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REVIEW PAPER

# Role of Nutrition in Orthodontics: A Review

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**ABSTRACT**

*Nutrition plays an important role in the development of dental and related structures from the fetal stage to maturation. The importance of diet and nutrition has been recognized in health and disease for ages. More so, the history of mankind has been to a large extent a struggle to obtain food. With the recognition of proteins, carbohydrates and fats as energy yielding foods and the discovery of vitamins and minerals, great advances have been made in the knowledge of nutrition and its practical application. Proper nutritional status of the orthodontic patient is important, since success is dependent on the response of skeletal, dental and soft tissues for the accomplishment of the desired results. In this review article, we will discuss about some of the important factors essential in the growth and development of the jaws, which has an influencing effect on orthodontic treatment of a patient.*

***Keywords**: Diet, nutrition, orthodontics*

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## INTRODUCTION

Adequate nutrition is important for proper body growth, its development and maintenance. Nutritional imbalances affect the normal growth and development of the individual directly or indirectly. Deficiencies resulting during the formative stages of an organ results in a more severe and irreversible damage, which follows the general rule that earlier the deficiency greater is the damage. Poor nutrition reduces the resistance of the tissues to infections and increases the length of healing period after surgery or an injury.

The proper nutritional status of the patient is of utmost importance in orthodontic treatment, since success depends on the response of bone to stimulation and reformation for the accomplishment of desired results. Only when we begin to understand these vital nutrients and the role-played by each one in the normal development of orofacial region and the body as a whole can we realize its relevance in clinical application. This will facilitate a comprehensive approach to orthodontic treatment as a whole.

## NUTRITION IN GROWTH AND DEVELOPMENT

Nutrition plays a vital role in the growth and development of an individual. Development is a process, which commences at conception and continues through birth until death. The perceptible visible evidences of developmental changes are growth.

Guilford[1] in 1874 was amongst the first to advocate dietary deficiencies as an underlying cause of dentofacial irregularities. Important relationship exists between diet and development, which can be seen during the nutrition of the foetus; placenta is the provider of the essential

nutrient substrates and fetal tissue synthesizes its own proteins and nucleic acids. Therefore, interferences with substrate availability results in decreased protein metabolic activity.

Although Cohen[2] suggested that some human dental deformities may be the result of allergy but Pottenger[3] has shown that allergic manifestations and dental disturbances comparable to those seen in human beings result from changes in food preparation.

Miller[4] suggested that "critical periods" exist during the development of an organ and that stress imposed by the nutritional imbalance during critical periods can result in irreversible changes. Critical periods are defined as that time in the development of an organ system, which is marked, by the rapid synthesis and accretion of protein. The critical period roughly equates with the intense hyperplastic growth phase. If imbalance occurs during hyperplastic phase then it causes irreversible damage to the tissues. If it occurs during hypertrophic phase then the growth may stop temporarily but will catch up later when adequate amounts of missing nutrients become available. Dietary deficiencies of essential nutrients during the critical periods of growth have caused retardation of growth and morphologic alterations of the orofacial area in both humans and animals.[5]

Malnutrition has been associated with shorter mandibles in the anteroposterior dimension, marked reduction in the ascending ramus, condylar region and the setting of the premolars; dentoalveolar inclination in the incisor region and reduction in the mesio-distal dimension of the third molars.

## EFFECT ON BONES

It is important to point out that a growing bone is different from a matured bone in its response to the environment. Any nutritional deficiency occurring during the active growth can be disastrous. Vitamin A deficiency, which frequently accompanies protein calorie malnutrition, may result in inadequate bone growth patterns with concomitant misalignment and malocclusion of the teeth. An excess of vitamin A during the critical growth period markedly inhibits the neural crest cell development and upsets the normal balance between bone formation and resorption. Increased Vitamin A also causes softening of the skull due to decrease in calcium deposition.

Calcium, Vitamin D and phosphorus are essential for the formation of bones and teeth. Deficiencies of these nutrients cause retarded jaw, teeth and condyle development.

Deficiency of Vitamin D causes rickets, maxillary dysplasia, and susceptibility to muscular traction. Facial sutures close with difficulty leading to open bite, transverse hypo dimension and misshapen palate.[2, 3, 11, 12, 13]

### *Cleft lip and palate*

World's most common birth defect is the cleft lip and cleft palate (1 in 900 births). A variety of nutrient deprivation or excess as well as teratogenic agents can produce a very high incidence of this congenital anomaly, as palatal tissues are very susceptible to environmental changes (**Figure 1**).

