

# **Oral Manifestations of Nutrient Deficiencies**

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## **Abstract**

There is a synergistic relationship between nutrition, oral health, and disease. Nutrient deficiency may result in oral symptomatology. Oral conditions and systemic diseases associated with oral manifestations may lead to nutrient deficiencies as a consequence of compromised mastication and swallowing, pain, or discomfort. Health professionals must recognize the manifestations of these deficiencies, consider their causes and provide early treatment to prevent further compromise in nutrition status and to promote optimal nutrition, oral and overall health.

**Key Words:** Nutrition, oral cavity, oral manifestations of nutrient deficiencies.

### **Introduction**

The relationship between nutrition and oral health is multifaceted. Nutrition has both local and systemic impacts on the oral cavity (1). While diet and eating patterns have a local effect on the teeth, saliva and soft tissues, the systemic impact of nutrition also has considerable implications and it too merits assessment as a component of comprehensive care. The systemic effect is the impact of the nutrients consumed as they assume their biological functions in relation to the development and maintenance of the extra- and intra-oral structures and secretions (1, 2). An adequate supply of nutrients is essential to the growth, development, and maintenance of tissues, effectiveness of the immune system, prevention of cell damage and, in general, to increased resistance to many chronic, and some infectious diseases (1). The oral cavity is often one of the first sites where nutrient deficiencies can be clinically noted.

Clinical manifestations of nutrient deficiencies can have a significant impact on the function of the oral cavity. Functional properties of the oral cavity include taste, salivation, mastication, and swallowing food. Any alterations in the structure and function of the oral cavity may compromise intake and contribute to the development of a nutrient-deficiency state. When the associated oral structures are affected, these alterations may be compounded even further, leading to subsequent inadequate dietary intake and compromised nutrition status. This article will focus on the development of nutrient deficiencies that have oral manifestations, the relationship of malnutrition and oral diseases, and nutrition management strategies. The relationship of systemic diseases associated with nutrient deficiencies and their oral manifestations will also be discussed.

### **Development of Nutrient Deficiencies**

Nutrient deficiencies result from an imbalance of supply and demand, that is, when the supply of nutrients is inadequate to meet the demands of the body (3). The imbalance may result from one of three primary causes: inadequate intake, impaired digestion and absorption, or increased losses. A deficiency of any one nutrient may in turn contribute to subsequent deficiencies of other nutrients. Clinical manifestations of deficiencies occur once tissue stores are depleted. They may present as symptoms reported by patients as well as by physical observations notable on examination (3). Extra-oral manifestations include alterations in appearance and integrity of the skin, while intra-oral manifestations may be reflected in altered integrity and appearance of the teeth, soft tissue, and tongue (Table 1). Left untreated, deficiency symptoms may progress to deficiency diseases.

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**TABLE 1**  
*Nutrition Risk Factors to Consider in Physical Examination*

Oral Cavity Area	Clinical Manifestation	Nutrient Deficiencies
Face	Malar pigmentation Bitemporal wasting	Niacin, B vitamins Protein-energy malnutrition
	Nasolabial seborrhea	Niacin, riboflavin, B6
	Edema	Protein deficiency
	Lack of color	Iron, malnutrition
Lips	Cheilosis Angular fissures	Niacin, B6, riboflavin Niacin, B6, riboflavin, iron
Gingiva	Spongy, bleeding, abnormal redness	Vitamin C
Tongue	Glossitis (red, raw, fissured)	Folate, niacin, iron, B6, B12
	Pale, atrophic, smooth/slick (filiform papillary atrophy)	Iron, folate
	Magenta color	Riboflavin

Once a negative nutritional imbalance has occurred, depletion of tissue levels and body stores occur. This is evidenced by depleted serum levels of nutrients and/or altered response to diagnostic tests. Serum levels may not always reflect nutrient stores. Once body stores are depleted, biologic and physiologic performance and cell functions of those cells dependent on the specific nutrient become altered. Following altered biologic and physiologic performance, clinical manifestations typically appear in the development of a deficiency (4). Once clinical symptoms become apparent, morbidity and mortality rise.

