Etiologies, Sequelae and Management of DRY MOUTH

By Fiona M. Collins, BDS, MBA, MA
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ABSTRACT

Dry mouth affects a significant proportion of the population, with an increased prevalence with age. Etiologies include medication use, autoimmune diseases, head and neck radiation, chemotherapy, certain viral infections and a number of other causes. In addition, etiologies of transient dry mouth include dehydration, mouth breathing, snoring, tobacco and alcohol. Given the functions of saliva, the oral complications of dry mouth are significant, including an increased risk of dental caries, dental erosion, oral infections and irritations. Patients also experience difficulties eating, drinking, swallowing and talking. The management and treatment of the oral complications of dry mouth is essential to help restore and maintain oral health and quality of life.

EDUCATIONAL OBJECTIVES

The overall goal of this article is to provide the reader with information on the causes and management of the oral complications of dry mouth. After completing this article, the reader will be able to:

• Review saliva production and the functions of saliva;
• List and describe etiologies for dry mouth;
• Describe common oral complications, signs and symptoms associated with dry mouth; and,
• Review options for the prevention, management and treatment of oral complications.

INTRODUCTION

Xerostomia, dry mouth and hyposalivation are often used interchangeably. However, xerostomia is the subjective assessment of dry mouth by the sufferer while hyposalivation is the objective assessment of dry mouth. The overall prevalence of dry mouth ranges from 10% to 46%, depending on the study and age group.¹ A prevalence of up to 42% has been found for xerostomia and up to 47% for hyposalivation, in both cases with a higher prevalence in women than men.¹ Dry mouth also disproportionately affects the elderly, particularly those living in healthcare or nursing facilities.

ABOUT THE AUTHOR

Fiona M. Collins, BDS, MBA, MA

Dr. Fiona M. Collins has authored and presented CE courses to dental professionals and students in the United States and internationally, and has been an active author, editor, writer, speaker and trainer for several years. Fiona is a member of the American Dental Association, the ADA Standards Committee working groups, Chicago Dental Society, and the Organization for Safety, Asepsis and Prevention (OSAP). She is the ADA representative to AAMI and a Fellow of the Pierre Fauchard Academy. Dr. Collins earned her dental degree from Glasgow University and holds an MBA and MA from Boston University.

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Salivary Flow and Production

Total salivary production is typically 0.5-1 liter/day in the absence of dry mouth, and up to 1.5 liters/day. Stimulated salivary flow is estimated to account for 80% to 90% of total saliva produced in a 24-hour period, with significantly decreased production of saliva at night (~0.1 ml/minute in a patient with normal salivary flow). The parotid gland supplies >50% of stimulated salivary flow. Twenty percent of unstimulated salivary flow is supplied by the parotid, 65% by the submandibular gland, and the remainder is from the sublingual and minor salivary glands. Unstimulated and stimulated salivary flow of <0.1 ml/minute and <0.7 ml/minute, respectively, are the accepted thresholds for hyposalivation. Serous saliva is produced mainly by the parotid glands, and mucous (thicker) saliva by the minor salivary glands found throughout the oral cavity. Saliva produced by the submandibular and sublingual glands is mixed, with serous and mucous components.

The secretion of saliva is primarily controlled by the autonomic nervous system, with salivary production stimulated by parasympathetic and sympathetic nerve stimulation. This involves: 1) Secretion of an isotonic primary fluid containing water and ions, mostly due to parasympathetic stimulation; and, 2) Secretion of proteins and peptides by vesicles in the acinar cells. The major neurotransmitters are noradrenaline and acetylcholine. Mucins are released from the mucous acinar cells, primarily following parasympathetic stimulation. The release of amylase from the serous acinar cells is mediated mainly through noradrenaline release (sympathetic stimulation). However, amylase is also released as a result of parasympathetic stimulation. Greater fluid flow through the cells is encouraged by acetylcholine, and the rates of secretion and ion concentration are influenced by acetylcholine and adrenergic activity.

