Have you missed something?
11 important relationships between diet, nutrition and oral health

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Abstract

The condition of the oral cavity is critical to health in general and good nutritional status in particular. Conversely, diet and nutritional factors can play important roles in oral health and disease. A host of factors, behavioral and physiological, can affect patients' oral and nutritional status. Today's dentist needs to understand the relationships between nutrition and oral health, and apply this knowledge to improve patient care. This means routinely screening patients for nutritional risk, providing dietary guidance related to oral health, and referring patients to nutrition professionals for treatment of nutrition-related systemic conditions. This paper will provide an overview of the important relationships between diet, nutrition, and oral health. Helpful resources will be provided in the hope that the following information will stimulate further study. First published in Dental Update 2000; 7 (3): 53-57.

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Nutrition and diet: Important factors in oral health

Although the terms "nutrition" and "diet" are often used interchangeably, each term has distinct implications in oral health. Nutrition is the science of how the body uses nutrients for synthesis and maintenance. Nutritional factors are important to the growth, maintenance, and repair of oral tissues and structures. Diet refers to patterns of food intake or eating habits. Dietary patterns are critical factors to dental caries risk. Dental problems can also radically affect eating habits, and subsequent nutritional status.

How nutrition affects oral health

1. Development and integrity of oral tissues and structures

Good nutrition is essential to the initial growth and development of oral tissues and to their continuous integrity through the lifespan. Optimal nutrition during periods of hard and soft tissue development allows oral tissues to reach their optimal potential for growth and resistance to disease. Conversely, malnutrition during critical periods of tooth development can have irreversible effects on the developing oral structures. In animals, malnutrition during these "critical periods" can result in increased caries susceptibility. In humans, enamel hypoplasia can result. Malnutrition after initial organ and tissue development is usually
reversible. However, nutritional deficiencies throughout the life cycle can impair tissue regeneration and healing, and can increase susceptibility to oral infections.

2. The elderly dental patient

The elderly are particularly susceptible to malnutrition. Compared to younger individuals, elders have a significantly decreased ability to respond to physiologic challenges. Sensory function decreases leading to impaired taste and smell. Changes in the gastrointestinal system can affect the ability to digest, absorb and utilize food properly. Functional problems, such as arthritis or vision difficulties can affect the ability to prepare and eat food. Psychosocial problems such as loneliness, depression, lack of money, and poor access to food can all undermine good eating habits. Nutrition is an important contributor to oral status in the elderly. In a sample population of 843 elderly people, there was a significant association between low ascorbic acid levels and the prevalence of oral mucosal lesions. Low calcium intake throughout life has been shown to contribute to osteoporosis. In turn, osteoporosis is thought to be an important contributing factor to the resorption of alveolar bone, which ultimately results in tooth loss. Since the alveolar process is thought to undergo resorption prior to other bones, change detected in the alveolar process may be used for early diagnosis of osteoporosis. The mandible seems to reflect the mineral status of the entire skeleton. In a study of 329 healthy post-menopausal women, an inverse relationship was shown between bone mineral density and number of existing teeth, with women who got dentures after the age of forty having the lowest bone mineral density.

3. Periodontal disease

Nutritional factors can affect host susceptibility to periodontal disease and modulate its progress. If both the defense and repair capabilities of the periodontal tissues are in balance, nutrition can be a determining factor in the extent and progression of the periodontal disease. The nutritional concepts that apply to preventing infection and enhancing wound healing in general, apply as well to the prevention and management of periodontal disease. These include the need for adequate protein, calories, vitamin C, iron, and zinc. Even with a healthy periodontium, there is continual need for nutrients to maintain the tissues. The relationship between malnutrition and infection is a close one, with infection aggravating malnutrition and malnutrition abetting infection. Along with the increased metabolic needs of infection, additional demands by the tissue cells attempting to maintain and repair damaged areas; result in a greater requirement for all nutrients. There is also evidence that nutrient requirements may be higher at local sites of increased stress than in the rest of the body. Such localized challenges may result in end-organ nutrient deficiencies in the periodontium.

How diet affects oral health

4. Dental caries promotion

Through years of epidemiological and clinical research, the causal relationship between consumption of sugars and dental caries has been well established. All of the mono and disaccharides can be cariogenic under certain circumstances. Sucrose plays a more dominant role than other sugars in the development of smooth surface caries. Corn sweeteners, particularly high fructose corn syrup, often replace sucrose in the manufacture of carbonated beverages and other processed foods.
Fructose, as well as glucose and maltose are nearly as caries promoting as sucrose. Milk, a source of lactose, has low cariogenicity, except when used in the infant nursing bottle at bedtime. Honey, composed of fructose, glucose, and sucrose, is as cariogenic as sucrose. People with very low sugar intakes tend to have low caries scores. People in nations that have high sugar intakes tend to have high rates of caries. Three clinical trials of English, United States, and Canadian school children examined the relationship between sugar intake and dental caries. In England 405 children with a mean age of 11.6 years were followed for two years. Total sugar intake (118 grams per day or 21% of total calorie intake) had the highest significant correlation with caries rates.