A first step in assessing nutrient deficiencies is to determine the cause (Table 2). A

**TABLE 2**  
*Causes of Nutritional Deficiencies from A to Z*

A norexia	N o sunlight
B ulemia	O ral contraceptives
C orticosteroids	P oor dentition
D iet	Q uackery
E thanol	R adiation therapy
F ungal infections	S oft tissue abnormalities
G one to a nursing home	T ooth loss
H omelessness	U lcerations in the mouth
I nflammatory bowel disease	V itamin abuse
J ust tea and toast diet	W eight loss
K aposi's sarcoma	X erostomia
L axative abuse	Y ellow fever
M edications	Z ero money for food

Careful review of the medical history and presenting symptoms with physical examination is critical to detecting deficiency conditions and possible etiologies. Illness and infection can increase nutrient needs and thereby contribute to a deficiency. Bacterial and fungal infections in the oral cavity may alter tissue integrity, increase nutrient utilization, and compromise intake. The end result is twofold, with increased needs and decreased dietary intake. Inflammatory bowel disease may cause deficiencies of water soluble vitamins including B6, B12, folate, trace elements, calcium, zinc, and magnesium due to altered digestion and absorption. Inadequate intake may be due to functional difficulties such as poor dentition, tooth loss, ill-fitting dentures, xerostomia, and systemic disease, as well as psychosocial problems including lack of income, homelessness, depression, and anorexia. A prolonged poor dietary intake due to ill-fitting dentures and difficulties with mastication has been shown to result in inadequate intake of zinc, calcium, and B6 (5).

### **Malnutrition and Periodontal Disease(s)**

Periodontal diseases, a group of infectious diseases which are mostly chronic, affect the supporting tissues of the teeth. Compromised host defense responses associated with malnutrition may make the periodontium more susceptible to infectious organisms that are a normal component of the oral flora. The acute phase protein response to tissue injury is impaired to varying degrees in malnourished individuals. During periods of malnutrition, the magnitude of the inflammatory response is limited, resulting in an impaired host response (6, 7). This could result in a greater amount of periodontal destruction, leading to a compromised dentition. Along with dental and/or pharmacological treatment of the underlying local etiologic factors, nutritional management goals focus on provision of adequate calories, protein and nutrients to promote tissue repair, restoration of the host defense mechanisms, and overall well being. Controversy exists regarding the relationship between nutrition status and periodontal disease (6–11). It is important to note that although some

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nutritional deficiencies (notably vitamin C and folate) can alter the disease process, periodontal diseases are not caused by these deficiencies nor can they be cured by nutrient supplementation alone (8, 9).

Gingivitis, a form of periodontal disease, refers to inflammation of the soft tissue component of the periodontium. There are multiple causes of gingivitis including: chronic diseases such as diabetes; medications including phenytoin and calcium channel blockers; pregnancy; and nutrient deficiencies. Spongy, red, bleeding and painful gingiva are also noted in scurvy, an advanced vitamin C deficiency disease. In severe gingivitis, the easy bleeding and soreness of the gingiva may make eating difficult and contribute to poor intake. Soft, nonirritating, temperate and mildly flavored foods and fluids should be provided to meet energy and nutrient needs. Historically, vitamin A deficiency (12) was cited as a cause of periodontal disease. There are no research studies published within the past decade showing that a deficiency of this vitamin is the cause of gingivitis. Clinical manifestations of folate deficiency, however, may include gingivitis.

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While nutrient deficiencies may contribute to abnormal color, topography, size and sensations in the oral cavity (13), other causes of abnormal findings such as glossodynia and glossopyrosis (painful and burning tongue and soft tissue), dysgeusia (altered taste), angular cheilitis (painful, dry cracked corners of the mouth), and changes in appearance and texture of the tongue must also be evaluated. Abnormal findings may reflect oral manifestations of a myriad of systemic diseases, medications, disorders unique to the oral cavity, or a nutrient deficiency (14). Three possible categories of etiologies include: oral manifestations of a nutrient deficiency, oral manifestations of a systemic disease that impacts on diet and nutrition status, and local oral disorders that interfere with dietary intake (Table 3).

