

# Effects of Vitamin D Deficiency on Oral Health

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**Abstract:** Vitamin D is a vital nutrient for human body. It is a fat - soluble secosteroid with a structure very similar to cholesterol. The Vitamin D receptor is a molecule that binds to the active form of Vitamin D2 and controls different processes, such as differentiation, inflammation, calcium and phosphorous absorption. Specifically, it's main function is maintaining serum concentrations of calcium and phosphorous within normal ranges. Vitamin D can be synthesized in the skin, and it helps to facilitate intestinal calcium absorption. Ergosterol, which occurs in plants, is a vitamin D precursor. The active form of vitamin D is a steroid hormone. Renal activation of vitamin D is regulated by several endocrine factors. Liver and/or kidney disease can result in a 1, 25 (OH) 2D deficiency. Parathyroid hormone deficiency can be treated through vitamin D supplementation. Cholecalciferol rodenticide poisoning can cause symptoms of vitamin D toxicity. Glucocorticoids and calcitonin can be used to reverse symptoms of vitamin D toxicity. These days, people think that diet and lousy maintenance of teeth will affect their oral health and cause tooth decay. However, oral health can also be affected by our nutritional consumption. Any body part may be affected by vitamin D deficiency. Initial symptoms include muscle weakness, lower back pain, muscle aches, throbbing bone pain. When it comes to oral health, vitamin D deficiency may lead to tooth decay, tooth loss, bleeding gums, gingivitis, enamel erosion, hypomineralization. Thus vitamin D is an essential nutrient for our body. It is a kind of a vitamin which functions as steroid hormone which is mainly obtained from sunlight and dietary supplements as well.

**Keywords:** Receptor, Teeth, Oral health, Enamel, Dentin, Bone, Hypomineralization, Guardian cell, Immunomodulation, Bone resorption, Bone density, Periodontal disease, Neurosteroid, Lactose intolerance, Skin pigmentation, Genetic polymorphism

## 1. Oral manifestations of Vitamin - D deficiency

Vitamin D plays a main role in stimulating our oral health. It helps in preventing from tooth decay and various types of gum diseases. Both calcium and phosphorous create a bony structure which makes up tooth enamel.

- Teeth are a living and functioning part of body which usually requires good, constant and superficial maintenance. Managing of minerals in our body is completely guided by calcium balance and immune system, which are completely regulated by Vitamin D.
- Tooth decay is a chronic condition that usually happens in kids and elder people.
- Teeth are surrounded by alveolar bone and is formed by three different connective tissues namely enamel, cementum and dentin. The mineralization process of teeth simultaneously occurs along with skeletal mineralization. Hence, when vitamin D levels are unregulated, the teeth become hypomineralized and defective. This makes them more vulnerable to fracture and decay.
- There are many studies which suggest from above basis that Vitamin D Deficiency leads to occurrence of mineralization defects. Then it may lead to **rachitic tooth** i. e. defective and hypomineralized organ in which bones or tooth would be highly susceptible to decay or damage or even bone fractures.
- There may be hypoplasia i. e. incomplete development of enamel. Vitamin D deficiency causes enamel to be mottled and yellow - grayish in color.
- Dentin is a connective tissue present under tooth enamel. It consists of **guardian cells** which are present at the border of tooth enamel and the main function of dentin is to release immune factors. These immune factors are able to repair damaged dentin with the help of Vitamin D3. But if vitamin D levels are low, then defense system won't be able to protect and repair infected or decayed teeth.
- Various studies stated that kids with Vitamin D deficiency will greater risk of developing tooth decay. Usually it should be 25 (OH) D, when it decreases to <20ng/ml it is considered as vitamin D in sufficiency in body.
- Various possible mechanisms have been put up to clarify the function of vitamin D reducing the risk of dental caries. One of these mechanisms involves the control of parathyroid hormone, serum phosphate, and calcium levels, which are essential for tooth protection, mineralization and calcification. Homeostasis of phosphate and calcium is required for creation, mineralization, calcification, and preservation of teeth, bone and hard tissues.
- The pulp horns of a tooth will change from U - shaped to a chair shaped pattern that resembles a skinny H - shape. Moreover, the absence / deficiency of Vitamin D may also cause hypomineralization and abnormal alveolar bone patterns, compromising tooth integrity.
- In recent times, there remains a growing requirement of micro and macro facial aesthetics, which has led to increased orthodontic treatments especially in young adults. It has been noted that Vitamin D plays a role in movement of tooth during orthodontic treatment. In cases of hypovitaminosis, intake of vitamin d supplements during orthodontic treatment by improving resorption in remodeling of alveolar bone.
- Bleeding gums is one of the major signs of Vitamin D deficiency.
- It also leads to development of high pulp horns and large pulp chambers. The closure of root apices also gets delayed, due to which the tooth can not only become more infected but can also result in loss of the entire tooth.
- When it comes to bleeding gums, it is a chronic inflammation disorder, which is sought to be one of the initial symptoms of periodontitis. It is not only a major symptom but also a major sign of deteriorating gum health.

- Vitamin D also affects the pathogenesis of periodontal diseases via immunomodulation, increases bone mineral density and reduces bone resorption, and is important in fighting against agents that cause periodontal diseases.

