Factors predisposing to oral yeast infections

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The discussion of factors predisposing to oral yeast infections is very important, and we can ask: what is primary and what is secondary? Without predisposing factors it is difficult to have oral yeast infections, and a yeast infection may also be the first sign of a developing basic illness. As long as the predisposing factors cannot be eliminated, recurrences of oral yeast infections are to be expected. We can say that local and systemic factors permit this microorganism to cause disease and that it is extremely rare to find a case of oral candidosis in which one or more of these factors cannot be identified. There are many kinds of lists in the textbooks and some review articles in the literature, but more research is needed for better understanding of factors predisposing to oral yeast infections. □ *Candidiasis, oral; fungal infections; oral flora; pathogenesis*

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Multiple factors predispose to fungal infections. Local and systemic factors so frequently permit *Candida* to cause disease that it is extremely rare to find a case of oral candidosis in which one or more of these factors cannot be identified (1). Odds (2) has presented a general classification of localized and systemic factors that predispose humans to candidosis: natural factors; dietary factors; mechanical factors; and iatrogenic medical factors.

The following list of such factors is based on a review of the literature (1–6):

Chronic local irritants
Ill-fitting appliances
Inadequate care of an appliance
Disturbed oral ecology or marked changes in the oral microbial flora by antibiotics, corticosteroids, or xerostomia
Dietary factors
Endocrine disorders
Immunologic deficiency
Malignant and chronic diseases
Severe blood dyscrasias
Radiation to head and neck
Abnormal nutrition
Age
Hospitalization
Oral epithelial dysplasia
Heavy smoking

Chronic local irritants/ill-fitting appliances/inadequate hygiene

Budtz-Jörgensen (7) estimated the frequency of denture stomatitis to be 40% among Danish denture wearers. Women are affected three times more often than men. Children wearing orthodontic plates may be similarly diseased (8). Denture stomatitis exists mainly in the maxillary denture-bearing area and is rarely found under the mandibular denture. High salivary yeast counts were much commoner in full-denture wearers than in dentate subjects (9). In over 80% of patients with angular cheilitis there is a coexistent denture stomatitis. Angular cheilitis is rare in patients with a natural dentition (1). According to the literature, the presence of yeasts in association with denture stomatitis was demonstrable in 78–100% of the cases (3, 10, 11).

Disturbed oral ecology/flora changes due to drugs or xerostomia

It is well known that many patients on broad-spectrum antibiotic therapy may be subjected to major alterations in the oral microflora. Postantibiotic stomatitis, glossitis, and

so forth, often caused by *C. albicans*, are well-known events (12, 13). Topical, systemic, and aerosolized inhalant means of administering corticosteroids are all important in this respect, and excessive use of antibacterial mouthrinses can also be followed by oral yeast infections. Drugs with xerostomic side effects (psychopharmaceuticals) predispose to oral mycoses (4). Salivary gland diseases (Sjögren's syndrome, sarcoidosis) also lead to marked changes in the oral microbial flora and xerostomia. The normal flow of saliva, with its antimicrobial constituents lysozyme, lactoferrin, the lactoperoxidase system, and salivary glycoproteins, is important. Competition for adherence and nutrition provided by oral and gastrointestinal bacteria are involved in limiting the growth and dissemination of fungi as well (14–18).

Dietary factors

There is some evidence that vitamin deficiencies may predispose to candidosis. Hypovitaminosis A has been detected in some cases of mucocutaneous candidosis (reviewed in Ref. 2). In some patients with oral thrush, folate deficiency has been shown to be a significant factor (reviewed in Ref. 2). Gentles & La Touche (referred in Ref. 2) listed a carbohydrate-rich diet as a factor predisposing to candidosis. The direct evidence for effects of high-carbohydrate diets on candida overgrowth and infection in vivo is still rather minimal. Sucrose oral rinses aggravated palatal candidosis in some patients with denture stomatitis, and denture adhesives mixed with sucrose support *C. albicans* growth in vitro (2).