### **Angular Stomatitis and Cheilosis**

Angular stomatitis (painful fissures at the corners of the mouth) and cheilosis (dry scaling of the lips and corners of the mouth) are common findings in riboflavin deficiency. Similar findings may be noted with niacin and B6 deficiency states. The similarity of these findings may be due to riboflavin's role in B6 and tryptophan (which is converted to niacin) metabolism. Angular stomatitis, however, may be associated with iron deficiency anemia (15). Angular cheilitis, however, is often associated with fungal infections, lip-sucking, and dehydration (16). Treatment must focus on correcting the deficiency state and providing adequate energy, protein, fluids and nutrients to promote healing. When angular cheilitis is due to opportunistic infections brought on by decreased resistance secondary to nutrient deficiencies, treatment should focus on antifungal therapy, correction of the nutrient deficiency, and diet modification to make eating a more comfortable experience. Temperate, non-spicy foods and fluids should be used to avoid further irritation to the lips and mouth. At least 6–8 cups of fluid per day should be encouraged. Individuals with angular stomatitis or cheilosis may experience difficulty and pain when they try to open their mouths wide to laugh or eat. They will lick their lips repeatedly with their tongues to moisten them, a habit that should be discouraged to prevent further irritation and infection.

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**TABLE 3**  
*Abnormal Oral Findings Associated With Local and Systemic Disease*

Clinical Feature	Associated Finding	Associated Disorder	Nutritional Considerations
Xerostomia	Dental caries Candidiasis Dysphagia	Drug-induced xerostomia Sjögren's syndrome	Push fluids, evaluate cariogenicity of diet Modify food consistency and choices to reduce pain (limit spicy, hot, acidic, and seasoned foods)
	Burning mouth and tongue	Connective tissue disorders Diabetes	Evaluate masticatory efficiency and modify food choices Evaluate glucose control, modify diet
Burning mouth and tongue	May be with or without associated erythema, edema (stomatitis)	Anemia Diabetes Candidiasis	Determine etiology of deficiency Determine cause of poor glucose control, modify diet, evaluate cariogenicity, evaluate for dysgeusia, dysphagia
	Glossitis	R/O deficiency of iron, folate, B6, B12, niacin and/or riboflavin	Determine etiology; treat with diet and/or supplements as needed
	Pale, atrophic, smooth Tongue	R/O deficiency of iron, folate and B12	See above
Angular fissures of the lips	Dry, cracked lips	R/O niacin, riboflavin, B6, iron deficiency, dehydration	Determine etiology
Thrush	White patches on palate or buccal mucosa that can be rubbed off	Candidiasis	See above
Difficulty biting/chewing food	Partial or total edentulism Lack of occlusion Ill-fitting dentures		Modify diet consistency Loss of anterior occlusion- modify for difficulty biting Loss of posterior occlusion- modify for difficulty chewing

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**Changes in the Tongue**

There are several changes that can occur on the tongue during nutrient deficiency states (Table 1). A painful, magenta colored, atrophic, smooth tongue is noted during a riboflavin deficiency. Glossitis may also be evidence of a vitamin B6, folate or B12 deficiency. However,

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during a chronic folate deficiency, the tongue papillae will become atrophied, resulting in a shiny, smooth surface appearance. Glossitis with loss of filiform papillae may also be seen in individuals with iron-deficiency anemia. A niacin deficiency results in a raw beefy, bright red, swollen, and painful tongue. Glossodynia may also be present in diabetes, resulting in painful mastication and swallowing. Medical nutrition management focuses on correcting the cause of the deficiency, provision of adequate calories, protein and nutrients for healing, and a nonirritating diet consisting of liquids and soft solid foods moderate in temperature and mild in taste.

