



Dental Management of Xerostomia — Opportunity, Expertise, Obligation

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ABSTRACT Xerostomia often goes undiagnosed and unmanaged. Failure to properly deal with this condition leaves patients at greater risk for other problems. Dentists have the opportunity, the expertise, and the obligation to identify and manage xerostomia and its complications. This article presents a practical approach to diagnosis and treatment of xerostomia and its complications.

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The term xerostomia comes from the Greek words “xeros” meaning dry and “stoma” meaning mouth.

It is defined in Stedman’s medical dictionary as “A dryness of the mouth, having varied etiology, resulting from diminished or arrested salivary secretions, or asialism.”¹

It is unfortunate the term has been commonly adopted to refer only to the perception of dry mouth. This has led to a difficulty in describing the epidemiology of xerostomia as some studies have been based only on the subjects’ perceptions rather than on objective findings of dry mouth.²

The prevalence of xerostomia in population-based samples has been reported to vary from 0.9 percent to 64.8 percent.² Dry mouth is a more common complaint in the elderly. Its prevalence has been estimated to be 30 percent in those 65 years and older.³ It is generally accepted this is mainly due to medical problems and their treatments rather than to any age-related physiologic changes.³

Etiology

Familiarity with the causes of xerostomia will help the clinician identify those patients at greatest risk for the problem. Most cases of xerostomia are the result of decreased saliva production or hyposalivation.⁴ The most frequent cause of this is medication use.⁵

A wide variety of prescription and over-the-counter medications may cause hyposalivation.⁶ The categories of medications most often associated with xerostomia are listed in **TABLE 1**. Many medications not included in these categories may also cause dry mouth, although less frequently.

Several medical conditions are known to affect the salivary glands and result in decreased saliva production (**TABLE 1**).^{3,5} The most well known is Sjögren’s disease, a chronic autoimmune disorder that is thought to affect more than 1 million people in the United States.⁷ It is most common in middle-aged females. It may occur as a primary disorder, also known as Sicca syndrome, affecting only the salivary

and lacrimal glands. It more often occurs as a secondary disorder in association with other conditions such as rheumatoid arthritis or lupus erythematosus.

Radiation therapy for the management of head and neck cancer is a well-recognized cause of xerostomia.

TABLE 1

Causes of Xerostomia

Medications

- Anticholinergics
- Antiparkinsonian
- Antidepressants
- Antineoplastics
- Antipsychotics
- Antihypertensives
- Central nervous system stimulants
- Diuretics
- Systemic antihistamines

Medical Conditions

- Sjögren's disease
- Connective tissue disorders
- Diabetes mellitus
- Diabetes insipidus
- Sarcoidosis
- HIV-disease
- Hepatitis C virus infection
- Graft versus host disease
- Parkinson's disease
- Psychogenic disorders

Radiation Therapy

Other

- Inadequate fluid intake
- Excessive caffeine or alcohol use
- Vomiting and diarrhea
- Mouth breathing
- Decreased mastication
- Smoking

Developmental Abnormality

- Salivary gland aplasia

TABLE 2

Patient History in Evaluation for Xerostomia

Medical History	Past and present medical diagnoses Past and present medical treatments Undiagnosed symptoms
Medication History	Name of medication Dosage/change in dosage Reason for taking How long taken
Dental History	Types of dental treatment Extent of dental treatment Oral home care practices Dietary habits
Patient Perception of Oral Condition	Do you have a sticky, dry feeling in your mouth? Do you have trouble chewing, swallowing, tasting, or speaking? Do you have trouble wearing a denture? Do you have a sore or burning feeling in your mouth? Do you have bad breath?

