Lect 18

Nutrition and oral health

Nutrition is an essential for the growth, development, and maintenance of oral structures and tissues. During periods of rapid cellular growth, nutrient deficiencies can have an *irreversible* effect on the developing oral tissues. Early malnutrition increases a child's susceptibility to dental diseases in the deciduous teeth, throughout life, nutritional deficiencies or toxicities can affect *host resistance,* healing, oral function, and oral-tissue integrity.

The oral cavity is a mirror of the nutritional status of the body. Nutrition is considered to be one of the most important factors that plays an important role in tooth formation as well as in bone development and metabolism, it may involved in disease process affecting the tooth and its supporting structure, deficiencies in many nutrients are thought to be linked to the development and progression of oral diseases.

Nutrition dental caries

During the pre-eruptive period of development of teeth, food exerts a systemic (nutritional) effect on the formation of the dental matrix and its mineralization.

➡ The first sign of tooth development of dental tissue occur around 28 days of intrauterine life and mineralization of dentin and enamel of primary teeth occur about 4-6 months in uteri so formation of teeth take long time and pass through a number of stages these are:

- ***Secretary phase*** when the organic matrix is formed
- ***Mineralization phase*** which consist of crystal formation and crystal growth
- ***Maturation phase*** during which water and organic matter withdrawn and the mineral content increase

These stages are considered critical periods (critical period of human development) that define as: time interval when specific nutrient are needed by a particular tissue programmed to develop at prescribed time and rate, inappropriate supply of nutrient at such time can result in sever irreversible changes that affect the growth of the

organ these changes in turn can result in permanent defects in function and decreased resistance to disease.

Aberrations that occur during period of formation may have potentially irreversible effect on the developing organism. Malnutrition during these critical periods of growth can result in a dentition that is more susceptible to dental caries.

Systemic effect: In the first half of previous century there was strong believes that good nutrition while tooth were forming was the principal way to prevent dental caries and caries was considered to be a deficiency disease

Nutritional factors may have an effect on the following:

- Morphology of the teeth
- The quality of dental hard tissues
- The quality of saliva

Morphology of the teeth

➪ It is well known that teeth with deep narrow fissures and marked pits and grooves are more susceptible to caries than those with fewer plaque retentive areas. The morphology of the tooth is largely determined by genetic factors but in many studies nutritional imbalance of protein, fat and carbohydrate affect the morphology of the teeth

Enamel defect

➪ The tooth developments include the formation of an organic protein matrix, followed by mineralization and maturation. The process, which follows a well-defined chronological pattern, involves several critical stages. Nutritional insult to protein synthesis or mineralization may disturb the tooth structure as well as the form of the teeth.

- ***If matrix formation is affected enamel, hypoplasia will ensue***
- ***If maturation is lacking or in complete hypocalcification of enamel will result in which deficiency in the mineral content of the enamel is found.***

Poor nutrition is one of many causes of dental defect, clear relationship between specific dietary nutrients deficiency during critical periods of developments and poorly calcified tooth had been demonstrated.

Based on many studies awareness has arisen that nutritional disturbances, such as deficiencies of calcium, phosphate, vitamin A, D and C and protein-energy, affect tooth tissue formation according to their biological roles.

Protein energy relation

When dietary energy intake is adequate, the amino acids derived from dietary protein are immediately used for whatever protein synthesis is required such as for growth and maintenance of the body tissue. While when dietary energy intake falls below a certain critical level (insufficient fat and carbohydrate are available to meet immediate energy needs), amino acids are used as a source of energy.

Vitamin D, calcium, phosphorus

It well known that 96% of dental enamel is apatite mineral principally calcium and phosphorus. Vitamin D is intimately involved with calcium metabolism and its intestinal absorption and therefore, it has a role in tooth formation.

Lady May Mellanby in the first half of previous century showed that vitamin D deficiency led to hypoplastic teeth (she recognized that children with vitamin D deficiency had delayed development of teeth, had very deficient poorly calcified enamel). She noticed improved appearance of teeth by provision of cheap milk or cod liver oil to pregnant and lactating mother, infants, and young children also addition of vitamin D to margarine and calcium carbonate to bread

In addition to the study by Mellanby, the importance of the role of vitamin D and plasma calcium level in the etiology and prevention of enamel hypoplasia was illustrated by many studies showed that enamel hypoplasia is related to disorder in calcium homoeostatic, which in turn is controlled in a complex way involving vitamin D, parathyroid hormone and calcitonin. They also suggested that hypocalcaemia was the mechanism by which chronic diarrhea caused dental hypoplasia.