### **Altered Taste**

Hypogeusia, or diminished taste, is noted in zinc deficiency. Other non-deficiency state causes of altered taste include radiation to the head and neck, diabetes mellitus, and Sjögren's syndrome. Taste tests should be conducted to determine which taste sensations remain. Diets should be tailored to highlight the remaining taste sensations and limit those foods or flavorings which are offensive. Dysgeusia refers to altered taste, which may also affect appetite and intake.

### **Xerostomia**

Xerostomia is rarely due to a nutrient deficiency. It may be seen in severe vitamin A deficiency states (13) and in protein calorie malnutrition. The primary causes of xerostomia (Table 4) include medications, Sjögren's syndrome, diabetes mellitus, and radiation to the head

**TABLE 4**  
*Causes of Xerostomia*

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Disease conditions:	
Type 1 and 2 Diabetes	AIDS
Sjögren's Syndrome	Rheumatoid arthritis
Medications:	
Anticonvulsants	Anti-anxiety agents
Antihistamines	Antidepressants
Diuretics	Narcotics
Muscle relaxants	Antihypertensive agents
Antiviral agents	Tranquilizers
Serotonin uptake inhibitors	

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and neck (17). Altered taste sensations are frequently reported by individuals with xerostomia (18). Artificial salivas may be used. However, they may also contribute to altered taste. Inadequate salivary flow can also contribute to oral infections, including dental caries and glossopyrosis (17, 18). Moist, non-spicy foods and temperate fluids should be provided; fluids are particularly important at mealtime. Individuals with xerostomia should be encouraged to use tart or citrus flavored sugar-free

gums and candies in place of the sugared varieties to increase salivary flow. Oral hygiene is very important to reduce risk of dental caries, particularly following meals and snacks.

### **Systemic Diseases Associated with Oral Manifestations and Nutrient Deficiencies**

The comprehensive management of patients with systemic diseases requires a coordinated team approach of the physician, dentist, registered dietitian (R.D.) and other health professionals. Medical, dental and nutritional management of the disease and associated sequelae are essential to maximize disease management and minimize the often harmful side effects of disease. Medical management should include reinforcement of medical nutrition therapy and oral hygiene principles provided by the R.D. and dentist respectively. Medical and dental professionals should screen and identify patients at nutrition risk and refer patients to an R.D. for comprehensive medical nutrition therapy.

### **Inflammatory Bowel Disease**

Inflammatory bowel diseases, including ulcerative colitis and Crohn's disease, may cause deficiencies of vitamin B6, B12, folate, iron, zinc, magnesium and calcium. The impact of these deficiencies on the oral cavity has been discussed in the previous section. In addition, Crohn's disease may cause a painful aphthous stomatitis which can compromise eating and nutritional status. Determination of the cause of the deficiency and appropriate management is important to prevent further deterioration in nutrition status and compromised eating ability.

### **Diabetes**

Diabetes mellitus is a systemic disease associated with delayed wound healing and oral manifestations which may alter nutrient intake and compromise nutrition status. Poorly controlled diabetes mellitus is associated with glossodynia, xerostomia, candidiasis, gingivitis, periodontitis and altered taste (17, 19, 20). Up to 30% of individuals over the age of 19 with type 1 diabetes have periodontal disease (20). Good oral health is important in order for individuals to be able to consume a diet adequate for maintaining glycemic control. Good glycemic control through diet is essential to restore oral and overall health, and maximize patient response to dental procedures including surgery, denture placement and operative care. Individuals with diabetes should be referred to an R.D. for medical nutrition therapy. Diet counseling is extremely important prior to and following surgical or treatment procedures which may alter eating ability.

### **Renal Disease**

Renal disease has significant dietary, nutritional and oral implications. Significant restriction of dietary protein, sodium, potassium, phosphorus and fluid intake is necessitated for management of patients with renal failure. Meanwhile, calorie and calcium intake, as well as other water soluble vitamins and iron, need to be increased to promote and maintain desirable body weight and nutritional status. Iron deficiency anemia, osteomalacia, and deficiencies of other water soluble vitamins may occur. Dental sequelae including ulcerative stomatitis, xerostomia, and urea in the saliva may further compromise nutritional status and dietary intake. The high simple carbohydrate diet followed by individuals with end-stage renal disease combined with the presence of xerostomia increases risk of tooth decay. Rinsing the mouth or brushing teeth following all meals and snacks should be

encouraged to minimize caries risk factors.