Radiation therapy causes transient or permanent damage to salivary gland tissue, which results in decreased or, in some cases, loss of saliva production. The severity and duration of radiation-induced xerostomia depends on the type of therapy, the dosage, and the specific area being irradiated.⁵

In some patients, xerostomia may be a side effect of dehydration. Dehydration may be due to inadequate fluid intake. Elderly patients who suffer from incontinence may underhydrate in an attempt to self-manage the problem. Dehydration may also be due to excessive use of caffeine or alcohol, both of which act as diuretics resulting in a net fluid loss. Vomiting and diarrhea are other causes of fluid loss that may result in xerostomia. Mouth breathing also may cause xerostomia as a result of superficial dehydration of oral soft tissues.

Mastication normally plays an important role in stimulating saliva flow. Loss of this stimulus may be a cause of xerostomia in patients who are unable to masticate due to dental, neuromuscular, or other problems. Smoking commonly

contributes to dry mouth. Although rare, developmental abnormalities such as salivary gland aplasia cause xerostomia.

Complications

The roles of saliva are numerous and varied.^{6,8} They include cleansing, buffering, remineralizing, moisturizing, lubricating, and fighting infection. It follows that the more common complications of hyposalivation include dental caries, periodontal disease, candidiasis, mucositis, and halitosis.⁸ Other complications such as difficulty chewing, swallowing, tasting, and wearing oral prostheses often interfere with eating, which decreases one's quality of life and may lead to nutritional deficiencies. With severe xerostomia even speaking may be difficult. In some cases, problems with speaking, eating, wearing prostheses, halitosis, or chronic mucosal pain may have significant negative psychosocial effects.

Diagnosis

Establishing a diagnosis of xerostomia is dependent on a thorough patient history and clinical evaluation.^{9,10} The

possibility of xerostomia should be considered even for patients who do not complain of dry mouth. Furthermore, the possibility of xerostomia should be considered not only upon initial evaluation but on an ongoing basis for all patients.

Specific information obtained in the medical history may raise concern for xerostomia (TABLE 2). In addition to information about diagnosed medical conditions, a complete medical history should include discussion about any undiagnosed symptoms. A thorough medication history with identification of potentially xerogenic agents is an essential part of every patient work-up.

The patient's dental history may also raise concern for xerostomia (TABLE 2). For example, xerostomia should be seriously considered in the patient who has required extensive dental treatment in spite of a good oral hygiene practices and a diet low in sugar and refined carbohydrates.

Every patient interview should include questions to determine the patient's perception of their oral condition (TABLE 2). Positive responses to these questions indicate further evaluation for xerostomia.

A wide variety of clinical abnormalities may be associated with xerostomia (TABLE 3).^{6,9-11} While most of these findings are nonspecific, when combined with appropriate historical information they can be supportive of the diagnosis and some, such as dry mucosa and an inability to stimulate saliva flow, may even be considered diagnostic.

Although a thorough history and clinical examination may be sufficient to diagnose xerostomia in most patients, specific diagnostic evaluations such as the measurement of unstimulated and stimulated saliva flow, labial salivary gland biopsy, salivary gland imaging, or blood studies may be required to establish a definitive diagnosis or to determine the cause.^{5,10,11}

TABLE 3

Clinical Findings in Xerostomia

Major Salivary Glands	Visible or palpable enlargement Tender to palpation Unable to express clear saliva on massage Purulent material expressed from ducts
Mucosa	Dry to touch Unable to stimulate saliva on manipulation Ulcers Atrophy Erythema White plaques Fissured tongue
Lips	Dry, chapped, or cracked
Dentition	High caries rate Heavy accumulation of plaque and debris
Other	Halitosis

Collection and measurement of whole saliva requires no specialized equipment and can be accomplished easily in the dental office.¹⁰ Patients should be instructed to avoid all forms of oral stimulation such as eating, drinking, smoking, chewing gum, or performing oral hygiene for 90 minutes prior to testing. To collect whole saliva, the patient is seated upright with eyes open, head tilted forward, and the mouth positioned over a funnel that sits within a test tube. For unstimulated saliva, the patient is asked to swallow first and then allow saliva to passively flow over the lower lip into the funnel. At the end of the five-minute collection period, the patient is asked to spit any saliva remaining in the mouth into the funnel. Collection of stimulated whole saliva is similar; however, the patient is given a piece of gum to chew at approximately 45 chews per minute and asked to clear the mouth of saliva by spitting into the funnel every minute for five minutes. The flow rate for each sample is calculated in milliliters per minute by dividing the volume collected by 5.

