In Brief

In addition to periodontitis and dental caries, other oral conditions commonly occur commonly in patients with diabetes. These include fungal infections, salivary gland dysfunction, neuropathy, and mucosal disorders. Many of these lesions can be easily examined and documented by non-dental providers.

Non-Periodontal Oral Manifestations of Diabetes: A Framework for Medical Care Providers

Evidence that diabetes significantly affects oral tissues is supported by data in an increasing number of publications. Diabetes causes changes in the periodontal tissues, oral mucosa, salivary gland function, and oral neural function and increases the risk for caries. Additionally, reproductive hormone changes during pregnancy significantly affect periodontal health in women with pre-existing and gestational diabetes. These oral manifestations, their mechanisms, and their interrelationships are shown in Figure 1.

Although dental care providers have traditionally played a primary role in the examination and diagnosis of the specific disorders of these tissues, other health care providers who are responsible for diagnosing and managing patients with diabetes and pregnant patients can also easily screen for these oral abnormalities. Changes in oral soft tissues, in addition to periodontal tissues, can be helpful in the diagnosis of diabetes in undiagnosed patients and may serve as aids in monitoring the care of patients with known diabetes.

The goals of this article are 1) to describe soft-tissue disorders in the oral cavity that are commonly observed in diabetes and can be easily recognized by all health care providers either by history or clinical appearance, and 2) to provide a checklist to facilitate oral examination for these conditions that may also serve as a tool for communication between medical providers.

Figure 1. Oral manifestations of diabetes and their mechanisms and interrelationships.
and dental providers. The checklist can also assist providers in informing patients that further oral health evaluation and care are indicated.

The oral tissues most commonly affected by diabetes are the periodontal tissues. This can appear as redness and swelling of the gingiva, bleeding from the gingiva with minor provocation, looseness and spacing of teeth, and exposed root surfaces (at risk for caries) that may or may not carry plaque and mineralized deposits (calculus), depending on the oral hygiene of the individual (Figure 2). The significance of occurrence and pathogenic role of periodontitis in diabetic patients is described elsewhere in this issue (p. 195) and in the scientific literature. The focus of this article will be on describing changes in the oral tissues of diabetic patients that include salivary gland dysfunction, mucosal changes, and neuropathy.

**Healthy Oral Mucosa**

The oral mucosa is normally protected by saliva when it is adequate in amount and quality. Saliva provides lubrication, cleansing, pH buffering, antimicrobial proteins such as secretory IgA, and aggregation and clearance of bacteria. The epithelium and minor salivary glands in the mucosa contribute to innate immunity via α- and β-defensins, histatin, and other antimicrobial peptides and proteins. These two major features affect the ability of the oral soft tissues to be resilient when challenged by injurious microbes; excessive exposure to mechanical trauma, which can occur if there are jagged edges of broken teeth, defective dental restorations, or poorly fitting dentures; or chemical trauma such as that caused by tobacco and excessive alcohol use. The health of the oral mucosa is also maintained by good nutritional status and adequate oral hygiene practices.

Because salivary gland function and immune function are negatively affected by diabetes, diabetic patients are at increased risk for mucosal lesions and other disorders. This has been supported by recent studies showing that oral soft-tissue disease occurs up to 10 times more frequently in patients with diabetes than in nondiabetic patients.

**Salivary Gland Changes**

The oral manifestations of diabetes in the salivary glands include sialoadenosis or noninflammatory, non-neoplastic enlargement of the parotid salivary glands, decreased salivary flow rates, and changes in salivary composition. Bilateral enlargement of the parotid salivary glands has been reported to occur in 10–48% of diabetic patients and may be more common in patients with poorly controlled diabetes.

The enlargements are caused by gradual accumulation of fat in the glands, hypertrophy of the acini or secreting units, and, eventually, impaired glandular secretion. These structural changes may be the result of alteration in autonomic neuroregulation of the glands and atrophy of the myoepithelial cells that facilitate secretion. Enlarged parotid glands are also observed in individuals with a history of alcoholism, malnutrition, eating disorders, or medication side effects, and these conditions should be included in a differential diagnosis. However, the pathophysiology of these conditions is different.

Xerostomia, or the sensation of dry mouth, is reported to occur in 40–80% of diabetic patients and is related to decreased salivary flow rates, particularly in unstimulated whole saliva (the combination of secretions from all the salivary glands in the mouth). Flow rates have been reported to be significantly lower in patients with poorly controlled diabetes compared to patients whose diabetes is controlled or nondiabetic patients.