Intake of sugary foods before bedtime was also highly correlated with caries incidence. In the United States, 499 children aged 11-15 years, living in nonfluoridated rural Michigan communities, were followed for three years. The average increase in decayed, missing, and filled surfaces (DMFS) over the three years was 3.1 in girls and 2.7 for boys. The daily average sugar intake was 142 grams; or 26.5% of their total energy intake. Children who obtained a higher percent of their total calories from sugars had more proximal surface caries. Simple sugars are not the only carbohydrate that influences caries development. Refined cooked starch-sugar combinations such as doughnuts, cookies, potato chips, and some ready-to-eat breakfast cereals produce a prolonged acidogenic response when retained in interproximal spaces. When starches are cooked, they are partially degraded. This allows the salivary alpha-amylase to convert starch particles retained in the mouth to maltose. The amount of sugars consumed may not be the primary dietary factor associated with caries development. Other food factors that may hinder or enhance caries development include:

- The frequency of eating, the physical form of the carbohydrate (liquid vs. solid);
- Retentiveness of a food on the tooth surface;
- The sequence in which foods are consumed (e.g., cheese eaten before a sweet food limits the pH drop), and
- The presence of minerals in a food.

Frequent between-meal snacking on sugar or processed starch-containing foods increases plaque formation and extends the length of time that bacterial acid production can occur. When total daily sugar intake was held constant, increasing the frequency of sugar intake for groups of rats increased the number of mutans streptococci in plaque and the amount of caries experienced. The positive relationship between frequency of sugar intake in humans was first demonstrated in the Vipelholm study. Subjects who consumed candies between meals developed more caries than did those who were fed equal amounts of sugars with meals. One snack between meals is probably not harmful since there will be time for remineralization; however, snacking many times throughout the day keeps the plaque pH low and extends the time for enamel demineralization to occur. Bacterial fermentation of simple sugars can continue as long as the sugars are in contact with dental plaque on enamel surfaces. Foods that are retained on tooth surfaces for prolonged periods of time extend acid production. Thus, solid foods are more likely to contribute to tooth decay than sugar-sweetened liquids that are rapidly cleared from the mouth. On the other hand, slowly sipping soft drinks and other sweetened beverages between meals increase the risk of caries. Likewise, retentive high
starch foods may be more acidogenic than high-sugar-low-starch foods that are rapidly eliminated from the mouth\textsuperscript{27}. The sequence in which foods are eaten also affects plaque pH levels. Sugared coffee consumed at the end of a meal will cause the plaque pH to remain low for a longer time than when an unsweetened food is eaten following intake of sugared coffee\textsuperscript{28}.

5. Diet factors that decrease caries risk

Some components of foods are protective against dental caries. Protein, fat, phosphorus, and calcium inhibit caries in rats\textsuperscript{29}. Aged natural cheeses have been shown to be cariostatic\textsuperscript{30}. When cheese is eaten following a sucrose rinse, the plaque pH returns to neutral faster than with the sucrose rinse alone. The protective effect of cheeses is attributed to their texture, which stimulates salivary flow, and their protein, calcium, and phosphate content, which neutralizes plaque acids. If peanuts are eaten before or after sugar containing foods, the plaque pH is less depressed\textsuperscript{31}. Fats appear to be caries protective. Some fatty acids in low concentrations inhibit growth of mutans streptococcus. Fats may also accelerate oral clearance of food particles. Some proteins found in plants, appear to interfere with microbial colonization and may affect salivary function\textsuperscript{32}. Other factors contributing to the caries decline in western countries are: fluoride intake, the use of fluoridated dentifrices, improved plaque control, the use of dental sealants, and more frequent visits to the dentist\textsuperscript{33}.

6. Diet factors in early childhood caries

One of the most severe forms of caries occurs in babies who are allowed to feed on bottles of sugar-containing liquids for prolonged periods. These may include, milk, juice, and other sweetened beverages. As a result, progressive dental caries on the buccal and lingual surfaces of newly erupted primary maxillary teeth of infants and toddlers may occur. Primary risk factors for early childhood caries include allowing a child to sleep with a bottle containing something other than water, allowing an infant to breast feed at will, and extending the use of the nursing bottle beyond one year of age. The 1991 National Health Interview Survey found that 16.7\% of American children aged 6 months to 5 years of age are put to sleep with a bottle containing liquid other than plain water\textsuperscript{34}. Furthermore, children who develop maxillary anterior caries are at increased risk of developing posterior caries in the future\textsuperscript{35}.