Functions of Saliva and Salivary Content

Saliva in health contains ~99% water, plus proteins, peptides, lipids, electrolytes, enzymes and antimicrobial agents; it has a pH of between 6 and 7. After exiting the salivary ducts, saliva becomes ‘whole saliva’ after mixing with gingival crevicular fluid, mucous from the nasopharynx, bacteria, sloughed cells, blood cells, food particles and chemicals / toxins present. Saliva performs many functions, including: 1) aiding digestion through lubrication for solubilizing, chewing and swallowing food; and by enzymes that start digestion such as, amylase, protease and lipase that, respectively, break down starches, proteins and lipids; 2) protecting oral mucosa and dental hard tissues; 3) aiding speaking and smiling (social interactions) through lubrication; and, 4) influencing taste perceptions. Saliva exerts an antimicrobial effect, helping to maintain and protect dental hard and soft tissues, and protects oral tissues against plaque enzymes, potential toxins and chemicals, and dehydration. Salivary clearance removes bacteria, fermentable carbohydrates, acids and debris. In addition, saliva contains an extensive array of antibacterial, antiviral and anti-fungal agents that help to maintain oral health. (Table 1) Interestingly, salivary histatins may play a role in wound healing.

Lubrication is provided by highly viscous, elastic mucins that adhere well to oral tissues and offer low solubility,
and by protein-rich glycoproteins (PRG). In addition, mucins inhibit bacterial and fungal adhesion to, and colonization of, oral tissues. Dental hard tissues are protected through lubrication, salivary dilution and by clearance of acids, and salivary buffering agents that protect against lowering of the pH to the level required for demineralization, and help elevate the pH after acid attacks. Buffering agents include bicarbonate, phosphate, sialin and urea. Importantly, saliva is a carrier for calcium, phosphate and fluorides which help prevent demineralization and promote remineralization. Salivary proteins (statherins and proline-rich proteins) help to maintain salivary supersaturation with calcium and phosphate relative to hydroxyapatite, inhibiting spontaneous precipitation of calcium phosphate salts, and are important for the development of the acquired pellicle. (Figure 2)

Etiologies of Dry Mouth
Medication use, autoimmune diseases, hormonal changes, head and neck radiation, HIV disease, hepatitis C, Parkinson’s disease, neoplasms, nerve damage, and a number of other diseases and conditions are etiologic factors for dry mouth. (Table 2) Transient dry mouth can result from dehydration, alcohol use, mouth breathing, stress and other emotional disturbances. Less frequent causes of dry mouth include thyroiditis, cystic fibrosis and primary biliary cirrhosis. Chemotherapy can reduce salivary flow and causes

<table>
<thead>
<tr>
<th>Table 1. Antimicrobial agents in saliva</th>
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<tr>
<td><strong>Antibacterial</strong></td>
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<tr>
<td>Mucins</td>
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<td>Lysozyme</td>
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<td>Lactoferrin</td>
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<td>Lactoperoxidase</td>
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<td>VEGh</td>
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<tr>
<td><strong>Antifungal</strong></td>
</tr>
<tr>
<td>Mucins</td>
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<td>Histatins</td>
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<td>Immunoglobulins</td>
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<th>Table 2. Factors associated with dry mouth</th>
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<tr>
<td><strong>Etiology of Dry Mouth</strong></td>
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<tr>
<td>Medication use</td>
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<tr>
<td>Auto-immune diseases</td>
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<tr>
<td>Hormonal changes</td>
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<tr>
<td>HIV disease</td>
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<tr>
<td>Head and neck radiation</td>
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<tr>
<td>Hepatitis C</td>
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<tr>
<td>Tumors</td>
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<td>Parkinson’s disease</td>
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<tr>
<td>Nerve damage</td>
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<tr>
<td>Drug use (street drugs)</td>
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<tr>
<td>Lymphoma</td>
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<tr>
<td>Sarcoïdosis and amyloidosis</td>
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<tr>
<td><strong>Transient dry mouth</strong></td>
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<tr>
<td>Dehydration</td>
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<tr>
<td>Mouth breathing, snoring</td>
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<tr>
<td>Alcohol use, drug abuse</td>
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<tr>
<td>Smoking</td>
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<tr>
<td>Eating disorders</td>
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<td>Stress, other emotional disturbances</td>
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changes in the consistency of saliva, making it feel thicker. While a frequent complaint, this effect is typically temporary.\textsuperscript{3,5} Cannabis is anticholinergic and its use causes dry mouth,\textsuperscript{11} and drug abuse with methamphetamines results in severe dry mouth, classic ‘meth mouth,’ rampant caries and excessive tooth wear.\textsuperscript{12}

