

Review Article

Caries Prevention: Vitamin Way - A Novel Approach

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Received: 14/12/2015

Revised: 23/12/2015

Accepted: 24/12/2015

ABSTRACT

Dental caries is a unique multifactorial infectious disease and is the predominant cause of tooth loss in children and young. It is a diet-dependent infectious disease primarily attributed to the presence of oral bacteria. Nutrients play an important regulatory role in preserving health of the human body and of all metabolically active tissues. Micronutrients, vitamins and antioxidants play an essential role for constant regenerative processes, for coping with oxidative stress, and also for adequate immune responses. Undernutrition or malnutrition concerning certain food components can lead to defects of the dental hard tissues, the oral mucosa and the periodontium. Deficiency in Vitamin D during periods of tooth development may result in developmental defects like enamel hypoplasia, a significant risk factor for severe early childhood caries (S-ECC). Research shows that vitamin K2 and vitamin D together result in a far greater reduction of tooth decay than does either vitamin alone. Sound nutritional habits and a sufficient supply of essential vitamins and minerals are of considerable importance for oral health.

Keywords: Dental Caries, Early Childhood Caries, Nutrition, Vitamins.

INTRODUCTION

Dental caries is the most prevalent chronic disease affecting the human race. In many ways it can be considered a disease of modern times as the occurrence of caries seems to be much higher in the last few generations. ⁽¹⁾ There is localized destruction of susceptible dental hard tissue by acidic by products from bacterial fermentation of dietary carbohydrates. ⁽²⁾ Thus it is a bacterial driven, generally chronic, site specific, multifactorial dynamic disease process that results from imbalance in the physiologic equilibrium between the tooth mineral and plaque fluid; that is when the pH drop results in net mineral loss over time. ⁽³⁾

The term dental caries is used to describe the results-the signs and symptoms of a localized chemical dissolution of the tooth surface caused by metabolic events taking place in the bio film covering the affected area destroying enamel, dentin, cementum. The lesions may manifest clinically in a variety of ways. ⁽⁴⁾

There are practically no geographic areas in the world whose inhabitants do not exhibit some evidence of dental caries. It affects persons of both sexes, in all races, all socioeconomic strata and in every age group, though some people may be more prone to it than others. Though it may be argued that the disease is not life threatening, the sequelae associated with it are far reaching. The cost involved in

treating the disease in terms of manpower and hours spent is enormous. Also, the excruciating pain experienced by the patient can affect the patient as much as the aesthetic problem it poses. Systemic complications such as subacute bacterial endocarditis have also been documented to be associated with dental caries. The masticatory apparatus may also be affected leading to difficulty in mastication and deglutition. ⁽²⁾

Vitamins and Dental Caries: Vitamins may be regarded as organic compounds required in the diet in small amounts to perform specific biological functions for normal maintenance of optimum growth and health of the organism. ⁽⁴⁾

The term "vitamine" was coined by the Polish biochemist Casimir Funk in 1912, when he isolated a substance (called beri-beri vitamine) that was present in rice bran, but not in polished rice and could alleviate the deficiency disease beriberi, endemic in many Asian countries. At the time, he assumed that all such essential compounds in the diet contain an amine group, hence, the term vitamine (vital-amine); the final "e" was later dropped to deemphasize the amine connection. ⁽⁵⁾

Vitamins can basically be classified into the following two categories:

- (1) Fat-soluble Vitamins -Include Vitamins A, D, E and K
- (2) Water-soluble Vitamins -Include Vitamins B and C

Vitamin A: Vitamin A is an essential nutrient that controls many crucial biological functions such as vision, reproduction, development, growth and immunity. All retinoids (vitamin A and its derivatives) in animals are derived from the diet either as preformed vitamin A [retinyl esters (RE), retinol (ROH) and very small amounts of retinoic acid (RA)] from animal products or as carotenoids, mainly β -carotene, from vegetables and fruits. Vitamin A is also an important antioxidant that may play a role in the prevention of certain cancers. ⁽⁷⁾

Vitamin A deficiency has definite effects on developing teeth in animals and preferably in human beings, although only a few reports on dental disturbances in Vitamin A deficiency in humans are available in literature. There are no human studies relating Vitamin A excess or deficiency, to the dental caries experience. ⁽⁸⁾

Vitamin D: Vitamin D regulates calcium levels and plays a key role in craniofacial development and the maintenance of good oral health. There are two main sources of obtaining vitamin D: endogenous synthesis and exogenous attainment from diet and supplementation. It has a critical role in enamel, dentin, and oral bone formation as ameloblasts and odontoblasts are target cells for 1, 25-dihydroxyvitamin D, the active form of vitamin D. Deficiency in vitamin D during periods of tooth development may also result in developmental defects including enamel hypoplasia, a significant risk factor for S-ECC. Vitamin D is associated with the two main oral diseases, caries and periodontal disease. In general, higher serum levels of 25-hydroxyvitamin D (25(OH)D) are associated with improved oral health outcomes. ⁽⁹⁾