It is generally considered that an unstimulated flow rate of 0.2 mL/minute or less and a chewing stimulated flow rate of 0.7 mL/minute or less are abnormally low.¹⁰ To control for the affects of circadian rhythm on salivary flow, it is recommended that unstimulated whole saliva tests be performed at a fixed time point or in a limited time interval early in the morning.¹²

Imaging studies are not routinely performed to diagnose xerostomia; however, scintigraphy (scintiscanning) has been demonstrated to provide useful information about functional capabilities of major salivary glands.¹³ The technique is based on uptake and secretion of ^{99m}Tc-technetium pertechnetate (Tc-99), a pure gamma emitting radionuclide, which is injected intravenously. Tc-99 is taken up by the salivary glands and then secreted with the saliva into the oral cavity. Uptake and secretions phases are detected on scans and a grading scale is applied to assess secretory function. Demonstration of secretory function could be used to predict effectiveness of secretagogue therapy.

Management

Management of a patient with xerostomia has many components. The ideal treatment plan would identify and eliminate the cause or causes of the problem; however, this is not always possible. Realistically, treatment is geared toward improving saliva flow, relieving symptoms, and preventing the complications of the disorder.

Medical Consultation

Often a consultation with the patient's physician is the first step in managing a patient with xerostomia. A medical evaluation may be necessary to identify or rule out an underlying systemic disorder. In the case of medication-induced xerostomia, the physician may be able prescribe an alternative medication that would be less xerogenic or may recommend that the patient take a lower dose of the current medication. In many cases of medication-induced xerostomia, the patient is taking multiple xerogenic medications and it may be necessary to make multiple adjustments before any benefits can be seen. Unfortunately in some cases, medication adjustments cannot be made.

Patient Education

Education is a critical component of patient management in xerostomia. Patients need to be educated regarding the cause of their problem; what, if any, measures can be taken to reduce xerostomia; and what actions will be taken to minimize its consequences. Patients must be made aware that xerostomia is a condition that can have a significant negative impact on oral health and can result in irreversible damage. They must understand they are at increased risk of developing dental caries, periodontal disease, and candidosis. Importantly,

they need to recognize they must play an active role in minimizing the detrimental effects of xerostomia (TABLE 4). Patient information brochures and Web resources serve to reinforce education provided in the dental office. The following Web sites are good examples of Web resources for information regarding xerostomia:

- <http://www.nidcr.nih.gov/Health-Information/DiseasesAndConditions/DryMouthXerostomia/DryMouth.htm>
- <http://www.niams.nih.gov/Health-Information/DiseasesAndConditions/DryMouthXerostomia/DryMouth.htm>
- <http://www.laclede.com>

Saliva Stimulation

Unless there has been total destruction of salivary gland tissue, saliva stimulants are usually effective in improving saliva flow (TABLE 5). There are many systemic agents that may be used for this purpose, but pilocarpine (Salagen) and cevimeline (Evoxac) are the most well-studied and the most widely used.^{5,14}

Both drugs act on muscarinic receptors to produce parasympathetic stimulation. Pilocarpine is a nonselective muscarinic agonist and interacts with M₂ and M₄ receptors of lung and cardiac tissues, as well as with the M₃ receptors of salivary and lacrimal glands. Cevimeline is reported to have M₁ and M₃ selectivity. Theoretically, this should decrease the risk of cardiac and pulmonary side effects; however, the safety and adverse event profiles of pilocarpine and cevimeline are very similar.^{3,14}

As with any systemic medication, medical contraindications, precautions, drug interactions, and side effects need to be considered. As there are many such considerations for both pilocarpine and cevimeline, it is prudent to consult with the patient's physician before prescribing them. Pilocarpine ophthalmic solution, taken orally, is a particularly cost effective means of