**Medication Use**

In excess of 500 drugs are associated with dry mouth.\textsuperscript{13,14} These include tricyclic antidepressants, psychotropics, anti-histamines, antihypertensives, anti-emetics, anti-diarrheals, cardiovascular drugs, proton pump inhibitors used for gastric reflux, protease inhibitors, and steroids.\textsuperscript{5,15,16} The elderly are particularly vulnerable to dry mouth, in large part due to their pattern of medication use,\textsuperscript{17} as well as the effects of diseases and conditions, rather than aging itself.\textsuperscript{18} (Figure 3) The Centers for Disease Control and Prevention estimates that the elderly in long-term care facilities take on average 8 drugs daily.\textsuperscript{19} One study found a correlation between the levels of stimulated and unstimulated salivary flow and the number of medications being used, with a significantly greater impact on stimulated salivary flow.\textsuperscript{20}

The main mechanisms of action for medication-induced dry mouth are through an anti-cholinergic or sympathomimetic effect, while a number of drugs have a cytotoxic effect or cause reductions in hydration. Anticholinergic drugs interfere with acetylcholine-related salivary production and sympathomimetic drugs interfere with noradrenaline-related salivary production.\textsuperscript{5,14,21} (Table 3)

**Head and Neck Radiation**

Dry mouth occurs in 93\% of patients during head and neck radiation therapy, and an estimated 74\% to 85\% of these patients experience long-term severe dry mouth.\textsuperscript{3} (Figure 4) Decreased salivary function occurs within 1 week of the start of therapy, with a dose-response relationship. A total dose of ≤26 Gy is required to preserve gland function and for improvement post-therapy. Radiation therapy also results in thicker saliva and other salivary changes within 2 months – including a decrease in salivary pH and in the levels of nitrate and thiocyanate, and an increase in lactate, formate, sulphate and chloride.\textsuperscript{23} Radiation-induced damage is decreased by using intensity-modulated radiation therapy, whereby multiple beams are used and arranged to reduce the impact on the parotid gland. This may not protect the submandibular glands, still leading to reduced unstimulated salivary flow and nocturnal dry mouth in particular.\textsuperscript{24,25} Other medications being used to protect against radiation damage include amifostine and botulinum toxin (the same toxin used in ‘Botox treatment’).\textsuperscript{25,26}

![](image)

**Figure 3. Percentage of individuals reporting dry mouth.**

**Table 3. Common anticholinergic and sympathomimetic drugs**

<table>
<thead>
<tr>
<th>Anticholinergic drugs</th>
<th>Sympathomimetic drugs</th>
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<tbody>
<tr>
<td>Tricyclic antidepressants</td>
<td>Appetite suppressants</td>
</tr>
<tr>
<td>Atropine</td>
<td>Decongestants</td>
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<tr>
<td>Antihistamines</td>
<td>Bronchodilators</td>
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<tr>
<td>Antiemetics</td>
<td>Amphetamines</td>
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<tr>
<td>Antipsychotics</td>
<td>Anti-hypertensives</td>
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<tr>
<td>Serotonin reuptake inhibitors</td>
<td>β-blockers</td>
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Autoimmune Diseases

Sjögren syndrome (SS) is a chronic inflammatory autoimmune disease affecting the salivary, lacrimal and other exocrine glands. Approximately 4 million people in the US alone suffer from this disease, mainly women. SS is the autoimmune disease most frequently associated with dry mouth; others include diabetes mellitus, rheumatoid arthritis and systemic lupus erythematosus. SS is further addressed in a separate article.

Viral Diseases – HIV and Hepatitis C

Salivary gland disease affects ~8% of people in the US living with HIV infection. This results in salivary gland enlargement and dry mouth, as do some of drugs used to manage HIV disease. (Figure 5) People infected with Hepatitis C also experience dry mouth.

Sequelae, Signs and Symptoms of Dry Mouth

Given the functions of saliva, the potential consequences of dry mouth are considerable. Patient complaints include a sticky and/or dry feeling in the mouth, a painful/burning mouth, alterations in taste, stringy or ropey saliva, difficulty speaking, chewing and swallowing food, nocturnal discomfort and difficulty wearing dentures. Patients who have received head and neck radiation therapy experience oral complications affecting every aspect of their lives; they may suffer from depression as a result and may question their will to live.

