

# Nutrition and Its Imbalance and Effects on Developing Oral Tissues

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## INTRODUCTION

Nutrition plays an important role in development of dental and related structures from the fetal stage to the maturation. The Impact of various malnutritions and denterious effects in the field of dentistry are studied and illustrated below.

## NUTRIENT IMBALANCE ON DEVELOPING ORAL TISSUES

### MATERNAL DIET AND CRANIOFACIAL DEVELOPMENT ESPECIALLY LIP AND PALATE

Maternal diet affects the child in later part of antenatal life rather during the early weeks when organogenesis is proceeding.

Maternal dietary deficiency, experienced for a brief time during a critical period in pregnancy, results in some biochemical alterations followed by morphological changes.

Cleft lip and/or Palate—one of most common birth defects (1 in every 800 births).

Animal studies and experiments clearly indicate a variety of nutrient deprivations or excesses, as well and teratogenic agents responsible for this congenital anomaly.

- Deficiency of folic acid, riboflavin and zinc are known to induce clefting.
- Suboptimal levels nutrients may potentiate other teratogenic agents.
- Excessive intake of Vitamin A can act as a teratogen.
- Other teratogenic agents consumed by the mother during the critical period of lip and palate formation eg; excessive alcohol, nicotine, epileptic drugs like phenytoin.

Evans, Nelson and Asling found that deficiencies of folic acid and biotin in the expectant mothers caused cleft palate and general growth retardation.

Van Creveld associated cleft palate, micrognathia and other congenital malformations to extremely deficient maternal diet during pregnancy.

Wakarny, experimenting on animals, repeatedly induced syndactylism, brachydactylism, cleft palate, congenital abnormalities of dentofacial development and occlusion, shortening of the mandible when maternal diet was deficient of riboflavin.

Iodine deficiency in the mother's diet causes cretinism in the offspring.

Therefore the diet and nutritional demand of a pregnant and lactating mother should be given considerable importance not only to safeguard the mother but also the child.

### 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 insure 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 – due to defective formation of the organic matrix during the formative stage

Hypocalcification – due to defective mineralisation of the organic matrix.

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.

Irreversible changes in salivary glands - may alter the salivary composition, in terms of amounts of saliva produced and its self-cleaning properties on oral structure and immunity due to changes in antibodies, with resulting colonization of cariogenic micro flora.

### Oral Epithelium

The Oral epithelium exhibits a rapid rate of turnover. The non keratinised stratified squamous epithelium of the gingival sulcus has one of the fastest tumor rates in the body with the cell population completely renewing itself in 3 to 7 days therefore its is in state of "continuous critical period. Therefore nutritional deficiency may affect obligatory DNA synthesis in the sulcular epithelial tissues and compromise an important component of its defense mechanism of the periodontal tissues.

### Skeletal Tissues

Development of bone occurs in two stages;

- The formation of an organic matrix, followed by
- The deposition of inorganic minerals into the organic matrix.

The early years from birth to childhood are "critical periods" for bone growth, since it is the for hyperplastic bone formation. The remodelling process of mature bone in response to the environment is hypertrophic growth of bone. Nutritional deficiency during the active growth phase, when the hyperplastic stage prevails can have severe irreversible effects.

Optimal growth and development of maxillary and mandibular bone is necessary to maintain a harmonious dental arch. Environmental factors can adversely effect tooth eruption, alignment and alveolar bone integrity.

Guilford advanced that dietary deficiencies cause dentofacial irregularities. Wolbach and Howe indicated that lack of vitamins C and D, may be causative factors in malocclusion by arresting growth of the maxilla and mandible.

Protein caloric malnutrition, vitamin A, D, E and C deficiencies, along with deficiency of mineral calcium phosphorus may result in inadequate bone growth patterns with malalignment and malocclusion.

Nutrition and Skeletal maturation: Prolonged nutritive failure in growing children shows a retarding influence on each of the 28 bone centers in the hand and the wrist which are used indicators of skeletal maturation. Correction of the dietary deficiencies of the bone forming nutrients brings acceleration in the overall rate of skeletal maturation but does not equally affect all bone centers.

### Role of Lipids in Orthodontic Tooth Movement

Dietary lipids contain two types of polyunsaturated fatty acids essential to the human body. The n-6 and n-3 series are derived from linoleic and alpha-linolenic acids,

respectively. The n-6 fatty acids produce arachidonic acid, which is released from cell membrane phospholipids mainly by the action of phospholipase A2. Arachidonic acid can be converted to series 2 prostaglandins (PGs) or series 4 leukotrienes (LTs) by the cyclooxygenase or lipoxygenase pathways.