There is a general agreement on the necessity of Vitamin D for the normal development of the teeth. Malformation, particularly enamel hypoplasia has been described in the deficiency state by Lady May Mellanby (1934). It was reported that 74% of the hypoplastic teeth were affected by caries and 80% of normal teeth were non carious. This has been supported by Bibby (1943) and Carr (1953). Angew and associates in 1933, studied effects of Vitamin D in 350 children and found out a reduction in the dental caries increment. ⁽⁷⁾ The analysis of data from controlled clinical trials suggested that vitamin D is a promising caries-preventive agent. (Hujoel PP, 2013). ⁽¹⁰⁾ Children with S-ECC have lower vitamin D levels. Schroth RJ, 2012 ⁽¹¹⁾ High proportion of children below 5

years, presenting with dental caries, are deficient in vitamin D (Brown T et al. 2012).⁽¹²⁾ This study found that maternal prenatal 25-hydroxyvitamin D [25OHD] may have an influence on the primary dentition and the development of ECC (Schroth RJ, 2014).⁽¹³⁾ Prevalence of dental caries is high among children with vitamin D deficiency (Bener A, 2003).⁽¹⁴⁾ Children with S-ECC appear to be at significantly greater odds of having low vitamin D status compared to their caries-free controls (Schroth RJ, 2013).⁽⁹⁾ Higher maternal vitamin D intake during pregnancy may be associated with a lower risk of dental caries in children (Tanaka K, 2015).⁽¹⁵⁾ Vitamin D might be a protective factor for tooth loss. The effect might partially be mediated by its effect on periodontitis. (Zhan Y, 2014).⁽¹⁶⁾

Vitamin K: Vitamin K is naturally produced by the bacteria in the intestines, and plays an essential role in normal blood clotting, promoting bone health, and helping to produce proteins for blood, bones, and kidneys. Vitamin K has been tested as possible anticaries agent by virtue of its enzyme inhibiting activity in the carbohydrate degradation cycle.⁽⁸⁾

Vitamin K was found to prevent acid formation in incubated mixtures of glucose and saliva in In vitro studies. (Fosdick, 1942).⁽¹⁷⁾

The traditional theory of dental caries considers only the oral environment and does not recognize any significant role for the brain. A healthy tooth is nourished by a centrifugal fluid flow through the dentin. This is moderated by the hypothalamus/parotid axis which signals the endocrine portion of the parotid glands. High sugar intake creates an increase in reactive oxygen species and oxidative stress in the hypothalamus. When this signaling mechanism halts or reverses the dentinal fluid flow, it renders the tooth vulnerable to oral bacteria, which attach to the tooth surface. Acid produced by oral bacteria such as Strep Mutans and

lactobacillus de-mineralize the enamel and irritate the dentin. The acid attack stimulates an inflammatory response which results in dentin breakdown from the body's own matrix metalloproteinases. Vitamin K2 (K2) has been shown to have an antioxidant potential in the brain and may prove to be a potent way to preserve the endocrine controlled centrifugal dentinal fluid flow. Vitamin K2, such as that found in fermented cheese, improves salivary buffering through its influence on calcium and inorganic phosphates secreted. Data collected from several selected primitive cultures on the cusp of civilization demonstrated the difference in dental health due to diet. The primitive diet group had few carious lesions compared to the group which consumed a civilized diet high in sugar and refined carbohydrates. The primitives were able to include the fat soluble vitamins, specifically K2, in their diet.⁽¹⁸⁾

Vitamin B: Eight of the water-soluble vitamins are known as the vitamin B-complex group: thiamin (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), vitamin B6 (pyridoxine), folate (folic acid), vitamin B12, biotin and pantothenic acid. Vitamin B6 (pyridoxin) has been proposed as in anti caries agent by selectively altering the oral flora by promoting growth of non cariogenic organism which suppress the cariogenic forms .Slight to significant reduction in the caries increment of children and pregnant women have been reported following the use of pyridoxin containing lozenges after each meal.⁽⁸⁾ Evidence suggests that pyridoxine (vitamin B6) may exert a cariostatic effect by enhancing decarboxylation activity in dental plaque. (Bowen WH, 1994).⁽¹⁹⁾ Vitamin B12, riboflavin, biotin are individually significantly associated with caries incidence. The association of micronutrient intake with caries was weak, isolated and not clinically relevant. Micronutrient intake was not an indicator

of the presence or absence of caries (MacKeown JM, 2003).⁽²⁰⁾

Vitamin C: Deficiency is well recognized as producing severe changes in the periodontal tissue and pulps of the teeth.⁽⁸⁾ Vitamin C plays an important role in maintaining the integrity of the teeth and also as a non-enzymatic antioxidant defence system. Serum and salivary Vitamin C level decreases with increase in caries activity suggesting the powerful antioxidant property of vitamin C. Vitamin C acts by neutralizing the free radicals (Hegde MN et al, 2013).⁽²¹⁾ Vitamin C is essential for the formation and maturation of collagen, and for the integrity of connective and osteoid tissues, and dentine.⁽²²⁾

CONCLUSION

There have been many exciting advances in our understanding of the caries process that should be changing the way we practice dentistry on a daily basis. There is a need to help bridge the gap between existing and newly developing evidence and routine practice, to improve the continuing dissemination of new information, and to enhance communication between dental research and the practice of dentistry in order to accelerate the implementation of validated approaches for the diagnosis and management of dental caries. We have the responsibility as Dentists, Researchers, and Educators to use the best available evidence in the detection, assessment, management, and monitoring of caries lesions.

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How to cite this article: Vanishree T, Panchmal GS, Shenoy RP et al. Caries prevention: Vitamin way - A novel approach. *Int J Health Sci Res.* 2016; 6(1):484-488.

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