### Vitamin D deficiency: Worldwide

Prevalence rates of severe vitamin D deficiency, defined as 25 (OH) D <30 nmol/L (or 12 ng/ml), of 5.9% (US), 7.4% (Canada), and 13% (Europe) have been reported. Estimates of the prevalence of 25 (OH) D levels <50 nmol/L (or 20 ng/ml) have been reported as 24% (US), 37% (Canada), and 40% (Europe). This may vary by age, with lower levels in childhood and the elderly, and also ethnicity in different regions, for example, European Caucasians show lower rates of vitamin D deficiency compared with nonwhite individuals. Worldwide, many countries report very high prevalences of low vitamin D status. 25 (OH) D levels <30 nmol/L (or 12 ng/ml) in >20% of the population are common in India, Tunisia, Pakistan, and Afghanistan.

In India, it has been estimated that 490 million individuals are Vitamin D deficient. High prevalence of vitamin D deficiency in a sun - rich country like India (Latitude—8° 4'–37° 6' N) most of India has adequate Ultraviolet B radiation (UVB) throughout the year has been reported due to several reasons including inadequate exposure to sunlight, dietary factors like inadequate vitamin D and calcium intake, high phytates and phosphates, intake of caffeine, high prevalence of lactose intolerance, skin pigmentation, pollution hampering penetration of ultraviolet rays, genetic polymorphisms and body fat percentage.

However, the contribution of various determinants that influence vitamin D concentrations in the Indian paediatric population is underreported. Taken together, given the importance of vitamin D status in children and adolescents and the reported prevalence of vitamin D deficiency in India is to be assessed.

### Diagnosis of Vitamin D deficiency

Doctors would make the diagnosis through a blood test, with values below 20 ng/ml being considered deficient, 20 - 30 ng/ml insufficient and 50 - 70 ng/ml optimal. In individuals who are diagnosed with Vitamin D deficiency, doctors would aim at optimising the values, which can be most reliably achieved by low - cost supplements, given in doses titrated by blood levels, plus adequate exposure to the midday sun.

### How to manage Vitamin D deficiency?

Hypovitaminosis can be managed by following some simple lifestyle and dietary changes.

- 1) **Spend some time in sun** - Primary source of Vitamin D is sunshine. Daily 30 minutes of exposure to sunlight are enough for an average adult. But be cautious that too much exposure to sunlight may lead to rashes and skin cancer too.
- 2) **Consume foods rich in Vitamin D** - These foods should be taken one to two servings per day for Vitamin D. These include eggs, fatty fish, cod liver oil, organ meats, cheese, butter and yoghurt. Particularly, foods

like cod liver oil, salmon and trout provide maximum Vitamin D levels per serving.

- 3) **Try to take Vitamin D supplements** - Vitamin D supplements are suggested by healthcare providers. They recommend you the proper dosage based on your Vitamin D levels.

## 2. Conclusion

There has been an increased awareness of Vitamin D deficiency among the global population in the last few years due to the higher prevalence among younger people. In this scenario, the public oral health awareness programs should be designed to highlight role of Vitamin D deficiency in bad oral health, and it's relation to chronic oral conditions. It will increase the awareness among people about relationship between Vitamin D and oral health. In addition, periodontitis patients had higher salivary calcium concentrations than controls, favouring the formation of dental plaque and calculus, the main etiological factors of periodontal disease. There is a need for adequate awareness regarding oral hygiene. Specifically, the effective preventive measures could help reduce the effect of vitamin D deficiency on oral health.

## References

- [1] Botelho J, Machado V, Proença L, Delgado A, Mendes J. Vitamin D Deficiency and Oral Health: A Comprehensive Review. *Nutrients*.2020; 12 (5): 1471.
- [2] Bener A, Hoffmann G, Al Darwish M. Vitamin D Deficiency and risk of dental caries among young children: A public health problem. *Indian Journal of Oral Sciences*.2013; 4 (2): 75.
- [3] Abdulmaguid R, Sherif S, Elsayed H. Assessment of Serum Vitamin D Levels in Young Adults and Correlation of Vitamin D Deficiency and Gingivitis. *Egyptian Dental Journal*.2017; 63 (3): 2413 - 2419.
- [4] Orbak R, Ozkan Y, Orbak Z. Dental manifestations of vitamin D deficiency in adolescents. *Endocrine Abstracts*.2019.
- [5] Ngangom A, Jain M, Verma S. Need of early dental intervention in vitamin D deficiency rickets. *Indian Journal of Dental Sciences*.2018; 10 (4): 229.
- [6] Khalaf RM, Almudhi AA. Effects of vitamin D deficiency on the rate of orthodontic tooth movement. An animal study. *Saudi DentJ [Internet]* 2022; 34 (2): 129 - 35.
- [7] Fulton A, Amlani M, Parekh S. Oral manifestations of vitamin D deficiency in children. *Br Dent J [Internet]* 2020; 228 (7): 515 - 8.
- [8] Swapna LA, Abdulsalam R. vitamin D Deficiency and its Effects on Tooth Structure and pulpal changes. *Open Access Maced J Med Sci [Internet]*.2021; 9 (F): 81 - 7.
- [9] Xavier TA, Madalena IR, da Silva RAB, Silva MJB, De Rossi A, et al. vitamin D deficiency is a risk factor for delayed tooth eruption associated with persistent primary tooth. *Acta Odontol Scand*.2021; 79 (8): 600 - 5.
- [10] D'Ortenzio L, Kahlon B, Peacock T, Salhuddin H, Brickley M. The rachitic tooth: Refining the use of interglobular dentine in diagnosing vitamin D