TABLE 4

The Role of the Patient in Xerostomia Management

- Ensure adequate hydration by frequently sipping water
- Limit caffeine
- Avoid alcohol
- Use a cool air humidifier (clean daily)
- Sleep on side if possible to reduce mouth breathing
- Avoid sugars and refined carbohydrates
- Practice optimal oral homecare (plaque control)
- Use supplemental fluoride as directed
- Seek professional dental care at least every six months

stimulating saliva flow and it can easily be titrated to the minimum effective dose.⁸

A number of studies have addressed the management of xerostomia in Sjögren's disease via use of medication to modify the underlying disorder. These have included studies with interferon α (IFN- α), corticosteroids, and hydroxychloroquine.⁵ The most promising results have been with low dose IFN- α . Administered as 150 IU lozenges three times daily, IFN- α has increased salivary output with minimal side effects and adverse events.^{5,14}

Saliva may also be effectively stimulated by chewing sugar-free gum or sucking on sugar-free candy. Several chewing gums on the market are sweetened with xylitol, which have been shown to have cariostatic effects.¹⁵

Biotene Dry Mouth Gum (Laclede, Rancho Dominguez, Calif.) not only contains xylitol but also antibacterial enzymes normally found in saliva. When selecting sugar-free candy, patients should be cautioned against those with cinnamon or strong mint flavoring that may irritate soft tissues. While lemon-flavored candies are very effective in stimulating saliva flow, the citric

acid they contain may irritate soft tissue or cause dental erosion with long-term use. An excellent option for safely stimulating saliva flow is SalivaSure (buffered citric acid lozenges, Scandinavian Formulas, Sellersville, Pa.). Since they are buffered, they do not irritate soft tissues or cause dental erosion. They also are sweetened with xylitol.

Moisture Replacement

Adding moisture to the oral environment is particularly important for patients in whom saliva cannot be

stimulated. While there are numerous saliva substitutes on the market, they are variably well-received by patients and their benefits tend to be short-lived. Many patients prefer sipping water to using a saliva substitute. Not only is water sipping the most cost-effective means of improving oral moisture in the short-term, it has the added advantage of contributing to improved hydration. Oral Balance Gel (Laclede), which may be spread on soft tissues or in dentures, provides longer-lasting moisture and

also contains antibacterial enzymes.

Patients with dry mouth often suffer from dry lips. Hydrous lanolin and aloe vera products are very effective in managing this problem. Oral Balance Gel may also be used to relieve dry lips.

General Oral Hygiene

Optimal oral hygiene, including regular tooth brushing and flossing or other interdental cleaning, is essential for patients with xerostomia. These patients should use fluoridated

TABLE 5

Saliva Stimulants

Agent	Directions for Use	Approximate Cost	Medical Considerations
Pilocarpine 5 mg tablet (Salagen or generic)	1 tablet PO TID	TID x 30 days Salagen ≈ 175.00 Generic ≈ 136.00	Contraindications <ul style="list-style-type: none"> ■ Hypersensitivity ■ Uncontrolled asthma ■ Narrow angle glaucoma ■ Acute iritis ■ Patient taking beta-blockers ■ Patient taking anticholinergics Precautions <ul style="list-style-type: none"> ■ Cardiac disease ■ Controlled asthma ■ Chronic bronchitis ■ Chronic obstructive pulmonary disease ■ Cholelithiasis ■ Biliary tract disease ■ Nephrolithiasis Drug interactions
Cevimeline 30 mg capsule (Evoxac)	1 capsule PO TID	TID x 30 days ≈ 183.00	
Pilocarpine 4% ophthalmic solution = 2 mg/drop (generic)	2 drops TID, in 1-2 table-spoons water, swish and swallow, or two drops placed on sugarless gum	TID x 30 days ≈ 7.00	
SalivaSure buffered citric acid lozenge, (Scandinavian Formulas)	Dissolve one lozenge slowly in mouth up to every hour as needed	90 lozenges ≈ 9.00	None