### **Human Immunodeficiency Virus (HIV)**

HIV-associated oral conditions include Kaposi's sarcoma, fungal, bacterial and viral infections, ulcerative stomatitis, and periodontal disease (21). These problems are all associated with functional limitations on eating ability, contributing to diminished oral intake and consequent malnutrition. In order to meet energy and nutrient needs, diets need to be individually tailored in texture, temperature and consistency to minimize pain and maximize intake. Appetite stimulants may be used to combat anorexia and promote weight gain. Oral nutrition supplements may be needed to meet the increased caloric and protein needs of the HIV<sup>+</sup> patient.

### **Head and Neck Cancer**

Head and neck cancer therapies are associated with painful oral conditions that may compromise intake. Surgeries may compromise mastication, increase energy and nutrient needs and permanently affect eating ability. Radiation to the oropharyngeal region may result in xerostomia, altered taste, tooth loss, stomatitis and muscle fibrosis. These complications, combined with anorexia, may lead to nutrient deficiencies and malnutrition. The vicious cycle of oral manifestations secondary to therapy, nutrient deficiencies and increased needs for nutrients is quite apparent in this population. Medical nutrition therapy is critical to meet energy, nutrient and fluid needs with a diet tailored to the taste, consistency and temperature needs of the individual. If needs cannot be met orally, enteral tube feedings should be considered to prevent further deterioration in nutrition status, replete deficiency states, and restore overall nutritional health.

### **Transplant Patients**

Oral health and nutrition status must be monitored in the management of the transplant patient. The immunosuppressive medications and steroids have oral- and nutrition-related sequelae including impaired glucose tolerance, osteoporosis, osteopenia and compromised integrity of the oral cavity soft tissue. Vitamin and trace element supplements are prescribed to promote repletion of body stores. Calcium in particular is needed to prevent osteoporosis associated with steroid therapy.

### **Conclusion**

The health care paradigm has shifted; physicians, dentists and registered dietitians, as well as other health professionals, are increasingly responsible for the conduct of comprehensive health screening, discipline-specific management and referral to the appropriate provider for more comprehensive care. Nutrition risk evaluation is part of the scope of practice of all health professionals; early detection of risk for nutrient deficiencies during medical or dental exams, recognition of oral manifestations of nutrient deficiencies and other diseases with referral to and the collaboration with the registered dietitian in the provision of nutrition therapy is the responsibility of all health-care providers (22–24). Registered dietitians have also assumed the responsibility of incorporating a comprehensive approach to patient assessment and management in addition to providing medical nutrition therapy (24).

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Further research is necessary to understand more fully the synergy between nutrition and oral conditions in health and disease. Given the diversity of information and misinformation available concerning nutrients, it is incumbent upon professionals to understand the relationships between nutrients and oral manifestations if they are to properly diagnose and triage their patients as well as review the scientific basis and research cited to support the claims and advise patients accordingly. Nutrition can only cure malnutrition. More is not always better; toxicities, particularly with certain trace elements and fat soluble vitamins, are possible.

There is a clear synergy between oral health and nutrition; nutrition plays a crucial role in maintaining the integrity and normal function of the oral cavity (24). Nutrient deficiencies and oral manifestations of disease which alter that integrity contribute to compromised dietary intake, resulting in deficiency states, malnutrition and poor wound healing following procedures or surgeries. It is the responsibility of all health professionals to be alert to risk factors for and clinical signs of nutrient deficiencies in their patient populations. Physicians, dentists, registered dietitians and other health professionals must collaborate in the provision of comprehensive patient care. Collaborative approaches to patient assessment, management and referral are critical to the emerging role of today's health care professional.

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