Indeed the health education authority in developed countries stopped giving advice concerning calcium and vitamin D and strongly healthy teeth many years ago, in order to concentrate the dietary aspects of dental health education on two uncontroversial messages reduce sugar consumption and using fluoride. It should be emphasized that these remarks concerning the unimportance of nutrition (other than fluoride), while teeth are forming apply at present time to developed countries where standards of nutrition are generally adequate, the same may not apply in countries when severe malnutrition is prevalent

The quality of the hard tissues:

The quality of the hard tissues of the tooth can influenced by nutrition, the changes may be importance for development and progression of dental caries.

Evidences that nutritionally derived variation in structure increase caries susceptibility have been presented.

⇨ In many studies deficiency of ***protein energy, vitamin A, zinc and iron*** during pre-eruptive period are reported to cause increased caries development that claimed to be related to impaired tooth tissue

⇨ Acid solubility of enamel is increased in protein energy deficiency during preeruptive period

⇨ It has been shown that feeding a diet high in sugar during pregnancy and lactation will result in changes in the offspring dental tissues namely higher level of carbonate, mucopolysaccharides in the enamel that later in life made them more susceptible to caries. Feeding diet high in protein during pregnancy and lactation resulted in offspring with lower level of carbonate; mucopolysaccharides in the enamel were found to be more resistance to caries

Quality of saliva

Nutrition may affect the quality of saliva it has been shown that individual on lacto-vegetarian , high protein or high fat diet produce saliva with a high buffering capacity where as individual on a high carbohydrate diet produce saliva lower buffering ability.

⇨ Salivary lactoferrin, lysozyme, sialin and statherin are protein molecules that are part of the defense arsenal secreted by salivary glands. All of these can be diminished in volume or altered in structure during sever periods of malnutrition.

⇨ However marginal protein energy deficiency during pre-eruptive period; impair the condition for the development of the salivary glands, which causes a decreased secretion rate and amount of protein secreted per minutes.

Evidences of the effect of some nutrients on dental caries

➡ -Vitamin A deficiency is known to impair enamel and dentin formation, impair immune function, reduces synthesis of specific glycoprotein such as salivary bacteria agglutinating glycoprotein (BAGP) and in cases of sever deficiency to reduce saliva secretions rate. It was reported that dental caries was increased when they fed vitamin A deficient diet

➡ -The possible influences of the hardness and calcium content of water on prevalence of dental caries has been suggested with inverse relation. Concerning people living in primitive village who were still not exposed to European civilization, demonstrating strong inverse association between the prevalence of dental caries and concentration of calcium in soil, also found an inverse association with phosphorus composition of local food in that village.

➡ -Iron was classified as caries inert element, deficiency of iron during pre-eruptive period of tooth development in animal caused increase caries development.

➡ -Caries susceptibility is increased among children with chronic malnutrition (stunted means deficient height for age) and acute malnutrition (wasting means deficient weight for height), as a result of systemic effect of protein energy malnutrition during pre-eruptive period. It has also been shown that protein-energy deficiency induced after completed tooth formation but during the early post-eruptive period, increases caries susceptibility to standardized cariogenic challenge. During the latter condition, impairment in saliva secretion rate and composition was found along with increased caries development.

Nutrition and eruption of teeth

- Among children with protein energy malnutrition, protein deficiency may be the reason for delayed eruption of their deciduous teeth, on the other hand, early eruption of teeth were noted among children whose height and weight were greater than average
- Several studies have demonstrated that the rate of dental development and dental eruption affected by pre-term birth, children with the lowest birth weight and shortest gestational age (prenatal malnutrition) have lowest rate of dental development
- The weaning period, which is a critical time, during which the infants diet predominantly liquid and soft food, begins to include more solid and usually going from a law protein to a high protein diet. If solid protein rich food intake (*meat with 20% protein compared to with milk 5% protein*) is not adequate, jaw and tooth mal-formation occur. As protein nutrition is a basic consideration in the growth and development of the oral cavity, if the diet include too little essential amino acids during critical period of active growth, permanent structural damage can occur, synthesis of protein in the cell disrupted, resulting in a disturbed tissue growth and development, this will affect the maxillary and mandibular bone, resulting in adverse effect on tooth alignment and alveolar bone integrity

  All proteins are synthesized from amino acids molecules; these can be classified into two groups: ***essential amino acids*** that cannot be synthesized by the body at a rate sufficient to meet the needs for growth and maintenance. It is essential that these amino acids be provided in the diet. ***Nonessential amino acids*** that the body can make adequate amounts from other compounds if necessary.
- Disease associated with unduly delayed eruption of teeth includes rickets that is caused by vitamin D deficiency, which is essential for calcification and growth of the jaw, and regulates the level of calcium in serum. So in many of this condition, where the level of calcium is lower than normal, found delayed tooth eruption.

From epidemiological view:

Under nutrition result in delays shedding of the primary teeth and delayed eruption of the permanent teeth, this may influence the caries prevalence at given age