

Preventive Dentistry
5th - Year- Dental Students
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Lec. 16: Nutrition and Oral Health

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A well-balanced, nutritious diet is important for general as well as oral health. Nutrient food supplies the body, bones, teeth and periodontium with what they need to renew tissues and to protect from infection and disease.

Good nutrition was shown to have a role in preventing both dental caries and periodontal disease. ***Nutrition*** is the process of providing or obtaining the food necessary for health and growth. Foods contain chemical substances (; **nutrients**) that varies according to their functions:

- ***Energy giving nutrients***: give energy for all types of body activities as (rice, wheat, corn, fats and oil, sugar, honey and starchy vegetables (; potato).
- ***Body – building nutrients***; to sustain growth, as milk, eggs, fish, meat, some vegetables as beans and nuts.
- ***Protective nutrients***; to protect from disease, as leafy vegetables and fruits.

Pre- eruptive effect of Nutrition on Teeth:

Observational as well as animal studies indicate the relationship of nutrition during tooth development to morphology and histological structure of teeth, chemical composition, eruption time, and to proneness caries.

- ***Morphology of teeth***: genetics is the primary determinant factor for the morphology of teeth, however, there are reports linking between dietary protein, fat and carbohydrate and tooth morphology. Fluoride intake during the period of tooth formation may affect tooth morphology changing the risk factor to dental caries.
- ***Histological and chemical composition of teeth***: nutrition may affect tooth quality during the periods of (enamel matrix formation) and (maturation). Diet rich with calcium, phosphorous taken during periods

of tooth developments greatly improve crystallinity of teeth. The deficiency in Vitamin D (essential for calcium metabolism) was reported to impair enamel matrix and result in hypoplastic teeth. This was first reported by **Lady May Mellanby (1920 -1930)** as conclusions of her studies: (the deficiency of vitamin D, calcium and phosphorous may lead to development of hypoplasia of teeth).

Enamel defects may develop also in presence of mal nutrition or deficiency of proteins, vitamin A and C and elements (; Zn and iron). These all may increase the risk to dental caries. As poor crystallinity and mineralization of teeth will increase the solubility of teeth in presence of acid attack, leading to dental caries. Fluoride taken in the pre- eruptive stage will improve crystallinity of teeth and reduce risk to dental caries.

The increase in carbonate level in teeth was reported to increase risk to dental caries, thus diet rich with sugar given during the period tooth development (for primary teeth in the intra- uterine life, for permanent teeth in the first years of life) may increase carbonate content decreasing resistant to dental caries.

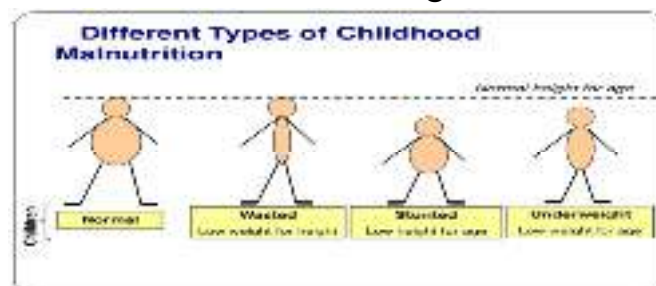
- ***Eruption time***: Delay in the eruption time of both primary and permanent teeth was reported among malnourished children. On the contrast, an earlier eruption of teeth was seen among over-weight children.

Malnutrition and Dental Health:

Malnutrition refers to deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients. The term malnutrition covers two broad groups of conditions:

- 1- Under nutrition; which includes ***stunting*** (low height for age), ***wasting*** (low weight for height), ***underweight*** (low weight for age).
- 2- Micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals).

Obesity on the other hand refers to over- weight.



Mal nutrition may increase susceptibility to dental caries by affecting:

- 1- Tooth: deficiency in essential elements (Ca, PO₄, Zn, Fe), vitamins (D, A, C), proteins was reported to increase susceptibility to dental caries. Further deficiency in protein energy may affect tooth quality. (; Protein energy: utilization of amino acid a source of energy in there is insufficient fat or carbohydrate).
- 2- Saliva: Quality (composition) of saliva was reported to be affected by diet. Food rich in fat and protein may improve the buffer capacity of saliva, increasing resistance against dental caries, as where diet rich with sugar decrease plaque and salivary pH, and increasing risk to dental caries.

Malnutrition may affect the oral immune system, a reduction in non- specific immune factors was reported in cases of malnourishments as lysozyme, statherins, lactoferrin.

- 3- Salivary glands: malnutrition may cause impairment in the development of salivary glands affecting the salivary flow rate. Reduction in secretion of saliva affects its cleansing activity, buffer capacity and oral immune system.

Note: Protein deficiency cause **kwashiorkor**, delayed eruption of teeth, hypoplasia and retarded cementum deposition, decreased salivary rate, increase caries susceptibility. Vitamin A deficiency causes atrophy of salivary gland, enamel hypoplasia, reduce salivary flow.

Food and Periodontal health:

Periodontitis is a ubiquitous disease with high prevalence in adults. It is influenced by a number of factors, dental plaque biofilm that is formed by bacteria and toxins is the primary etiology. Other factors however are present contributing to periodontal diseases as genetic factors, systemic health (as diabetes), in addition to nutrition.

Diet and Periodontitis: The local effect of diet on the integrity of periodontium is through:

- 1- Relation to plaque formation: Diet high in fermentable carbohydrates has been established as the major contributing factor in plaque formation. Dental plaque is the major etiological factor for both dental caries and periodontal disease. Frequent sweet consumption may

provide a substrate for bacteria, thus supragingival plaque formation. On the other hand, sugar substitutes as xylitol, may have an antibacterial effect against periodontal pathogens such as Porphyromonas gingivalis and Aggregatibacter actinomycetemcomitans. Thus proper oral hygiene measures and reduction of sugar intake may reduce the risk of gingival inflammation.

