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Antioxidants and their vital significance in periodontal health

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ABSTRACT

Given that periodontitis is so common worldwide, there is growing interest in this condition. The disruption of the vital balance between the virulence factors generated by bacteria and the inflammatory host response leads to this inflammatory disease. Several attempts have been made before to treat this illness and restore periodontal health. The gold standard has been seen to be nonsurgical debridement, which targets the underlying cause. Nonetheless, studies have indicated that an unbalanced diet and dietary deficiencies may have an impact on the periodontium. Therefore, an effort toward the maintenance of optimal conditions, as well as the improvement of oral health, necessitates the introduction of adjunctive nutritional therapy, which can benefit the patients. Antioxidants in the diet have some remarkable benefits and valuable properties that play an irreplaceable role in the maintenance of periodontal health. These have emerged as excellent adjuncts that can enhance the outcomes of conventional periodontal therapy. The aim of this review article is to highlight some of these dietary antioxidants that can make a notable difference by striking a balance between health and disease.

1. Introduction

A common, long-term, inflammatory illness that affects the tissues that support teeth is called periodontitis. The illness is brought on by a particular kind of bacterium or a combination of germs, which ultimately results in the gradual degradation of the alveolar bone and periodontal ligament (PDL). An aberrant host response to the biofilm organisms appears to be necessary for the development of this devastating illness.[1] Although specific, primarily facultative or anaerobic Gram-negative bacteria within the subgingival biofilm are thought to be the primary etiological agent of the disease, most periodontal tissue destruction is thought to be caused by an inappropriate host response to those microorganisms and their products.[2,3]

It can lead to tooth loss, impaired masticatory function, changes in nutritional intake, and malnutrition if this improper host response is not addressed and the condition is not properly identified and treated. There are several risk variables that have been shown to alter the host response and shift the scales from health to illness. These variables may be divided into three categories: genetic, environmental (stress, bacterial challenge, etc.), and lifestyle/behavioral (smoking, exercise, poor diet, etc.).

Furthermore, a variety of systemic disorders, including diabetes, rheumatoid arthritis, and cardiovascular disease, have been linked to periodontal disease as a major risk factor. Thus, natural antioxidants as prospective adjuncts are now receiving more attention, given the importance of diet and the requirement to maintain appropriate antioxidant

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levels for the maintenance of periodontal health. These antioxidants are easily gained via our everyday food intake and are essential for maintaining an optimal level of health.[4]

2. Role of Key Nutrients in Periodontal Health

2.1. Carbohydrates

Consumption of sugar has long been known to be the primary cause of plaque development. Because sugars are fermented by bacteria and produce acid, which demineralizes the tooth structure, they are linked to dental caries and periodontal disease. One artificial sweetener that is used in place of regular sugars is xylitol, a sugar alcohol that is created when xylose sugar is hydrogenated. Against periodontal pathogens like Porphyromonas gingivalis and Aggregatibacter, it might have an antibacterial effect. Hence, a reduction of sugar intake, coupled with scaling, root planing, and the use of xylitol- and maltitol-containing gums, have the potential to improve the periodontal health of the general population.[5]

2.2. Vitamin C

It is discovered that vitamin C is in the aqueous phase and is a strong antioxidant radical scavenger. A severe periodontal disease known as "scorbutic gingivitis," or "scurvy," is brought on by a severe vitamin C shortage and is characterized by inflammatory gingivitis, fast periodontal pocket formation, and attachment loss. With its quick intestine absorption, ascorbic acid is an important nutrient.[6]

Certain cells, such as PMNLs, mononuclear cells, platelets, and endothelial cells, accumulate high concentrations of ascorbic acid.[7] PMNLs and macrophages contain vitamin C concentrations that are 10–40 times higher than those in the plasma. It has been thought that the high ascorbic acid levels in these cells contribute to their ability to respond to inflammatory stimuli and phagocytic ability of neutrophils.[8] Vogel and Wechsler reported that the everyday intake of vitamin C in a group of periodontitis patients studied was considerably less than that in the control group.[9] The daily recommended dietary allowance (RDA) for women was raised to 75 mg and for males to 90 mg. According to Levine et al., consuming 200 mg of vitamin C per day from a variety of fresh fruits and vegetables is the recommended consumption.[10]

2.3. Vitamin D

There is little data indicating a connection between periodontal health and vitamin D and calcium. According to certain research, people with osteoporosis experience a greater loss of periodontal bone.[11]

Due to its ability to suppress immune cell cytokine expression and induce the release of potently antibiotic-effecting molecules from monocytes and macrophages, vitamin D is recognized to be important for maintaining calcium and bone homeostasis as well as acting as an anti-inflammatory drug. It is true that a vitamin D deficiency may raise the risk of contracting infectious infections. Therefore, in addition to its direct effects on bone metabolism, vitamin D is helpful in the treatment of periodontitis.[12]

When it comes to vitamin D, the National Osteoporosis Foundation advises persons under 50 to take 400–800 IU of the vitamin once a day and those over 50 to take 800–1000 IU.[13]