TABLE 6

Prescription Neutral Sodium Fluoride Supplementation

Brush-On One Step <ul style="list-style-type: none"> ■ Prevident 5000 Plus ■ Fluoridex ■ Control Rx 	Brush with pea-sized amount twice daily. Spit out excess. NPO ½ hour after.
Brush-On Two Step <ul style="list-style-type: none"> ■ Prevident 1.1% NaF Gel ■ NeutraCare 1.1% NaF Gel 	Brush with pea-sized amount twice daily <u>after</u> cleaning teeth. Spit out excess. NPO ½ hour after.
Custom Fluoride Trays <ul style="list-style-type: none"> ■ Thera-Flur-N 0.5% NaF Gel 	Apply thin film to inner surface of trays and hold on clean, dry teeth five to six minutes daily. Spit out excess. NPO ½ hour after.

toothpaste that is free of sodium lauryl sulfate, a detergent used as a foaming agent in most commercial toothpastes. Biotene toothpaste (Laclede) is SLS-free and contains antibacterial enzymes normally found in saliva.

Patients with xerostomia who use mouthwash should use a product that is alcohol-free. They should also avoid cinnamon and strong mint flavoring, which may irritate the soft tissue. Biotene mouthwash (Laclede) is alcohol-free and contains xylitol, as well as antibacterial enzymes normally found in saliva.

TABLE 7

Management of Oral Candidiasis

Medication	Dosage and Directions ¹
Chlorhexidine 0.12% alcohol-free aqueous ²	15 ml mouthrinse and expectorate TID. NPO ½ hour after use.
Nystatin 100,000 units/ml sugar-free oral suspension ³ or amphotericin-B 25 mg/ml sugar-free oral suspension ³	5 ml mouthrinse 1 min and expectorate ⁴ QID (PC and HS). NPO ½ hour after use.
Nystatin 100,000 units/ml oral suspension ⁵	5 ml mouthrinse 1 min and expectorate ⁴ QID (PC and HS). NPO ½ hour after use.
Ketoconazole 2% cream (Nizoral) or clotrimazole 1% cream (Lotrimin)	Apply thin film to inner surface of denture(s) and/or corners of mouth QID (PC and HS). NPO ½ hour after use.
Clotrimazole 10 mg oral troches (Mycelex)	Dissolve 1 troche slowly in mouth 5x daily. NPO ½ hour after use. ⁶
Ketoconazole 200 mg tablets (Nizoral)	1 tablet PO QD for 7 to 10 days. Do not take antacids within two hours of this medication. ⁷
Fluconazole 100 mg tablets (Diflucan)	1 tablet PO BID for first day, then 1 tablet PO QD for 10 to 14 days.

Fluoride Supplementation

Topical fluoride supplementation is a key component of the management of xerostomic patients and should be implemented before caries become a problem. Patients with mild xerostomia may be directed to use an over-the-counter fluoride mouthrinse daily. Patients with more significant xerostomia should use a prescription-strength topical fluoride, which may be delivered in custom fluoride trays or in a brush-on preparation. To avoid soft tissue irritation and excessive staining, neutral sodium fluoride is the best choice for patients with xerostomia (TABLE 6).⁸

Mucositis Management

Patients with xerostomia may require management for candidiasis or non-microbial forms of mucositis, such as aphthous stomatitis, traumatic ulcers, or nonspecific mucositis.⁸ Often, mucositis management is required on an ongoing basis. It is important to establish a definitive diagnosis before initiating treatment. In most cases, a clinical diagnosis of candidiasis can be confirmed with cytologic preparations.¹⁶ Although the diagnosis of aphthous stomatitis is typically based on clinical and historical

1. In most patients, decreased frequency and dosages may be used if maintenance therapy is required.
 2. Available from Sunstar-Butler for in-office dispensing or can be prepared by experienced compounding pharmacist. Causes extrinsic staining and may cause dysgeusia.
 3. Must be prepared by a compounding pharmacist.
 4. May be swallowed for pharyngeal involvement.
 5. Should not be used in dentate patients.
 6. May be difficult to use in moderate to severe xerostomia.
 7. Acidic environment is required for absorption.