- 2- Physical consistency: Chewing fibrous food is able to stimulate salivary flow rate, thus clearance of both carbohydrate, food debris and bacteria from oral cavity. Fibrous food may also act as a massage or a local exercise for the gingiva and at the same time strengthen the periodontal ligaments and increasing density of alveolar bone.

Note: Fibrous food does not remove plaque at the gingival level of the tooth, but stimulate salivary flow and aid in clearance of debris. It also does not increase keratinization of tissue but only produce a type of exercises, strengthen the periodontal ligaments.

Nutrition and Periodontitis: The systemic effect of nutrients on the integrity of periodontium is through:

- 1- *Antioxidant micronutrients:* as vitamin A, vitamin C (ascorbic acid), vitamin E, enzymes (as glutathione), minerals (as Zn, Se) may overcome inflammation of periodontal tissues. Pathogens (in dental plaque) stimulate the production of reactive oxidative species (ROS) by immune cells. ROS may play a part in the inflammation of gingival tissue and in activating osteoclasts, cells responsible for resorbing bone. However, the antioxidant defense enzymes reduce the ROS to minimize cellular damage (reduce periodontal disease).

Pathogens (Plaque) → Stimulation ROS → Periodontal Disease
Antioxidants → Reduce ROS → Minimize Cell Damage

Note: Oxidation is a chemical reaction that transfers electrons from a substance to an oxidizing agent, producing free radicals, which start chain reactions that damage cells. While antioxidants are molecules capable of slowing or preventing the oxidation of other molecules.

- 2- *Anti-inflammatory effect:* Human and animal studies showed that protein deprivation resulted in the breakdown of periodontal ligaments, degeneration of gingival tissues, and resorption of the alveolar bone. At

the time an inverse relationship recorded between high protein intake and periodontitis. Vitamin C (ascorbic acid) is primarily required for the synthesis of collagen and it also prevents oxidative damage by acting as a ROS scavenger. The oral manifestation of scurvy (deficiency in vitamin C) is gingival inflammation manifested as gingival bleeding and pain. Reports are present regarding vitamin E in relation to periodontal health and controlling inflammation.

Note: Radicals scavengers; are antioxidant spares the cell material from damage as vitamin C, beta carotene, vitamin E. They convert oxidizing agent to harmless substances.

Deficiency vitamin c causes enlargement of marginal gingiva, ANUG, lack of periodontal support. Deficiency of Riboflavin cause angular stomatitis and cheilosis.

3- *Other effects:* Periodontal disease is the result of an inflammatory response resulting from the interaction between pathogenic bacteria and the host's immune response. Nutrients may affect the immunological response to bacterial antigen. Other nutrients may possess an antimicrobial activities, thus affecting the quality (; composition) and growth (quantity) of plaque biofilm.

Food and Oral Cancer:

The prevalence of cancer was reported to be less among people eating a large quantities of fresh fruits and vegetables. These dietary items provide the body with vitamins and minerals that acts as antioxidants and protect from cancer. These includes vitamins as A, C, E in addition to minerals as selenium, Zn and Mg.

Protection from cancer is either:

- Through prevention of initiation and activation of cancer (primary prevention) or by
- Inhibition of tumor progression and promotion (secondary prevention).

Food constituents and the physical make-up (cooking) of the food can effect nitrosamine formation (; carcinogens). Ascorbic acid and sulfur dioxide are used to inhibit nitrosamine formation in foods.

Retinoid (; chemical compounds related to vitamin A), is used as a chemo-preventive agent for oral pre- malignant lesions, and in prevention of substances specific for tumor promotion.

Soybeans was reported to protect from cancers, attributed to its anti carcinogenic action.

Food and other Oral Diseases:

Oral manifestation of malnutrition may vary according to the severity of mal nourishments, as oral ulceration, delay healing of post - operative surgery, glossitis and angular stomatitis, burning sensation, oral infection as candidiasis. Oral manifestation of **sever protein deficiency** (; **Kwashiorkor**) may include tongue edema and papillary atrophy, angular stomatitis, xerostomia and hypo- pigmentation.

Note: Soya beans are rich in protein

Appendix

- It is advice to consume whole fresh fruits as opposed to fresh fruit juices, as their mastication stimulate salivary secretion. Fresh fruit contain non milk extrinsic sugar.
- The first sign of tooth development is at 28 days of intrauterine life, mineralization of enamel and dentine of primary teeth occur about 4-6 months in uteri. Stages of formation (secretary phase: organic matrix formation), mineralization phase (crystal formation and growth), maturation phase (water and organic withdrawn and mineral content increase).
- Acid solubility of enamel is increased in protein energy deficiency during pre-eruptive period.
- The oxidizing agent either produced within the body as a part of its normal metabolic process or enter the body from atmosphere.
- Free radicals are unstable form of oxygen have lost an electron from their molecule structure.
- **Free radicals attack** (as the lipids of cell membranes) can initiate a highly damaging chain reaction leading to widespread damage to the structure.
- Vitamins act as catalysts. Its deficiency causes gingival bleeding and swelling
- **Carcinogenic agents:**1- exogenous agents (physical as U.V. light, biological as viruses, chemical as nitrosamines). 2- Endogenous (normal products of oxidative metabolism that can cause damage to DNA and convert normal cell to cancer).
- Free radicals are unstable form of oxygen have lost an electron from their molecule structure. To replace this electron the free radical seek out electron from other substance in the body causing damage to tissues. Targets of free radicals are (cell proteins, enzymes, fatty acids and the genetic material of DNA). Damage to these structures trigger the development of cancer. *A force that acts on oxygen to create free radicals are called oxidative stresses.*