During palatal development a number of macromolecules increase during the critical stages of palatal fusion like glycoprotein, enzymes, actin and mucopolysaccharides. If these are not supplied in the required amounts due to nutritional deficiency then will lead to the anomaly. Studies suggest that an excess of vitamin A during this phase may lead to cleft palate formation.[2,3,6]

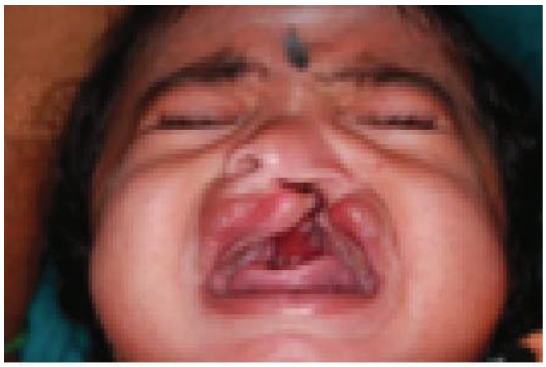

**Figure 1** Unilateral CLCP patient

Singh and Chawla conducted a study on the contribution of diet in malocclusion in north Indian population. They stated that occasional or no consumption of coarse and fibrous food had a positive influence on the incidence of class II div 1 and skeletal type of malocclusions.[6]

The diets of rural populations, which usually contain an abundance of raw vegetables, offer adequate muscular stimulation and hence suffer from orthodontic problems. It thus appears that these changes to softer food caused unfavorable changes in muscle tone and a tendency for skeletal and dental problems to develop.

## EFFECTS OF NUTRITION ON TEETH AND SALIVARY GLANDS

Teeth and salivary glands enter into hypertrophic and hyperplastic growth phases, critical periods do exist in the development of the teeth, salivary glands during which time and imposed stress (nutritional imbalance) will lead to irreversible changes in these tissues. Therefore a variety of amino acids, vitamin A, D and C, calcium and phosphorus must be present to ensure optimal calcification during the teeth formation and calcifying periods.

Fluorides do not cross the placental barrier in sufficient amounts to provide optimal incorporation into tooth enamel crystal and therefore strengthen the tooth against carious challenge. Deficiency of essential nutrients results in the following effects on teeth.

Hypoplasia is due to defective formation of the organic matrix during the formative stage. Hypocalcification is due to defective mineralization of the organic matrix (**Figure 2, 3**). Other defects include: abnormal shapes, sizes and location of teeth, e.g., peg laterals, increased susceptibility to caries due to poor calcification of teeth resulting in enamel solubility.

**Figure 2** Enamel Hypocalcification

**Figure 3** Enamel defects

## DIET

Diet affects teeth in 2 distinct ways. One is the local effect and depends on the intra oral chemical or physical action on the external surfaces of the teeth. The other is the systemic nutritional factor, which is important during the period of tooth development.

**Effects of carbohydrates, proteins and fats on dental caries:**

## CARBOHYDRATES

They have been demonstrated to be important etiologic agents in dental caries. Immediately following the bathing of the teeth with carbohydrates there is a drop in pH of the plaque, the return of the tooth plaque to its original base line pH is rather slow, about an hour. This drop in pH is indicative of acid production and most investigators conclude that bacterially produced acids are a major factor in the production of incipient carious lesions. Carbohydrates associated with formation of dental caries must:

- Be present in the diet in meaningful quantities.
- Be cleared slowly or ingested frequently.
- Be readily fermented by cariogenic bacteria.

## PROTEINS

Although it is a well known fact that carnivorous animals rarely develop tooth decay and that persons ingesting high protein diet have no particular susceptibility to dental caries, it is too early to assess the importance of this finding in terms of dental caries etiology. However, it does point out to the possibility that under certain conditions modifications of the constituent's dietary proteins may affect caries initiation.

## FATS

Dietary fats have a limited influence on dental caries. Experiments with animals suggest that the inhibition mechanism is a local one, very possibly associated with an oil film on the tooth surface, thus altering the surface properties of the enamel and possible interference with the metabolism of oral micro organisms.

## DEMINERALIZATION

A common concern in orthodontics is the potential development of decalcification, caries and periodontal problems. These problems can be associated with bonds or bands when combined with an improper diet involving unregulated sugar consumption and inadequate oral hygiene.

The relationship between dental caries and the ingestion of fermentable carbohydrates has been known for a long time. Many foods contain substances called buffers that neutralize any acids formed for, e.g., Calcium from milk or protein from meat can neutralize or absorb acids.