2.4. Flavanoids

Polyphenolic substances are called flavonoids. Their functions include anti-tumor, anti-inflammatory, anti-allergic, antiplatelet, and antioxidant. Additionally, they exhibit bacterial collagenase inhibitory properties. It has also been demonstrated that flavonoids and vitamin C work synergistically.[14] Foods high in flavonoids can prevent blood vessels from rupturing or leaking. They also aid in preventing the body's excessive inflammation and shield cells from oxygen damage. Green tea, one of the most widely consumed drinks in the world, is the most well-known flavonoid. It contains up to 1 g of "catechins," which are flavonoids. Green tea catechins, including (-) epigallocatechin gallate, have been shown in a number of *in vitro* experiments to suppress periodontal pathogens and stop the degeneration of periodontal tissue. With 157 mg of flavonoids per day, tea was shown to be the most significant source, particularly for flavan-3-ols and flavonols. The majority of supplements available for sale have doses (daily) ranging from 30 to 200 mg, which is suitable for everyday maintenance.[15,16]

2.5. Carotenoids

Carotenoids are a group of pigments that occur naturally in the body and include alpha-, beta-, crytoxanthin, lutein, lycopene, and zeanxantin. They possess antioxidant properties and safeguard the vitamins C and E. Additionally, by scavenging reactive nitrogen species, they exhibit synergistic effects. The primary dietary source of provitamin A is β-carotene. Because of their profound effects on other antioxidants, carotenoids are regarded as essential components of antioxidant defense systems. In a homogeneous group of Western European men, Linden et al. evaluated the relationship between periodontal health and the serum levels of several antioxidants, such as carotenoids, retinol, and vitamin E. The authors observed that there was a higher prevalence of periodontitis in these patients who had low serum levels of several carotenoids, specifically β-cryptoxanthin and β-carotene.[17]

It has been discovered that lycopene is one of the most potent antioxidants among all the carotenoids. There is a correlation between congestive heart failure

risk and periodontitis, and in patients with periodontitis, high lycopene consumption considerably modifies this relationship. Additionally linked to malondialdehyde, a crucial indicator of oxidative stress, lycopene has been shown to dramatically lower stress levels. One of the main types of carotenoids is vitamin A. Each person's RDA for vitamin A is different.[18]

The recommended daily allowance (RDA) for babies is 400 μg for ages 0–6 months and 500 μg for ages 7–12 months. The RDA for children is 400 μg/day. The RDA for adult females is 700 μg/day, and for adult men, it is 900 μg/day. The recommended allowance for breastfeeding women is approximately 1300 μg/day, whereas for pregnant women, it is up to 770 μg/day.[19]

3. Role of Antioxidants in Periodontal Wound Healing

A few periodontal procedures may need wound healing, and food may help promote wound healing in addition to maintaining periodontal health. According to this research, patients may benefit from macronutrients such as docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA) and micronutrients like vitamins D and B. In comparison to patients with lower serum 25(OH)D levels, those on a vitamin D-rich diet (serum 25(OH)D > 50 nmol/L) before open-flap debridement surgery had higher clinical attachment levels and decreased probing depths after surgery. Furthermore, vitamin B complex (50 mg thiamine HCl, riboflavin, niacinamide, d-calcium pantothenate, pyridoxine HCl); 50 μg d-biotin cyanocobalamin; and 400 μg folate) was beneficial to patients following an access flap procedure.[20,21] Combining acetylsalicylic acid (81 mg) with fish oil (900 mg DHA and EPA) reduced probing depths in patients in need of curative treatment, increased clinical attachment, and decreased salivary levels of MMP-8 and receptor activator of nuclear factor kappa-B ligand (RANKL), two well-known indicators of inflammation. Acetylsalicylic acid (75 mg), DHA (900 mg), and EPA (450 mg) together showed a significant increase in clinical attachment levels, reductions in probing depth, and decreases in interleukin-1β found in the GCF in patients with a furcation defect necessitating a bone allograft.[22]

4. Conclusion

In conclusion, periodontitis is a slowly progressive chronic inflammatory disorder, which generally occurs in response to an imbalance between the antioxidant defense mechanisms and repair efforts by ROS. If this balance is tipped toward the increased generation of FRs, then there is cell damage and tissue destruction. Therefore, for the prevention of this tissue damage and maintenance of optimal oral health, sufficient antioxidant levels are to be present in the oral fluids. Many of these nutrients cannot be manufactured by the body, and therefore, they must be supplied in the diet.

Dietary antioxidants play a vital role in the maintenance of oral health and have a potential to influence periodontal disease management, which positively affects clinical outcomes. A strong association exists between periodontal health and antioxidants, both of which have an inverse interrelationship. Thus, obtaining enough antioxidants through our diet to promote healthier tissues is essential to reduce the unwanted effects of these FRs. This explains the indispensable role of dietary antioxidants in periodontal health.

5. Source of Funding

None.

6. Conflict of Interest

None.

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