Hyposalivation results in dry or parched-looking oral mucosa, dry or cracked lips, angular cheilitis, a parched or globular appearance to the tongue and oral irritations. (Figure 6) A dental mirror sticking to the cheek during an examination is indicative of dry mouth, as is a digit adhering to oral mucosa during palpation.

Patients with hyposalivation are at increased risk for dental caries and dental erosion due to reduced clearance of bacteria (caries), fermentable carbohydrates (caries), extrinsic and intrinsic acids (erosion); reduced/lack of salivary protective factors including antibacterial agents (caries), calcium and phosphate; and, reduced buffering capacity with a prolonged dip in pH following acid attacks (caries and erosion).
erosion). (Figure 7) As a component of erosive tooth wear, patients are also at greater risk for attrition and abrasion. With loss of enamel and subsequent dentin exposure, dentinal hypersensitivity associated with exposed open dentinal tubules may be present. Increased levels of dental plaque, food retention, periodontal disease, halitosis, candidal and other oral infections also occur in patients with hyposalivation. Oral mucositis affects almost all head and neck radiation patients, and up to 40% of high-dose chemotherapy patients.37,38 (Table 4)

Table 4. Oral complications of dry mouth

<table>
<thead>
<tr>
<th>Complications</th>
<th>Risk factor for</th>
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<tbody>
<tr>
<td>Dry or sticky feeling in mouth</td>
<td>Dental caries</td>
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<tr>
<td>Burning mouth or tongue</td>
<td>Dentinal hypersensitivity</td>
</tr>
<tr>
<td>Difficulty chewing or swallowing</td>
<td>Gingivitis and periodontal disease</td>
</tr>
<tr>
<td>Difficulty speaking</td>
<td>Other oral infections</td>
</tr>
<tr>
<td>Difficulty wearing dentures</td>
<td>Dental caries</td>
</tr>
<tr>
<td>Angular cheilitis</td>
<td>Dental caries</td>
</tr>
<tr>
<td>Depression</td>
<td>Dental caries</td>
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</tbody>
</table>

Screening, Assessing and Diagnosing Dry Mouth

Dental patients should be screened for dry mouth, starting with the medical history form that asks about diseases, conditions, habits and medication use. Since dry mouth may be subjective or objective, the patient’s perception of dry mouth and its level of inconvenience/impact on quality of life should be assessed, as well as salivation. Including questions on dry mouth, dry lips, difficulty speaking, or eating and swallowing without sipping water, helps to discover patient concerns.34,39,40 Other questions to ask include changes in taste, ocular/throat dryness and whether there is a sensation of ‘burning mouth.’ A visual analog scale may also be used to have patients indicate their perceived level of dry mouth/discomfort.

Salivary Testing

Stimulated and unstimulated salivary flow are measured separately by having the patient salivate and expectorate into a cup for five minutes for each test. For stimulated saliva collection, the patient should first chew gum or paraffin wax. For unstimulated saliva collection, the patient should refrain from eating, drinking (except water), smoking, chewing gum, and consuming caffeine for one hour prior to the test, and sit still while saliva is collected.41 Easy-to-use chairside tests are also available that measure stimulated and unstimulated salivary flow, unstimulated and stimulated salivary pH, buffering capacity and salivary consistency. Laboratory testing may also be indicated, such as minor salivary gland biopsy or identification of autoantibodies for Sjögren syndrome; imaging to identify tumors, salivary stones and other abnormalities; scans; and, radiopaque fluid-assisted radiography.5

Preventing and Managing the Sequelae of Dry Mouth

Management and prevention include thorough oral hygiene, stimulation of saliva (where possible), palliative care and/or treatment to relieve dry mouth and its associated symptoms, and treatment to prevent and manage the other potential complications of dry mouth.
Managing and Relieving Dry Mouth

Sipping water frequently, and sucking small amounts of ice or sugar-free lozenges/candies, may help to relieve discomfort. Patients should be advised to avoid acidic/sour candies, which are highly erosive. Chewing sugar-free gum ad libitum can be recommended – this stimulates saliva (when salivary gland function is present) and helps to remove plaque. Since many patients already enjoy chewing gum, this is not onerous. Xylitol chewing gum may help as part of a preventive program, and chewing gum with casein phosphopeptide-amorphous calcium phosphate supplies calcium and phosphate.