**NUTRITIONAL INFLUENCE ON PERIODONTIUM**

Majority of the research findings on the effects of nutrition on oral and periodontal tissues point to the following:

1. There are nutritional deficiencies that produce changes in the oral cavity; these changes include alterations of the lips, oral mucosa, bone as well as the periodontal tissues.
2. There are no nutritional deficiencies that cause gingivitis or periodontal pocket.

There are however, nutritional deficiencies that can aggravate the injurious effects of the local irritants on the periodontium.

***Physical character of diet***

Soft diet leads to plaque and calculus formation whereas hard and fibrous food provide surface cleansing action and stimulation, which leads to decreased plaque and gingivitis.

Chewing of fibrous foods doesn't increase gingival keratinisaton as believed, but it produces a type of oral muscular activity or physiotherapy that can have a beneficial stimulatory effect on strengthening the periodontal ligament and increasing the density of the alveolar bone.[7, 8, 9]

***Effect of vitamin deficiency on periodontium***

1. **Vitamin A** deficiency leads to keratinizing metaplasia of the epithelium, increased susceptibility to infection and disturbances in bone growth, shape and texture. Animal experiments suggest that vitamin A deficiency may predispose to periodontal disease.
2. **Vitamin B** deficiency leads to gingivitis, glossitis and glossodynia, angular chelitis and inflammation of the oral mucosa. Folic acid deficient animals present necrosis of the gingival, periodontal ligament and alveolar bone without inflammation. The absence of inflammation is the result of deficiency-induced granulocytopenia.
3. **Vitamin C** deficiency leads to scurvy. It has been suggested that ascorbic acid may play a role in periodontal disease by one of the following mechanisms:
   a) Low levels of ascorbic acid influence the metabolism of collagen within the periodontium, thereby affecting the ability of the tissue to regenerate and repair itself.
   b) Vitamin C deficiency interferes with bone formation and remodeling of the periodontal bone
   c) Its deficiency may aggravate the gingival response to plaque and worsen the edema, enlargement and bleeding

Mc Canlies et al studied the effect of vitamin C on the mobility of pig incisors under orthodontic forces and observed increased osteoclastic activity and large resorption lacunae in pigs with decreased or no vitamin C in diet.[15]

4. **Vitamin D** is essential for the absorption of calcium, for the maintenance of Ca and PO4 balance and for the formation of teeth and bones. Its deficiency is characterized by the osteoporosis of alveolar bone and cemental resorption.

***Effect of Orthodontic treatment on nutrient intake***

Diet can affect the periodontal health, oral microbial composition; wound healing, protein synthesis, growth and I.Q. But when a person is undergoing orthodontic treatment, his or her dietary requirements and habits change which should be kept in mind before commencing the treatment.

The diet of adolescent patients becomes more important because moving teeth creates an increased nutrient demand. Physical, physiological and emotional stresses caused by orthodontic treatment sets in motion hormonal reactions that increase nutrient mobilization and utilization. This raises the nutritional requirement of the patient. Maintenance of diet is especially important to prevent infection, promote growth and development and allow the healing of periodontal tissues during treatment.

Giordan (1997) studied the effect of orthodontic treatment on nutritional intake of the patient and concluded that there was a significant decrease in the fibre content of diet and higher fat and low carbohydrate soft food consumption.[9]

Strause and Saltzmann[10] also concluded that there was a decrease in the Mn and Cu intakes during orthodontic treatment, which may lead to decreased bone remodeling.

## NUTRITIONAL CONSIDERATION IN ORTHODONTIC TOOTH MOVEMENT

Tooth movement involves biologic responses to orthodontic forces, which may be influenced by ascorbic acid. 17-72% of orthodontic patients are deficient in Vitamin C. Lack of Vitamin C interferes with collagen synthesis thus affecting both periodontal ligament and the formation of osteoid. Animal studies have shown that Vitamin C deficiency causes enlarged endosteal spaces with osteoclasts, uneven periosteal surfaces with osteoclastic activity. [12, 13, 14, 15,16]

Vitamin C deficiency also affects the stability of orthodontic correction, i.e., it affects retention. This has been confirmed from experiments on guinea pig incisors, where the Vitamin C deficient group experienced more relapse.

## CONCLUSION

The oral cavity and the contiguous structures of the craniofacial complex provide an excellent barometer for the patient's health status. However, since orthodontists are mechanically oriented it is difficult to maintain a biologic perspective and to continue to think in terms of the biologic process. Therefore, the need arises for the orthodontist to contribute towards a holistic approach of treatment becoming conscious of the patient as a whole. The main objective of orthodontist should not only include esthetic harmony.

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