7. Eating disorders

Eating disorders, especially bulimia, are often first diagnosed in the dental office. Patients, usually young females, present with severe erosion of teeth, especially lingual surfaces. The oral tissues are often red, sore and painful. The esophagus may be inflamed, and salivary glands are often swollen. Bulimia is characterized by recurrent episodes of binge eating (consumption of large amounts of food at a time) followed by self-induced regurgitation (purging). Patients may also use laxatives and/or diuretics to induce malabsorption and fluid loss. The acid from stomach regurgitation irritates the esophagus and the oral soft tissues. The regurgitated acid in combination with xerostomia, result in rapid and extensive destruction of tooth enamel\textsuperscript{36}. Patients often first deny having an eating disorder. However, when confronted with the oral evidence, they often admit to the disorder. The dentist should refer the patient to an eating disorders program and elicit patient agreement to undergo treatment. The patient must be cautioned that only palliation is indicated, and that for
dental rehabilitation to be successful, the underlying problem (the eating disorder and its causes) must be resolved.

How oral health affects nutrition

8. Children and the elderly

In children, unrecognized dental pain can contribute to failure to thrive. Oral pain can cause a child to avoid eating and chewing and can lead to weight loss. In young children, who cannot articulate their problems, the cause of this anorexia may go undetected for prolonged periods. Problems in the oral cavity can be major contributors to poor eating habits and subsequent malnutrition in the elderly. Several studies have shown that dentate status can affect eating ability and subsequent diet quality. Individuals with one or two complete dentures had a 20% decline in diet quality compared to those with at least partial dentition in one or both arches. In another study, edentulous individuals consumed less fiber and carotene, fewer vegetables, and more cholesterol, saturated fat and calories than did those with 25 or more teeth. Dentures can also affect taste and swallowing ability, especially if they are maxillary dentures. The denture covers those taste buds found on the upper palate. And when the upper palate is covered, it becomes difficult to detect the location of food in the mouth. For this reason, dentures are thought to be the major cause of choking in adults. Dry Mouth (Xerostomia) is common in the older population, due primarily to the large numbers of xerostomic medications commonly taken. Xerostomia makes eating more difficult and increases the cariogenic potential of the diet. It has also been associated with burning mouth syndrome and inadequate diet.

9. Oral surgery and wired jaw patients

The patient who has had oral surgery needs an adequate diet to support adequate post-surgical response. The risk of nutritional deficiency increases with the length of the eating impairment. Surgery itself can result in anorexia, inability to chew, and increased metabolic requirements. After surgery, a patient may need a liquid diet for 1 or 2 days but should be graduated as soon as possible to a soft diet of high nutritional quality until normal eating ability is restored. In some cases, nutritionally complete liquid supplements may be appropriate and should be prescribed in consultation with the patient’s dietitian and physician. Multi-vitamin/mineral supplements may be needed as well.

How medical conditions can affect diet, nutrition, and oral health

10. The diabetic patient

The diabetic dental patient is at greater risk for developing oral infections and periodontal disease than the non-diabetic. Dietary management of Diabetes Mellitus has moved from the high fat, low carbohydrate diets of past decades to the more liberal use of complex carbohydrates and the reductions in fat recommended today. Since the use of cariogenic fermentable carbohydrates should be infrequent, a diabetic diet should be low in cariogenicity. Frequent use of hard candies or other foods designed to counteract hypoglycemia are signs that the diabetes is not well controlled. Patients with uncontrolled diabetes should be referred to their physician for further medical care. In the dental office, quickly assimilated carbohydrate sources such as juices, milk, and crackers, should be kept readily available in case a diabetic patient develops symptoms of hypoglycemia.
11. Immune-compromising conditions (cancer, AIDS)

Immune-compromised patients, such as those with cancer or AIDS, often have increased requirements for nutrients in the face of major physiologic and psychosocial impediments to eating. Cancer often sets up a syndrome of weight loss and wasting in which metabolic rate and nutrient losses are increased. The cancer often causes severe anorexia, taste changes, and early satiety. The pain and discomfort of oral infections, such as the herpes simplex and oral candidiasis found in AIDS patients and after chemotherapy, can also impair the desire and ability to eat\textsuperscript{54}. Over 60% of head and neck cancer patients are nutritionally compromised at initial diagnosis\textsuperscript{55}. Radiation therapy compounds eating difficulty by causing painful oral mucositis and severe xerostomia\textsuperscript{56}. When providing dental services to patients suffering from cancer or AIDS, team members need to understand the nutrition principles underlying the care so that dental services provided can be coordinated effectively with total care. The nutrition care plan initially focuses on providing high caloric intake in frequent small meals. Liquid supplements may be used if optimal nutrition cannot be achieved via food alone. In more serious cases, patients may need enteral (tube) feedings or more advanced nutritional support. A high calorie diet will likely be high in sugars as well as total calories\textsuperscript{57}. In these cases, the dental team should not caution patients to reduce the frequency of eating, since this will contradict nutritional management goals. Rather, thorough cleaning after each eating period and use of fluoride mouth rinses before bed should be stressed. This approach is standard for immuno-compromised patients as part of an aggressive preventive dental program\textsuperscript{58}. All cancer patients should be cautioned, however, about the potential oral sequelae of an increased frequency of eating. Patients should also be cautioned to avoid the use of slowly dissolving hard candy often used to assuage the xerostomia. The most important monitoring tool for these patients is weight status. The patient should be queried at each visit about how their weight is being maintained. Involuntary weight loss of 10 pounds or more is a warning for the need for more intensive care.