Oral Lubricants and Saliva Substitutes

Saliva substitutes are viscous and ‘moisturize’ the oral mucosa; they contain xanthan gum, carboxymethylcellulose, polyacrylic acid or mucin as the thickening agent. Xanthan gum and mucin may provide better wetting and flow than carboxymethylcellulose, and may be preferred for head and neck irradiated patients and those with Sjögren syndrome. Over-the-counter spray saliva substitutes are easy-to-use and portable. Examples of sprays include Allday Dry Mouth Spray (Elevate Oral Care), Biotène Moisturizing Mouth Spray (GSK), Entertainer’s Secret (KLI Corp.), Moi-Stir (Kingswood Laboratories, Inc.), MouthKote (Parnell Pharmaceuticals, Inc.) and Salivart (Gebauer Company).

Dry mouth moisturizing gels and rinses typically contain hydroxyethylcellulose, carboxymethylcellulose, or glycerin as the moisturizing and lubricating agent; buffers to reduce acidity (calcium bicarbonate); antibacterial agents; or, combinations of these. Dry mouth rinses containing fluoride help provide protection against dental caries. Natural-based mouthwashes containing plant extracts are also available. A recent systematic review of 36 randomized controlled trials found insufficient evidence to make recommendations on saliva substitutes for palliative relief of dry mouth. However, individual studies have demonstrated significant benefits – in some cases providing relief without increasing salivation, and benefitting patients including those with severe hyposalivation. Gels are recommended for night-time use as they are thick and adhere for long periods of time to the mucosa.

Other options

Dry mouth chewable moisturizing lozenges are available that contain bicarbonate as a buffering agent, calcium, and arginine. Lozenges are also available that are nonchewable and moisturize as they slowly dissolve. A time-release mucoadhesive disc containing xylitol is available that helps to moisturize and lubricate the oral cavity (Xylimelts, OraCoat), as well as a muco-adhesive patch (OraMoist, DenTek). Applying vitamin E oil (or from a capsule with a hole in it) directly to the mucosa is also recommended for relief, used 2 or 3 times daily.

Prescription Products

Supersaturated calcium phosphate rinses are also available. Originally, this type of rinse came as two vials containing solutions mixed immediately before use. An effervescent tablet version has now been developed (Caphasol, EUSA Pharma), and powder sachets that are mixed with water immediately before use are available (NeutraSal, Orapharma; SalivaMAX, Forward Science) Recent studies, and one review, reported improvements in patients’ perceptions of xerostomia and taste, oral lubrication, and ease of eating, drinking, swallowing, and talking with use of supersaturated calcium phosphate rinses. In one recent study, using a visual analog scale, patients reported an average rating of 9 (1 being ‘dry as a desert’ and 10 being normal), compared with an average score of 2 at baseline 28 days earlier prior to using supersaturated a calcium phosphate rinse.

Sialogogues

Pilocarpine hydrochloride (Salagen; MGI Pharma) and cevimeline hydrochloride (Evoxac; Daiichi-Sankyo) are cholinergic agents that stimulate salivary gland function. They are indicated for severe hyposalivation associated with head and neck radiation or Sjögren syndrome. Pilocarpine is prescribed at a dose of 5 mg, three or four times daily for at least 12 weeks to provide clinical benefit and use must be ongoing. Cevimeline is prescribed at a dose of 30 mg, 3 times daily. Both pilocarpine and cevimeline are clinically effective, and pilocarpine has been found to be effective during head and neck radiation therapy. Sialogogues have potentially serious side effects such as...
dizziness, alterations in vision and stomach upset and, rapid or slowed heart rate.\textsuperscript{64}

### Oral Hygiene and Prevention

Thorough brushing and interdental cleaning are essential. Patients should be advised to brush twice-daily using a soft-bristled powered toothbrush,\textsuperscript{49} and fluoride toothpaste or dry mouth toothpaste containing fluoride. For some patients, using toothpaste with a low level of SLS, or a dry mouth toothpaste with no SLS, may reduce the risk of aphthous ulcers and irritations; patients can also experience irritation with strong/minty flavors, therefore a mild-flavored toothpaste is preferable.\textsuperscript{45} Antibacterial toothpastes help to control plaque and gingivitis, and may also reduce halitosis. Selection of oral care products should be based on clinical efficacy, safety, and the needs and preferences of the individual patient.