Orthodontic tooth movement is accompanied by the appearance of osteoclasts and subsequent alveolar bone resorption, which is mediated through the local production and action of PGS. Inhibitors of PG synthesis; NSAIDs, inhibit the appearance of osteoclasts and reduce the rate of tooth movement. Dietary n-3 fatty acids have actions similar to those of NSAIDs, and the intake of dietary lipids affect bone remodeling and subsequent orthodontic tooth movement. The number of osteoclasts and the degree of bone resorption on the pressure side during tooth movement

### NUTRITIONAL CONSIDERATIONS IN THE ORTHOGNATHIC SURGICAL PATIENT:

Post operatively the ortho-surgical patient is confronted with increased nutritional requirements and difficulty in adequate nutrition intake. Suboptimal levels of some nutrients could result in decreased resistance to infection as well as delayed soft and hard tissue repair.

The focus at the time of surgery should be on achieving optimal nutritional status for optimal host response rather than on preventing classic deficiency syndromes because of the elective timing of the surgery.

In the postoperative patient the metabolic responses to the surgery can increase the caloric requirements by 50% or more. The caloric requirements should be met by sources other than proteins, since proteins being essential to the regulation of osmotic pressure, lipid transport, formation of antibodies and repair of injured tissue are a potential source of energy.

\*A high caloric diet, high in carbohydrates is instituted few days preoperatively, so that liver glycogen stores and possibly spare proteins will be increased for a short time post operatively, when caloric requirements are high and patient is not able to eat an adequate diet.

\*The protein intake should be increased during convalescence and not post operatively and hence while the normal requirement for protein is about 65 gm/day it should be raised to approximately 150gm/day during convalescence.

\*Vitamin A, is important for all differentiation and protein synthesis and is important for tissue repair.

\*Vitamin C, is required for collagen synthesis and for soft and hard tissue healing.

\*Vitamin D and Calcium are essential for the repair of fractures and hard tissue healing line is among the trace elements that is required for tissue healing.

\*Supplements of the Vitamins and zinc are shown to increase healing response in patients who undergo oral surgery.

### Allergies to Dietary Constituents

Often dietary substances act as allergens and sensitise the human immune system resulting in hypersensitivity reaction. Such allergies can cause allergic rhinitis leading to oral breathing, which can affect the growth and development of maxillary and mandibular dental arches and the skeletal bases often irreversibly also called long face syndrome. Common allergens include cows milk, used in processed infant foods, wheat and wheat products, fish, egg etc.

### VITAMIN C

Scurvy was a disease that affected English sailors, who knew the disease could be prevented taking fresh limejuice. Szent-Gyorgi in 1928 isolated a substance from adrenal gland called hexuronic acid, which was later identified by Waugh and King as Vitamin C.

Chemistry: Ascorbic acid is a white crystalline substance with a very acidic taste.

Sources: Fresh green vegetables, salad vegetables eg; cabbage, lettuce, spinach, citrus fruits eg; lemons and oranges, berries and melons. Gooseberry is one of the richest sources of vitamin.

Metabolism: It is rapidly absorbed from the gastrointestinal tract and with very little storage. It is excreted in urine.

### Daily requirements

Average requirements of 50 mg/day. 30mg/day for infants and 70mg/day in adults.

### Functions

1. Maintains the redox potentials of the cell. Plays role of coenzyme in Hydrogen transfer reactions.
2. Collagen Synthesis: formation of hydroxyproline by hydroxylation of proline, which is an important amino acid in collagen.
3. Tyrosine metabolism: P-hydroxy phenylacetic acid conversion to homogentisic acid.
4. Absorption of Iron: for conversion of inorganic ferric iron to ferrous iron.
5. Functioning of the adrenal cortex.

### Deficiency

produces Scurvy, characterized by failure to deposit intercellular matrix. Therefore the capillaries are fragile, increasing tendency for hemorrhage and delayed wound healing. Osteoid of bone is of a poor quality resulting in hypomineralization of bone. Pseudoarthrosis and subperiosteal haematomas occur as a result of hemorrhages. Oral manifestations: The gums are spongy and swollen and bleed at the slightest provocation. The dentin and enamel formed at the time of deficiency is hypomineralised.

### Diagnosis

Tourniquet test to demonstrate petechial hemorrhages.

### CONCLUSIONS

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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