**Summary**

Nutritional status and dietary habits can affect and be affected by oral conditions. Comprehensive patient care requires that nutritional factors be considered in the etiology, progression, and sequelae of oral problems\textsuperscript{59, 60}. Dental team members need to develop the necessary skills to be able to routinely screen patients for nutritional issues, and provide dentally-oriented counseling. They also need to refer patients to qualified nutrition professionals for further care. The nutritional implications in dental condition are many and complex. No longer can nutrition in dentistry be summarized as "sugar is bad and fluoride is good".


**摘引**

口腔环境对于总体健康，特别是良好的营养状况至关重要。而反过来，膳食及营养因素在口腔健康和疾病中扮演着重要作用。很多因素，如行为的以及生理的因素，会影响病人的口腔和营养状况。今天的牙医们需要了解营养和口腔健康之间的关系并将其知识加以运用，以改善对病人的护理。这意味着在日常实践中筛选出具有营养风险的病人，提供有关口腔健康的
Resumen

La condición de la cavidad oral es crítica para la salud en general, en particular para un buen estado nutricional. A su vez, los factores dietéticos y nutricionales pueden jugar un rol importante en la salud oral y la enfermedad. Factores anfitriones, de comportamiento y fisiológicos, pueden afectar el estado oral y nutricional del paciente. Los dentistas hoy en día necesitan comprender la relación entre nutrición y salud oral, y aplicar este conocimiento para mejorar el cuidado del paciente. Esto significa examinar rutinariamente a los pacientes en busca de riesgos nutricionales, proporcionando una guía dietética relacionada a salud oral y refiriendo a los pacientes a profesionales nutricionistas para tratamientos de condiciones sistemáticas relacionadas a nutrición. Este documento les dará un resumen de las relaciones importantes entre dieta, nutrición y salud oral. Se proporcionarán fuentes útiles con la esperanza de que la siguiente información estimule estudios adicionales. Publicado primero en Dental Update 2000; 7 (3): 53-57.

References


30 minutes is all you need for Oral Health Check

BASIC ROUTINE SCREENING
As part of initial assessment, which can easily be incorporated as part of a routine dental check-up, the tests are for checking the quality of both resting and stimulated saliva.

1 minute for... Saliva pH test
The GC Saliva pH Indicator measures the pH of both resting and stimulated saliva. A low saliva pH indicates an oral environment favouring demineralisation. Patients are therefore at increased risk of sensitivity, erosion or caries.

<table>
<thead>
<tr>
<th>Saliva pH</th>
<th>5.0-5.8</th>
<th>6.0-6.4</th>
<th>6.5-7.0</th>
<th>7.0-7.4</th>
</tr>
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<tbody>
<tr>
<td>Results</td>
<td>Red</td>
<td>Yellow</td>
<td>Green</td>
<td>Blue</td>
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Results are available immediately.

5 minutes for... Plaque Check pH test
The GC Plaque-Check + pH Kit measures the pH of plaque. A low pH reading indicates that the biofilm (plaque) is creating a sufficiently acidic environment to demineralise tooth surfaces and it is only a matter of time before lesions will develop.

Results are available after 5 minutes.

COMPREHENSIVE ASSESSMENT
A comprehensive assessment which includes the checking of saliva and plaque pH together with other tests, giving the dental team a better understanding of the patient’s oral environment.

10 minutes for... Saliva Check Buffer test
The GC Saliva Check Buffer Kit allows the dental team to check a range of salivary functions to determine whether the protective properties of saliva are in place. This will assist in assessing whether the cause of salivary dysfunction is due to lifestyle or life situations or due to systemic reasons.

Testing time and results in approximately 10 minutes.

1.5 minutes for... Saliva Check Mutans test
Saliva Check MUTANS KIT is the first chair side diagnostic test for rapid detection of high levels of streptococcus mutans without the need for innovation. A test strip will register an easy-to-read result line indicating a level of s.mutans equal to or above 300,000 colony forming units per ml (cfu/ml) saliva.

Results are available after 1.5 minutes.

To learn more concepts and products, following literature are available upon request:

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