### Fluoride, Calcium and Phosphate

Recommended preventive care includes frequent professional application of 5\% sodium fluoride varnish, at least every 3 or 6 months, as patients with hyposalivation are at high risk for caries.\textsuperscript{64} Silver diamine fluoride is now also available in the US, and has been shown to be effective in arresting and preventing dental caries.\textsuperscript{66} These are off-label uses. Prescription-level fluoride paste once or twice daily provides added benefit, increasing protection against dental caries and is recommended for at-risk patients.\textsuperscript{67} Fluorides also help strengthen enamel against erosive acid challenges.\textsuperscript{68-70} Rinsing with an alcohol-free fluoride mouthrinse is of benefit, and recommended when the mouth feels dry or after eating/drinking.\textsuperscript{67} It is also available as a dry mouth rinse containing aloe vera. Calcium and phosphate products may also be recommended. In head and neck radiation patients in one study, caries reductions were observed in patients using a sodium fluoride toothpaste containing amorphous calcium phosphate compared to those using a regular fluoride toothpaste.\textsuperscript{71} Casein phosphopeptide-amorphous calcium phosphate paste with fluoride can be applied at night, and left on the teeth, providing a source of calcium, phosphate and fluoride.\textsuperscript{45} In addition, in one study \((n=134)\) when used up to three to four times daily, together with daily use of a prescription-level fluoride toothpaste, supersaturated calcium and phosphate rinse reduced dental caries in patients with severe dry mouth. Statistically significant reductions in coronal and root caries, and remineralization of existing caries lesions, were observed \((p<0.0001)\).\textsuperscript{58}

### Sealants

Pit and fissure sealant placement on molar and bicuspid surfaces may also be indicated for at-risk children and adults.\textsuperscript{72}

### Additional Advice and Recommendations for Patients

Patients should be advised to sip water frequently to improve oral hydration and comfort, and to sip water during meals to aid chewing and swallowing. In addition, eating softer foods can help; foods with sweeteners or flavorings (not sugars or spices), and that are favorites, can help increase salivary flow. A low-sugar diet reduces the risk of caries. Patients should avoid acidic chewing gum, and acidic foods, vegetables and drinks (including carbonated drinks), as these increase the risk of dental erosion, and should also avoid spicy foods, alcohol, street drugs, alcohol-containing rinses, caffeine and smoking as these irritate the oral mucosa and increase dryness.\textsuperscript{48} (Table 5) Using a humidifier at home (and not a dehumidifier) may help, especially at night when salivary flow is lowest. Denture use at night should be discouraged and dentures must fit well. Denture hygiene using a brush and denture cleansers will remove debris and microorganisms. Rinsing with baking soda (water with 1 teaspoon of baking soda) helps to counteract bacterial and erosive acids, and to prevent demineralization, by acting as a buffer and increasing the intraoral pH. (Table 5)

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<th><strong>Table 5. Additional patient recommendations</strong></th>
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<tr>
<td><strong>DO</strong></td>
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<tr>
<td>Sip water frequently and during meals</td>
</tr>
<tr>
<td>Eat softer foods, preferred flavorings</td>
</tr>
<tr>
<td>Suck sugar-free candies or small pieces of ice</td>
</tr>
<tr>
<td>Chew sugar-free gum</td>
</tr>
<tr>
<td>Use a humidifier, especially at night</td>
</tr>
<tr>
<td>Rinse with baking soda</td>
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</tbody>
</table>
Managing Oral Mucositis

General guidelines include use of a soft-bristled toothbrush, replaced on a regular basis, regular oral hygiene, and regular professional and preventive care. Specifically for patients who have received high-dose chemotherapy and total body irradiation, keratinocyte growth factor-1 (palmiferin) is recommended and FDA-approved for the prevention of mucositis. Based on a recent systematic review, there is currently insufficient evidence to make an evidence-based recommendation on the use of supersaturated calcium phosphate rinses. However, individual studies have reported on the efficacy of supersaturated calcium phosphate rinses and success in managing oral mucositis, and in reducing its occurrence and severity, and the associated pain. This rinse can be used at least 4 and up to 10 times daily to treat oral mucositis and relieve symptoms, and patients should avoid eating or drinking for at least 15 minutes after use. Another option for the management of oral mucositis is a prescription rinse containing glycerin and carbomers (MuGard, AMAGPharma), using up to 10 ml four to six times daily.

