



## Vitamin A and Oral Health: A Review

### KEYWORDS

enamel hypoplasia, vitamin A, xerostomia

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**ABSTRACT** *The word vitamin means vital amine. Vitamin A is one of the earliest vitamins discovered and is an essential part of the nutrients. Deficiency of Vitamin A causes night blindness, xerophthalmia, keratoconjunctivitis, enamel hypoplasia, xerostomia, gingivitis, periodontitis and irregular dentinal tubular formation. Excess intake of Vitamin A results in angular cheilitis. Evidence is generating regarding the use of this vital nutrient in acute promyelocytic leukemia, oral leukoplakia and oral submucous fibrosis. This essential component must be routinely supplemented in the diet.*

### Introduction

The good nutritional health promotes good oral health (encompassing gingival tissue status, the well-being of teeth and jaws, salivary quantity and quality and pain). On the other hand, poor nutritional status is associated with poor oral health and vice versa. Poor oral health can affect nutritional quality and intake in a manner that potentially increases the risk of several systemic diseases.[1] Tooth loss can result in chewing difficulties. Reduced chewing ability affects food selection which in turn can influence the nutritional status. Pain resulting from caries, advanced periodontal disease, soft tissue lesions or poorly fitting prosthesis may affect the nutritional status. Most studies relating tooth loss and nutrition suggest that nutrient intake deteriorates in quality with fewer teeth.[2] Research indicates that loss of natural teeth causes reduced masticatory efficiency even after replacement with dentures. Among community-dwelling older adults, complete tooth loss may contribute to weight loss as chewing difficulty or discomfort due to poorly fitting dentures can lead to diminished nutrient intake. It has also been reported that denture-wearing individuals consume more refined carbohydrates and dietary cholesterol than individuals with natural dentition. Such detrimental changes in food choices may, in turn, increase the risk of certain systemic disorders. Factors affecting nutritional intake include the general health status of the individual, use of alcohol, drugs and medications and adverse habits like smoking. Ample evidence has been presented here to show that nutrition affects oral well-being and vice versa.

Vitamin is an organic substance that occurs in food in small amounts and is necessary for the normal metabolic functioning of the body. Vitamin A is the first fat soluble vitamin recognized. The precursor of Vitamin A is beta carotene which is basically derived from plants.

### Absorption and Bioavailability

Seventy to ninety percent of vitamin A from the diet is absorbed in the intestine. The efficiency of absorption for vitamin A continues to be high (60-80%) as intake continues to increase. Greater than 90% of the retinol store within the body enters as retinyl esters that are subsequently found within the lipid portion of the chylomicron.[3] The maximum absorption of Vitamin A occurs two to six hours after digestion. Within the intestinal lumen the vitamin is incorporated into a micelle and absorbed across the brush border into the intestinal luminal cells. Within the cells, precursors of vita-

min A i.e. beta carotene and other carotenoids are converted from inactive form to its active form. These active products and additional precursors are then packaged into chylomicrons and readied for transport throughout the body.

### Transport

After leaving the intestinal luminal cells, chylomicrons, which carry retinyl esters, carotenoids and unesterified retinol along with triglycerides, are carried first through the lymphatic system and then through the general circulation. Upon reaching extra-hepatic tissues, chylomicrons release triglycerides; however Vitamin A is retained within the chylomicrons which become chylomicron remnants after releasing triglycerides. The chylomicron remnant then travels back to the liver where it is taken up and further stored or metabolized. Whenever required, retinol is transported from the liver and requires the use of a carrier for transport through the blood. Retinol-binding protein (RBP) is the specific carrier used to transport all-trans retinol in the plasma. This specific carrier is manufactured and secreted by the parenchymal cells of the liver. Each molecule of retinol released binds equivocally with RBP to form holo-RBP. This compound is then attached to a molecule of transthyretin (TTR), formerly known as prealbumin. This newly formed retinol-RBP-TTR complex is not filtered by the kidney, but instead it freely circulates throughout the plasma. Retinol is taken up by the tissues via cellular retinoid-binding protein. Retinoic acid is believed to be manufactured by the cells as per the requirements of the body. Hence, the transport of retinoic acid is not substantial but instead, the cells possess intra-cellular proteins that regulate the amount of retinoic acid produced.