Endocrine/immunologic disorders

Chronic hyperplastic candidosis may occur as part of chronic mucocutaneous candidosis, often with identifiable immunologic or endocrine abnormality as a major factor predisposing the patient to development of similar lesions around the nails and other skin sites or, alternatively, as isolated oral lesions (1). These endocrine disorders have a familial incidence and are found in children and young adults only, most frequently in girls. The most frequently associated endocrine manifestations include idiopathic hyperparathyroidism and hypoadrenocorticism (4, 19, 20).

Malignant and chronic diseases

Host defense mechanisms are impaired by the malignant process and its chemotherapy, which lead to disordered numbers and dysfunction of polymorphonuclear and mononuclear phagocytes (5, 18, 21). In the acquired immunodeficiency syndrome (AIDS) oral mycoses often occur (22, 23).

Severe blood dyscrasias

Acute forms of oral mycoses are frequent in patients with myeloproliferative diseases and provide potential sources for fungal septicemia (18, 24, 25). According to Kostiala (18), *C. albicans* was isolated in virtually all episodes of fungal stomatitis in patients with hematologic malignancies. Other species of fungi also occurred, such as *Geotrichum candidum* and *Saccharomyces cerevisiae.*

Radiation to head and neck

Radiation therapy to the head and neck is also a factor predisposing to oral yeast infections. In experimental animals irradiation of the salivary glands leads to disturbed excretion of immunoglobulins in the saliva, which can lower the efficiency of humoral immunologic defense mechanisms against infection in the oral cavity (26).

Abnormal nutrition/age/convalescence

Abnormal nutrition (malabsorption, parenteral nutrition), certain age groups (infants, elderly people), and convalescence after operations (heart and transplantation

Table 1. Tests for underlying disorders of yeast infections

Routine blood and urine examination	Tests for endocrine function	Tests for salivary gland abnormalities	Tests of immunologic function
Blood film	Protein-bound iodine	Parotid flow rates	Humoral immunity
Hemoglobin	Random blood sugar	Labial gland biopsy	Local
Absolute values	Serum Ca^{++}, PO_4^-	Sialography	Salivary immunoglobulins
Erythrocyte sedimentation values	Alkaline phosphatase	Salivary duct antibody	Salivary antibodies to *Candida*
Leukocyte count	Synacthen test	Rheumatoid factor	Systemic
Serum iron/total iron-binding capacity		Antinuclear factor	Serum immunoglobulins
Proteins			Serum antibodies to *Candida*
Vitamin B_{12}			Cell-mediated immunity
Folate			Skin tests: *Candida*, purified protein derivative of tuberculin, streptokinase, mumps antigen
Pyridoxine			Lymphocyte transformation: phytohemagglutinin, *Candida*
Dextrostix test			Production of lymphokines: M.I.F. assay
			Tests of neutrophil function
			Nitroblue tetrazolium
			Myeloperoxidase stain

surgery) are also factors predisposing to oral yeast infections (4).

Epithelial dysplasia/smoking

Oral epithelial dysplasia, congenital or acquired, is often seen in lesions of chronic hyperplastic candidosis. Clinically, these lesions cannot be differentiated from leukoplakia, and candidosis must be confirmed by biopsy (8, 27). The etiology of candidal leukoplakia is unclear, but smoking predisposes. About 10% of biopsy specimens from oral leukoplakia-like lesions showed histologic changes typical of candidosis (4).

The discussion of the significance of predisposing factors to oral yeast infections is very important, and we can ask: is oral yeast infection always secondary to some underlying disease or factor? Without predisposing factors it is difficult to have oral yeast infections, and a yeast infection may also be the first sign of a developing basic illness such as diabetes. As long as the predisposing factors cannot be eliminated, recurrences of oral yeast infections are to be expected (4). Probably, the most effective treatment of oral candidosis will also correct the predisposing factors.

For the underlying disorders of yeast infections Jenkins (6) suggested the tests shown in Table I.

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