The mechanism by which salivary flow is affected in diabetic patients is thought to be the result of autonomic nerve dysfunction or microvascular changes that diminish the ability of the salivary glands to respond to neural or hormonal stimulation. Other causes may include dehydration or side effects of concomitant drug therapy commonly used in diabetic patients (e.g., antihypertensives, diuretics, and antidepressants).

Low salivary flow rates are significant because saliva provides a protective coating for the oral mucosa that contains antimicrobial proteins and immunoglobulins, buffers acidic foods and liquids, and contains calcium, which is important for mineral exchange at the tooth surface. Lack of adequate saliva leads to an increased risk of oral yeast infections, increased caries rate, and difficulty with maintaining oral hygiene, as well as a decrease in quality of life because of discomfort from eating, swallowing, and talking.

Validated signs and symptoms of an abnormally low salivary flow rate have been described in the literature. These signs and symptoms (Figure 3) can facilitate the detection of impaired salivary function by health care professionals and support referral to a dental health care provider to manage or provide preventive or intervention care for these conditions.

**Mucosal Disorders**

Disorders of the oral mucosa commonly occurring in diabetic patients include atrophy of the mucosa, candidiasis (thrush), and lichen planus or lichenoid mucositis. These disorders are related to chronic salivary hypofunction and to the generalized immune dysfunction seen in diabetic patients.

**Tongue Abnormalities**

After periodontal tissues, the oral site most frequently affected in diabetes is the mucosa of the tongue. Normally, the dorsal surface of the tongue has an even distribution of the filiform and fungiform papillae, giving a textured appearance that is light pink in color. The ventral and lateral surfaces of the normal tongue are smooth, free of papilla, and darker pink in color, occasionally with prominent veins. In a fissured tongue, the smooth texture of the dorsum is interrupted with one or more fissures that are predominantly aligned along the length of the tongue (Figure 4).

This fissuring may be the result of a chronic low salivary flow rate, which alters the environment in the oral cavity such that slow-healing soft tissues are more easily traumatized than in nondiabetic patients. A recent study of 405 diabetic individuals showed that 5.4% of patients with type 1 diabetes had fissuring of the tongue dorsum compared with 0.4% of patients with type 2 diabetes.
of control subjects without diabetes ($P < 0.0001$). In another study of 146 type 2 diabetic patients,\textsuperscript{1} the rate of fissured tongue was 17.8% compared to 3.6% in the 111 age- and sex-matched control subjects ($P < 0.001$).

Complete or patchy atrophy of the tongue papilla, resulting in the appearance of a “bald” tongue (Figure 4), is also more common in diabetic patients.\textsuperscript{3} Generalized atrophy of the papilla of the tongue has been attributed to nutritional deficiencies, particularly if it is very red in appearance.\textsuperscript{32} Focal areas of atrophy may indicate an infection with candida organisms.\textsuperscript{33}

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**Diabetes and Oral Health Checklist for Non-Dental Providers**

**Date of Last Dental Visit ________________**

**Questions and Signs for Oral Dryness or Neuropathy**

- Do you have trouble swallowing food? 
- Do you have trouble chewing? 
- Do you need liquid to help swallow food? 
- Do you feel you have an adequate amount of saliva? 
- Do you have a burning sensation of tongue, lips, or palate? 

  □ Yes □ No

**Signs of Salivary Hyposecretion:**

- Wooden tongue blade sticks to oral mucosa
- Lack of pooling of saliva under the tongue
- Enlargement of parotid glands

  □ Yes □ No

**Oral Mucosal Changes**

**Tongue:**

- Fissured tongue
- Atrophic (“bald”) tongue surface
- Median rhomboid glossitis (midline posterior “bald” spot)
- Benign migratory glossitis (patchy, irregular, well-demarcated “bald” areas on tongue)

  □ Yes □ No

**Palate** (for edentulous denture wearers—possible candidiasis):

- Redness of mucosa under upper denture
- Swollen appearance of palatal mucosa

  □ Yes □ No

**Lips:**

- Angular cheilitis (fissures or inflammation at lip corners)

  □ Yes □ No

**White surface changes of buccal, labial, palatal mucosa or tongue:**

- Wipes off, leaves underlying reddened surface (possible candidiasis)
- Does not wipe off, lacy appearance over reddened surface (possible lichenoid lesion)