### Storage

Approximately 50 to 85% of the total body retinol is stored in the liver when vitamin A status is adequate. Retinol returning to the liver is re-esterified before storage. Because of this, over 90% of the retinol is stored as retinyl esters. The retinol is stored in star shaped hepatic cells along with droplets of lipid. Thus constitutes the fat-soluble property of vitamin A.[4] With increase in retinol levels, the size of hepatic cells increases. When threshold level is reached, the hepatic cells get saturated with retinol and hypervitaminosis results. The precursor to vitamin A, beta-carotene, can be stored in fat cells of the body. The side effect of excess beta-carotene is the yellowing of the skin. Serum levels of beta-carotene gives an indication of recent intake and not body stores.

The kidneys are the main paths of RBP and retinol excretion mainly via renal catabolism and glomerular filtration. Those persons suffering from renal disease often experience elevated serum levels of RBP and retinol and therefore must be more aware of vitamin A toxicity.

#### Vitamin A Deficiency

The major etiological factors for Vitamin A deficiency include inadequate intake, disorders of digestion, defective absorption and alteration in metabolism and increased metabolic demands. Vitamin A deficiency results in night blindness, epithelial proliferation and maturation defects, hyperkeratotic white patches, xerostomia, gingivitis, periodontitis, tooth morphogenesis defects, decreased odontoblast differentiation, enamel hypoplasia.[5] Retinol deficiency can reduce mucin production which leads to compromised salivary flow leading to weakened tooth integrity and marked increase in risk for caries. Vitamin A deficiency also leads to irregular tubular dentin formation and decreased taste sensitivity.

Vitamin A deficiency is diagnosed mainly clinically, by checking blood Vitamin A levels and by seeing the response to replacement therapy. The intake of retinol palmitate, 30 mg peroral for two days and treatment should encompass treatment of associated malnutrition and super added infections.

#### Role of Vitamin A

Vitamin A plays an important role in vision, immune defenses, maintenance of body linings and skin, bone growth, normal cell development, reproduction, keeps mucous forming cells from becoming keratinized, allows for differentiation of cells, stimulates osteoclasts. Vitamin A toxicity results in angular cheilitis, hair loss, joint pain, stunted growth, bone and muscle soreness, nausea, diarrhea, rashes, enlargement of liver and spleen, appetite loss, growth failure and itching of the skin.

Safety and effectiveness have not always been proven. So, these conditions must be evaluated by a qualified health care provider. In acute promyelocytic leukemia, the prescription drugs all trans- retinoic acid is a Vitamin A derivative that is an established treatment for acute promyelocytic leukemia and it improves median survival in this condition. Strict medical supervision is advised for these cases. Vitamin A should not be supplemented with all trans- retinoic acid due to risk of increased toxicity. In anemia, Vitamin A deficiency leads to lack of mobilization of iron, impair red blood cell forma-

tion and increase susceptibility to infection. There is evidence that Vitamin A has been shown to raise haemoglobin levels and serum iron concentration particularly in children and pregnant women. There is evidence that Vitamin A enhances the efficacy of iron supplementation in patients with Vitamin A deficiency and iron deficiency anaemia. Retinol is teratogenic; the incidence of birth defects in infants is high with vitamin A.

#### Vitamin A in Oral Health

Vitamin A plays an important role in measles, oral leukoplakia, oral submucous fibrosis, growth promotion and wound healing in oral cavity. It is also important for immune defenses, maintenance of oral cavity linings, bone growth, normal cell development, keeps mucous forming cells from becoming keratinized, allows for differentiation of cells, stimulates osteoclasts and permits normal tooth spacing.[6] Teeth are made from protein matrix that is mineralized with collagen, calcium and phosphorus (requires Vitamin A and D). Synthesis of glycoproteins such as mucin is also a function of Vitamin A.

#### Current Dietary Reference Intakes (DRI)

The Recommended Dietary Allowance (RDA) established in 1980 for vitamin A was set at 800 ug retinol equivalent (RE) for adult women and 1000 ug (1mg) retinol equivalent (RE) for adult men. It should be noted that 1 RE of vitamin A is equal to 3.33 IU of the vitamin. The levels (RDA) were not changed in 1989 when the RDAs were revised. The RDA has also been based on the amount needed to raise the plasma vitamin A levels to normal in depleted subjects.[7] Dietary Reference Intakes (DRI) was developed to replace the RDA in 2000. For vitamins, the DRI was not established. The absence of a safe upper limit plus the numerous carotenoids has led the National Academy of Sciences to not establish a DRI at this time. The RDA is the current dietary guideline being used in place of the DRI. For men the RDA is 1000 mg of retinol equivalents (RE) and for women the RDA is 800mg of retinol equivalents.

#### Conclusion

Vitamin A is required for the oral health and the general health of the body in totality and be provided in the diet. Regular monitoring for the deficiency symptoms must be done. Vitamin A supplements are to be included in the diet in case the need arises.

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