journal article	In vitro study of effect vitamin D on human gingival epithelium and human periodontal ligament infected with P. gingivalis	The production of HBD-3 in HGE and HPL cells enhanced by vitamin D plays a crucial role in the prophylactic effect on P. gingivalis infection by inhibiting the expression of TNF-α, IL-8 and IL-12 cytokines in the host cell
4	Ahmed & Kudva (2020) (36)	To evaluate and to assess the relationship between vitamin - D & chronic periodontitis a clinico biochemical study.	Journal article	Relationship between vitamin D and periodontal health	Vitamin D level is decreased in the periodontitis group and also revealed that there is inverse relationship between the mean vitamin D3 level and mean serum CRP level which showed the anti-inflammatory effect of vitamin D.
5	Bhargava et al. (2019) (37)	Relationship between VITAMIN D and chronic periodontitis	Journal article	Correlation of serum level vitamin D with PI, GI, PPD and CAL	A statistically significant relationship between serum 25(OH) D level and GI, PPD and CAL. No re- lationship between 25(OH) D levels and PI. Overall low levels of serum Vitamin D in patients with Chronic Periodontitis but the levels of Vitamin D did not decrease with the increase in the severity of periodontitis
6	Madi et al.(2020) (38)	The association between vitamin D level and periodontal disease in Saudi population, a preliminary study	Journal article	Correlation of serum vitamin D level and alveolar crest high (ACH)	A weak negative correlation was found between vitamin D and ACH in all groups. Serum vitamin D level seems to be an important factor that influences oral health, especially the periodontal condition, of both male and female patients.
7	Bayirli et al (2020) (39)	Serum vitamin D concentration is associated with antimicrobial peptide level in periodontal diseases	Journal article	Association VDD with GCF and gingival tissue antimicrobial peptide (AMP) level ini CP and gingivitis patients	Lower serum 25(OH)D concentrations were associated with compromised antimicrobial peptide expression in GCF and gingival tissues in gingivitis and CP patients
8	Bonnet et al. (2019) (40)	The Relation Between Periodontal Disease and Vitamin D	Journal article	Association between 25(OH)D level and markers of periodontal disease (GI and LOA)	Vitamin D status was inversely associated with GI at the bivariate level, but not at the multivariate level. Conversely, vitamin D status was not associated with LOA at the bivariate level, but it was inversely associated with LOA at the multivariate level. These results provide modest evidence supporting a relation between low plasma 25(OH)D concentrations and periodontal disease as measured by GI and LOA.
9	Constantini et al. (2020)(41)	Evaluation of Salivary Cytokines and Vitamin D Levels in Periodontopathic Patients	Journal article	Saliva levels of 25(OH)D3, TGFβ, IL-35, IL-17A, and MMP9 in periodontitis	An increase in TGFβ, IL-35, MMP9, and IL-17A salivary levels and a reduction in 25(OH)D3 levels in PD patients with respect to the healthy controls. Significant positive correlation between cytokines and highly negative correlation between 25(OH)D3 and salivary cytokine levels. The increase of TGFβ salivary level, associated with worse periodontal conditions and with pro-/anti-inflammatory molecules, leads to speculate that TGFβ plays an important role in PD

CONCLUSION

VitD with dose of 3,000–5,000 IU daily is essential for proper bone hemostasis. The body should maintain vitD levels of at least 30 ng/mL on a regular basis. This need may be met by getting enough sunshine and eating meals such eggs, fatty fish, and fortified foods. VDD will have a negative impact on bone mineralization, muscular contraction, and nerve transmission.

VitD is important in periodontology because it aids the production of proteins required for the development of mucous membranes. This forms a physical barrier, preventing germs from spreading farther into deeper tissues. Antimicrobial protein production by immunological and epithelial cells is stimulated, as are non-specific immune responses. Although the cause is unknown, periodontal disease has been related to VDD. According to the findings of pilot studies on anti-inflammatory dietary and risk of periodontal disease , vitD may be important required elements in healthy diet. Several effects on human life, namely changing lifestyles, reducing outdoor activities that resulting less sunlight exposure, which is the main source of vitD. Change diet to a lot consumption of sugar and less fiber, stress, Western diet and VDD can promote gut homeostasis disturbances and rise in chronic illness, for example periodontal diseases. Role of vitD on orthodontic treatment is still unclear. Some reviews claim that VDD does not result in external resorption during orthodontic treatment, despite studies showing that it slows down tooth movement and increases bone resorption.

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