- deficiency. *Int J Paleopathol* [Internet].2018; 22: 101 - 8.
- [11] Yogesh Hole et al 2019 *J. Phys.: Conf. Ser.*1362 012121.
- [12] Zihni Korkmaz M, Y emenoglu H, Günaçar DN, Ustaoglu G, Ates Yildirim E. The effects of vitamin D deficiency on mandibular bone.
- [13] Ramseier CA, Anerud A, Dulac M, Lulic M, Cullinan MP, Seymour GJ, et al. Natural history of periodontitis: Disease progression and tooth loss over 40 years. *J Clin Periodontol.*2017; 44 (12): 1182 - 91.
- [14] Botelho J, Machado V, Proenca L, Delgado AS, Mendes JJ. Vitamin D Deficiency and Oral Health: A Comprehensive Review. *Nutrients.*2020; 12 (5): 1471.
- [15] Holick MF, Binkley NC, Bischoff - Ferrari HA, Gordon CM, Hanley DA, Hanrey RP, et al. Evaluation, treatment, and prevention of Vitamin D deficiency: an Endocrine Society clinical practice guideline. *J Clin Endocrinol Metab.*2011; 96 (7): 1911 - 30.
- [16] Dragonas P, El - Sioufi L, Bobetsis YA, Madianos PN. Association of Vitamin D with Periodontal Disease: A Narrative Review. *Oral Health Prev Dent.*2020; 18 (1): 103 - 14.
- [17] Olszewska - Czyz I, Firkova E. vitamin D3 Serum Levels in Periodontitis Patients: A Case - Control Study. *Medicina (Kaunas).*2022; 58 (5): 585.
- [18] Girgis E, Reyad AA. Vitamin D: Pharmacology and Clinical Challenges in Oral Health Care. *J Int Acad Periodontol.*2019; 21 (3): 118 - 24.
- [19] Machado V, Lobo S, Proenca L. Mendes JJ, Botelho J. Vitamin D and Periodontitis: A Systematic Review and Meta - Analysis. *Nutrients.*2020; 12 (8): 2177.
- [20] Wells G, Shea B, O'Connell D, Peterson J, Welch V, LososM, et al. The Newcastle - Ottawa Scale (NOS) for assessing the quality of nonrandomized studies in meta - analyses. Ottawa (Canada): The Ottawa Hospital [accessed April 2022].
- [21] Kuraner T, Beksac MS, Kayakirilmaz K, Caglayan F, Onderglu LS, Ozgunes H. Serum and parotid saliva testosterone, calcium, magnesium, and zinc levels in males, with and without periodontitis. *Biol Trace Elem Res.*1991; 31 (1): 43 - 9.
- [22] Acharya A, Kharadi MD, Dhavale R, Deshmukh VL, Sontakke AN. High salivary calcium level associated with periodontal disease in Indian subjects— a pilot study. *Oral Health Prev Dent.*2011; 9 (2): 195 - 200.
- [23] Antonoglou G, Knuuttila M, Niemela O, Hiltunen L, Raunio T, Karttunen R, et al. Serum 1, 25 (OH) D level increases after elimination of periodontal inflammation in T1DM subjects. *J Clin Endocrinol Metab.*2013; 98 (10): 3999 - 4005.
- [24] Millen AE, Andrews CA, LaMonte MJ, Hovey KM, Swanson M, Genco RJ, et al. Vitamin D status and 5 - year changes in periodontal disease measures among postmenopausal women: The Buffalo OsteoPerio Study. *J Periodontol.*2014; 85 (10): 1321 - 32.
- [25] Braegger C, Campoy C, Colomb V, Decsi T, Domellof M, Fewtrell M, et al. Vitamin D in the healthy european paediatric population. *J Pediatr Gastroenterol Nutr.*2013; 56: 692–701.
- [26] Munns CF, Shaw N, Kiely M, Specker BL, Thacher TD, Ozono K, et al. Global consensus recommendations on prevention and management of nutritional rickets. *J Clin Endocrinol Metab.*2016; 101: 394–415
- [27] Cashman KD. Vitamin D deficiency: defining, prevalence, causes, and strategies of addressing
- [28] Vos R, Ruttens D, Verleden SE, Vandermeulen E, Bellon H, Van Herck A, et al. High - dose vitamin D after lung transplantation: a randomized trial. *J Heart Lung Transplant*
- [29] Lee P, Nair P, Eisman JA, Center JR. Vitamin D deficiency in the intensive care unit: an invisible accomplice to morbidity and mortality? *Intensive care Med.*2009; 35: 208–32