Relieving Pain from Oral Irritations and Oral Mucositis

Pain relief from mucositis may involve local application of analgesic agents and rinses, and opioids for relief from severe pain. Palliative care of localized oral irritations can be achieved using topical analgesic pastes containing 20% benzocaine or 2% lidocaine. For extensive areas, a barrier cream or rinse is recommended. Mucoadhesive rinses are available that provide a coating and protective barrier (Rincinol, Sunstar Americas; Gelclair, OSI Pharmaceuticaus). ‘Magic mouthwash’ contains viscous lidocaine, Maalox, and Benadryl and can be used to manage extensive oral irritations/ulcerations and oral mucositis. If severe pain is present, a 2% morphine mouthwash may be indicated and may be prescribed in specialist settings.

Candidal Infections

Oral candidiasis can be treated with topical nystatin or clotrimazole, often applied as a cream or ointment. Topical nystatin is applied as a thin layer 4 times per day. Other antifungal options include miconazole gel, nystatin oral suspension, nystatin pastilles and amphotericin lozenges. In severe cases, systemic ketoconazole or fluconazole may be required. If a denture wearer is experiencing candidiasis, an antifungal ointment should also be used under the denture when wearing it. The wearer should also be advised to clean the denture by soaking it overnight in chlorhexidine gluconate rinse.

Emerging and Potential Treatments for Hyposalivation

Hyposalivation treatments being investigated and/or already in use on a small scale include acupuncture, electrical nerve stimulation (including via an osseointegrated dental implant) and extra- and intra-oral reservoir hydration devices. Replacement full dentures with reservoirs containing saliva substitute may also provide relief. Acupuncture has been shown to help for head and neck radiation patients, with the benefit maintained for 6 months and lasting up to 3 years if additional acupuncture therapy is provided. Overall, however, there is currently insufficient evidence on the efficacy of electrostimulation devices in relieving the discomfort associated with dry mouth, and low evidence on the effects of acupuncture. More promising potential therapies for the future treatment of dry mouth include the use of growth factors, stem cell therapy and the development of artificial salivary glands.

Summary

Dry mouth is a debilitating condition that significantly affects oral health and quality of life. The prevention, management and treatment of the oral complications of dry mouth must be tailored to the needs of individual patients. Management and treatment protocols are aimed at relieving dry mouth and the associated discomfort, reducing the risk of disease and conditions associated with xerostomia and managing these should they occur, and improving quality of life. Future therapies are promising, including biologic and tissue regenerative interventions that would restore salivary function.

Acknowledgement

Figures 4 and 6 courtesy of Sandra Boody, RDH; Figure 5 courtesy of Dr. David Reznik and HIVdent; and, Figure 7 courtesy of Dr. John Comisi.
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References

48. Silvestre FJ, Minguéz MP, Sune-Rnegre JM. Clinical evaluation of a new
1. Xerostomia is the __________ assessment of dry mouth by the sufferer while hyposalivation is the __________ assessment of dry mouth.
   a. subjective; subjective  
   b. subjective; objective  
   c. objective; subjective  
   d. objective; objective

2. Unstimulated and stimulated salivary flow of __________, respectively, are the accepted thresholds for hyposalivation.
   a. <0.1 ml/minute and 0.5 ml/minute  
   b. <0.1 ml/minute and 0.6 ml/minute  
   c. <0.1 ml/minute and 0.7 ml/minute  
   d. none of the above

3. Some of the functions of saliva are to __________.
   a. protect dental hard tissues and oral mucosa  
   b. aid digestion and influence taste perception  
   c. aid speaking and smiling  
   d. all of the above

4. Saliva contains an extensive array of anti-bacterial, antiviral and anti-fungal agents that help to maintain oral health.
   a. True  
   b. False

5. Statherins and proline-rich proteins __________.
   a. help to maintain salivary supersaturation with calcium and phosphate relative to hydroxyapatite  
   b. reduce the intraoral pH  
   c. provide intraoral moisture  
   d. aid speaking and eating

6. Anticholinergic drugs interfere with noradrenaline-related salivary production and sympathomimetic drugs interfere with acetylcholine-related salivary production.
   a. True  
   b. False