  □ Yes □ No

**Ulcer(s):**

Location, size: ____________________________________________

  □ Yes □ No

**Signs of Periodontitis**

- Bleeding, redness of gums
- Loose teeth, spacing between teeth
- Presence of grey/yellow deposits on teeth

  □ Yes □ No

**Signs of Caries**

- Cavitations or visible holes in crowns or roots of teeth
- Discoloration or visible holes in exposed roots of teeth

  □ Yes □ No

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Figure 3. A checklist to facilitate oral examination by non-dental providers and promote communication between medical and dental providers.
A unique condition in which an atrophic “bald” spot is located at the midline, posterior surface of the tongue, anterior to the V-shaped circumvallate papillae, is called median rhomboid glossitis (Figure 5). It is commonly smooth and flat, but may be depressed or have a lobular to papillary surface. It is a recognized manifestation of chronic candidiasis.

In a study of 176 diabetic patients, atrophy of the tongue was found in 26.9% of the patients, with almost all appearing as central papillary atrophy. In another study, median rhomboid glossitis was significantly more prevalent in diabetic patients than in nondiabetic patients and was associated with elevated levels of Candida pseudohyphae in oral smears and diabetic complications of nephropathy and retinopathy.

Another condition of the tongue that is more common in diabetic than in nondiabetic patients is geographic tongue, or benign migratory glossitis (Figure 6). This condition features focal atrophy of the papilla of the tongue in an irregular “geographic” pattern with characteristic prominent white or yellowish raised borders that “migrate” over time. This condition is not caused by a candida infection but is characterized as inflammation and may also be associated with similar symptoms of pain, itching, and burning of the mucosa.

Oral Candidiasis

The combination of a low flow rate and immune dysfunction greatly increases the risk of oral candidiasis, which is supported by the finding of significantly higher rates of candida carriage in patients with diabetes compared to control subjects. This may also be the result of increased salivary glucose levels, which promote overgrowth of Candida, as well as decreased antifungal immunoglobulins in saliva caused by diabetes.

Candidiasis may also affect the palate, buccal, or labial mucosa. Denture stomatitis is a diffuse redness of the mucosa occurring under upper dentures in edentulous patients (Figure 7), particularly when patients complain that their dentures do not fit well. The most common symptom is a burning sensation, although patients may also be asymptomatic. This is considered to be a form of candidiasis with the organism actually infecting the porous denture acrylic and causing contact hypersensitivity inflammation of the adjacent mucosa.

In a study of 110 edentulous individuals with type 2 diabetes compared to 50 control subjects, 57.3% of the diabetic patients versus 30% of control subjects had denture stomatitis. In another study of 405 subjects with type 1 diabetes compared to 268 nondiabetic patients, elevated A1C was shown to be significantly associated with the presence of denture stomatitis or the presence of Candida pseudohyphae in oral swabs.

White areas on oral mucosal surfaces that can be wiped off with cotton gauze leaving a reddened, bleeding surface (without loss of the surface epithelium) are likely to be acute pseudomembranous candidiasis (Figure 8). Typically, patients complain of a burning sensation of the mucosa. If the wiping procedure causes separation of the surface epithelium from the underlying tissues (known as Nikolsky’s sign), it is suggestive of a vesiculobullous lesion such as in drug reactions or dermatological autoimmune conditions and requires biopsy for definitive diagnosis.

Angular cheilitis is redness or fissures at the corners of the mouth involving the junction of the mucosa and skin and may also represent a form of candidiasis. This condition occurs significantly more frequently in diabetic than in nondiabetic patients. Other causes of angular cheilitis that should be included in a differential diagnosis include vitamin deficiencies, anemia, staphylococcal infections, and decrease in face height caused by mouth overclosure from loss of teeth.

Oral Lichen Planus and Lichenoid Drug Reactions

White areas of the mucosa that do not wipe off may be a sign of a condition known as lichen planus, a chronic subepithelial inflammatory disorder that results in a characteristic lacy or patch-like white pattern over reddened mucosa (Figure 9). Although its exact etiology is not known, the presence of this mucosal disease has been frequently associated with diabetes.