TABLE 8

Management of Non-microbial Mucositis

Medication	Dosage and Directions ¹
Triamcinolone acetonide (Kenalog) 0.1% or 0.2% aqueous suspension ^{2,3}	5 ml mouthrinse and expectorate QID (PC and HS). NPO ½ hour after use.
Triamcinolone acetonide (Kenalog) 0.1% or 0.5% ointment or gel ⁴	Apply thin film to inner surface of medication tray(s) ⁵ and seat for 30 minutes BID-TID <u>or</u> apply to involved area QID (PC and HS). NPO ½ hour after use.
Fluocinonide (Lidex) 0.05% ointment or gel ⁴ or clobetasol (Temovate) 0.05% ointment or gel ⁴	Apply thin film to inner surface of medication tray(s) ⁵ and seat for 30 minutes BID <u>or</u> apply to involved area BID-QID (PC and HS). NPO ½ hour after use.
Triamcinolone acetonide (Kenalog) 0.5% ointment 1:1 with Orabase	Apply thin film to dried mucosa BID-TID. <u>Do not rub in</u> . NPO ½ hour after use.
Fluocinonide (Lidex) 0.05% or clobetasol (Temovate) 0.05% 1:1 with Orabase	Apply thin film to dried mucosa BID. <u>Do not rub in</u> . NPO ½ hour after use.
Misoprostol ^{2,6}	May be compounded in various topical forms and dosages with or without corticosteroids <u>and/or</u> antifungals.
Triamcinolone acetonide (Kenalog) injectable 40 mg/ml diluted to 10-20 mg/ml with local anesthetic with vasoconstrictor ⁷	Anesthetize area first and inject 10 to 40 mg into base of lesion.
Prednisone	30 to 60 mg PO QD (AM 1½ hour after arising) for five days, then 5 to 20 mg QOD (AM 1½ hour after arising) for 10 days.

1. In most patients decreased frequency and dosages may be used if maintenance therapy is required.

2. Must be prepared by a compounding pharmacist.

3. May be compounded in nystatin (edentulous patients only), nystatin sugar-free suspension or amphotericin-B sugar-free suspension.

4. May be mixed 1:1 with clotrimazole 1 percent or ketoconazole 2 percent cream or prepared by a compounding pharmacist in ointment form or mucoadhesive base to provide full strength of both medications.

5. Custom tray(s) fabricated by a dentist for management of gingival mucositis. Gel is best for medication tray use. Brush teeth after removing medication trays.

6. Contraindicated in women of childbearing age. Decreases pain and increases rate of healing of ulcerated mucosa.

7. For management of recalcitrant solitary lesions.

Conclusion

The assessment of salivary gland function should be a routine part of initial and ongoing evaluation for every patient. When signs or symptoms of xerostomia are identified, they should be proactively managed to minimize potential complications. As with any other medical or dental problem, detailed information regarding the assessment, management and follow-up evaluation should be documented in the patient record. Establishing, implementing, and documenting protocols for the diagnosis and management of xerostomia will not only eliminate potential liability from

features, a biopsy may be required to rule out other types of ulcerative mucositis.

There are many treatment options for oral candidiasis (TABLE 7) and nonmicrobial mucositis (TABLE 8).^{8,16} Use of topical agents is preferred as it minimizes the risks of systemic side effects and drug

interactions. However, some contain sugar, which should be avoided in dentate xerostomic patients, and/or alcohol, which should be avoided in all xerostomic patients. Fortunately, compounding pharmacists can prepare formulas that are both sugar-free and alcohol-free.

failure to diagnose this common oral disease, but will also assure the highest quality of patient care. ■■■■

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