7. In head and neck radiation patients, reduced salivary function __________.
   a. occurs within 1 week of therapy starting  
   b. is always reversible  
   c. results in thinner saliva  
   d. increases the amount of antimicrobial agents contained in saliva

8. Protection against radiation-modulated damage is helped by using.
   a. intensity-increased radiation therapy  
   b. amifostine  
   c. antioxidants  
   d. attenuation

9. A sticky and/or dry feeling in the mouth and alterations in taste, stringy or ropey saliva are __________.
   a. inevitable in patients taking antibiotics  
   b. frequent complaints for dry mouth patients  
   c. infrequent complaints for dry mouth patients  
   d. rarely debilitating

10. __________ is not one of the signs of dry mouth.
    a. parched-looking oral mucosa  
    b. angular cheilitis  
    c. a parched appearance to the tongue  
    d. allergic mucositis

11. Patients with hyposalivation are at increased risk for __________.
    a. dental caries  
    b. dental erosion  
    c. oral infections and irritations  
    d. all of the above
12. A patient’s perception of dry mouth and its level of inconvenience/impact on quality of life should be assessed, because this will be indicate _______.
   a. the level of salivation
   b. how much fluoride is contained in the excreted saliva
   c. whether any treatment or prevention is needed
   d. the patient’s subjective assessment of his/her condition

13. Patients with dry mouth can be advised to suck small amounts of ice or sugar-free lozenges/candies and to avoid acidic/sour candies.
   a. True
   b. False

14. Saliva substitutes ________.
   a. are ultra-thick and nourish the oral mucosa
   b. contain a strong flavoring agent
   c. provide palliative relief from dry mouth
   d. should only be recommended if the patient’s dry mouth is severe

15. Supersaturated calcium phosphate rinses have been reported by patients or clinicians to ________.
   a. improve their ability to eat and drink
   b. provide relief from dry mouth
   c. help manage oral mucositis
   d. all of the above

16. Home use of 5,000 ppm fluoride prescription paste once or twice daily is one of the ways to help to increase protection against ________.
   a. dental caries
   b. abrasion
   c. oral irritations
   d. hyposalivation

17. Patients with dry mouth can be advised to ________.
   a. brush twice-daily using a soft-bristled powered toothbrush
   b. use a dehumidifier
   c. avoid foods containing any preservatives
   d. rinse with an alcohol-containing mouthrinse for its antimicrobial activity

18. ________ are recommended to help reduce demineralization.
   a. fluoride varnish applications
   b. xylitol rinses
   c. calcium lavages
   d. titanium oxide pastes

19. If a denture wearer is experiencing candidiasis, he/she can be advised to clean the denture by soaking it overnight in a ________ rinse.
   a. chlorhexidine gluconate
   b. supersaturated calcium phosphate rinse
   c. 0.05% or 0.2% fluoride rinse
   d. baking powder

20. Management and treatment protocols for dry mouth patients are aimed at ________.
   a. relieving dry mouth and the associated discomfort
   b. reducing the risk of, and managing, associated diseases and conditions
   c. improving the patient’s quality of life
   d. all of the above
**EDUCATIONAL OBJECTIVES**
1. Review salivary production and the functions of saliva;
2. List and describe etiologies for dry mouth;
3. Describe common oral complications, signs and symptoms associated with dry mouth; and,
4. Review options for the prevention, management and treatment of oral complications.

**COURSE EVALUATION**
Please evaluate this course using a scale of 3 to 1, where 3 is excellent and 1 is poor.

1. Clarity of objectives ...........................................
2. Usefulness of content ........................................
3. Benefit to your clinical practice ............................
4. Usefulness of the references ...............................
5. Quality of written presentation ............................
6. Quality of illustrations ......................................
7. Clarity of quiz questions ...................................
8. Relevance of quiz questions ...............................
9. Rate your overall satisfaction with this course ........
10. Did this lesson achieve its educational objectives? **Yes** **No**
11. Are there any other topics you would like to see presented in the future? 

**COURSE SUBMISSION:**
1. Read the entire course.
2. Complete this entire answer sheet in either pen or pencil.
3. Mark only one answer for each question.
4. Mail answer form or fax to 732-303-0555.

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### AGD Code: 149,730

#### QUIZ ANSWERS
Fill in the circle of the appropriate answer that corresponds to the question on previous pages.

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