However, similar mucosal changes called lichenoid drug reactions occur as an adverse side effect to medications that diabetic patients are commonly prescribed. These include antihyperglycemic and antihypertensive
medications. Lichen planus or lichenoid reactions may be symptomatic with pain, burning sensation, and sensitivity to acidic foods. They are associated with an increased risk for dysplastic or cancerous transformation. Therefore, it is important to refer patients with this mucosal change to the dental team for further evaluation.1,12

**Oral Cancer**

Lesions of the dorsal surface of the tongue are unlikely to be cancerous but should be referred to the dental team for diagnosis and treatment. However, the occurrence of a lesion of the lateral or ventral tongue, whether it is white or red or a nonhealing ulceration is always of concern and should be referred immediately to rule out squamous carcinoma.34 This recommendation also applies to lesions occurring in other areas of high cancer risk such as the floor of the mouth and tonsillar areas. Patients with diabetics are at higher risk for oral cancer occurrence than patients without diabetes, particularly if there is a history of chronic smoking and excessive alcohol intake.43–47

**Effects of Smoking**

There is substantial evidence that the presence of a smoking habit in diabetic patients significantly increases not only the risk of oral cancer, but also the risk periodontal disease48 and mucosal disorders of any type.1,3,5 These factors support frequent thorough oral examinations and regular oral care, as well as smoking cessation programs in the management of oral mucosal and periodontal disease in patients with diabetes who smoke.

**Burning Sensation of the Oral Mucosa**

A burning sensation of the oral soft tissues is a frequent complaint in diabetic patients, making diabetes the systemic condition most frequently associated with this symptom.49–51

Although oral mucosal conditions such as *Candida* infections, lichen planus, and dryness can cause burning sensations in diabetic patients, a neuropathic basis is supported by observations that the burning sensations in diabetic patients are frequently accompanied by changes in taste (dysgeusia) or other sensory distortions.31,33–35 Additionally, patients with peripheral diabetic neuropathy are more likely to have burning sensations in oral tissues than those without peripheral neuropathy.56 Therefore, questions about sensations of burning in the soft tissues of the oral soft cavity will be helpful to determine the possible presence of candidiasis, lichen planus, oral dryness, or neuropathy, all of which may assist in evaluation of irregular glycemic control.2

**Clinical Oral Health Checklist for Diabetes**

Fortunately, most oral tissues can be examined easily and palpated by any health care provider. Good illumination with a lamp, flashlight, headlamp, or otoscope light is important. All surfaces of the tongue should be examined. The tip of the tongue can be gently grasped with a 2-inch cotton gauze square to stabilize and manipulate the tongue, or a wooden tongue depressor may be used to retract, depress, or lift the tongue. The tongue depressor can also be used to retract soft tissues to examine the other oral surfaces, including the buccal and labial mucosa, floor of mouth, hard and soft palate, periodontium, and teeth. White areas on the surface of the mucosa should be wiped with a gauze square to see if they wipe off or indicate an integral mucosal alteration.

Figure 3 offers a sample checklist containing items to assist health care team members in detecting and documenting oral findings that can contribute to the diagnosis of diabetes and management of diabetic patients. Additionally, this checklist can be the basis of a structured referral form in an electronic health record that can be used for communication between the medical and dental care providers, keeping in mind that, for any form to be successful, the care providers must discuss mutual expectations and agree on what constitutes effective and efficient communication for their particular relationship.57

We recommend that the clinical standard of comprehensive care for diabetic patients should include, at a minimum, a yearly screening of oral health status by medical providers, similar to the screening frequency for eye and foot health.5 If patients have one or more of the findings on the checklist, they should be evaluated for level of glycemic control and referred to a dentist for evaluation and care of the oral condition.59 Yearly or more frequent prophylactic care, including dental cleanings, restorative work as needed, and oral hygiene instruction by a dental team, is also recommended, depending on the oral health status and glycemic control of the patient.

**Conclusion**

In addition to periodontitis, certain non-periodontal oral lesions and conditions have been associated with and are commonly observed in patients with diabetes. These include oral dryness, caries, burning mouth sensation or other neuropathy, enlarged parotid glands, atrophic or lichenoid mucosal changes, and mucosal infection such as candidiasis.

We have included photos, a diagram to help illustrate the oral manifestations of diabetes, and a checklist to help non-dental health care providers evaluate patients’ oral signs and symptoms of diabetes and monitor therapy. The checklist also provides criteria for the clinical recognition of oral lesions that may occur in undiagnosed diabetes. It can and should be customized to suit the needs of specific health care teams to deliver care efficiently and to obtain the best oral and systemic health outcomes for their patients.

**References**


Diabetes Spectrum Volume 24, Number 4, 2011


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