

# Dry Mouth: Simplified

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**X**erostomia (xero=dry, stomia=mouth) is defined as the subjective sensation of oral dryness that may or may not be associated with a decrease in the production of saliva.<sup>1,2</sup> Saliva is one of those things that is appreciated only in its absence, when the patient perceives a significant negative effect on quality of life.<sup>3</sup>

Xerostomia is estimated to affect about 20% of the adult population<sup>2</sup> and is becoming one of the fastest growing oral health concerns world-wide. It is increasingly common in developed countries where the aging population is consuming multiple medications to promote health and longevity.<sup>4</sup>

## FUNCTIONS OF SALIVA

Saliva plays a vital role in the patient's oral as well as systemic health. It is nature's primary defense system in the oral cavity, protecting all hard and soft tissues.

Saliva functions in the following capacities:<sup>9</sup>

- Hydrating and moisturizing

oral tissues

- Lubricating the oral cavity for swallowing and speech
- Taste sensing by acting as a solvent
- Digesting by the actions of amylase and lipase
- Clearing of material from the oral cavity
- Buffering acids and alkali in plaque and food
- Serving as a reservoir for calcium, phosphorus and fluoride ions needed for remineralization
- Providing antimicrobial activity through lysozyme, lactoperoxidase and other enzymes

## PRODUCTION AND COMPOSITION OF SALIVA

Saliva consists of 99% water with dissolved and suspended proteins and electrolytes.<sup>5</sup> The unstimulated flow rate is 0.2 to 0.3 ml per minute. When the flow rate is stimulated through taste and chewing it increases to 1.5 to 2 ml per minute. The average person produces 0.5 to 1.5 L of saliva per day,<sup>6</sup> a very wide range of normal.

Autonomic parasympathetic

and sympathetic nerves regulate salivary gland activity. Parasympathetic stimulation produces more watery secretions, while sympathetic stimulation produces a sparser, more viscous flow.<sup>7</sup>

## SALIVARY FLOW

Since xerostomia is defined as the subjective response to oral dryness, it includes a wide range of etiologies, salivary flow hypofunctions and symptoms. Therefore, it is best to establish the cause of the individual patient's xerostomia. This will lead to better management of the symptoms and complications.

The major causes of decreased salivary flow are as follows:<sup>6,8,9</sup>

- Medication (by far the most common cause)
- Autoimmune diseases (Sjogren's syndrome, lupus)
- Systemic diseases (diabetes, asthma, kidney, sarcoidosis, HIV)
- Radiation therapy to head and neck (which can cause injury to the salivary glands)
- Stress/anxiety/depression
- Gender (xerostomia is higher

**CATEGORIES OF MEDICATIONS THAT MAY CAUSE XEROSTOMIA**

Antacids	Bronchodilators
Anti-anxiety agents	Cholesterol Reducing agents
Anticonvulsants	Decongestants
Anti-depressants	Diet pills
Anti-emetics	Diuretics
Anti-histamines	Hormonal Replacement Therapy agents
Anti-hypertensives	Muscle relaxants
Anti-parkinsonian agents	Narcotic Analgesics
Anti-psychotic agents	Sedatives

TABLE 1

**4 STEPS TO DIAGNOSIS**

1. Medical History
  - Sjogren's Syndrome
  - Uncontrolled Diabetes
  - Radiation to Head and Neck
2. Medications
  - Over 400 drugs can cause hypo-salivation
3. Patient Self Assessment
  - Ask patient set of 5 questions
4. Dentist Clinical Assessment
  - Does mirror stick to tissues?
  - Check for soft and hard tissue changes
  - Use Saliva Check Buffer Kit (GC America)

TABLE 2

**AT HOME STEPS FOR RELIEF OF MILD TO MODERATE SYMPTOMS AND COMPLICATIONS**

- Chew Xylitol flavored gum (5-7 g/day divided over 3 periods)
- Use salivary substitution products: gels, liquids and sprays to maintain hydration throughout the day and especially at night (Biotene, GSK)
- Avoid alcohol mouth rinses and SLS toothpastes
- Use Water Flosser before bed for complete flushing of accumulated food debris
- Limit caffeine, alcohol, acidic foods and drinks

TABLE 3

**AT HOME STEPS FOR RELIEF OF SEVERE SYMPTOMS AND COMPLICATIONS**

Depending on the severity of symptoms:

- Fluoride rinses or gels (1% sodium fluoride OR .4 % stannous fluoride)
- High fluoride (5000 ppm) or fluoride/ xylitol combination toothpastes
- Remineralization products:
  - Novamin XPUR toothpaste, Oral Science
  - Recaldent MI Paste, GC America
  - Tri-calcium phosphate Clinpro 5000, 3M ESPE
- Chlorhexidine for gingivitis

TABLE 4

**IN OFFICE STEPS FOR RELIEF OF SEVERE SYMPTOMS AND COMPLICATIONS**

- Caries removal
- Glass ionomers for caries control
- Fluoride varnish
- Candidiasis medication if required
- Frequent relines of dentures

TABLE 5

fer kit (GC America) evaluates the rate of production, viscosity and pH of resting saliva as well as the rate of production, pH and buffer capacity of stimulated saliva. (Figure 1)

The lack of effective salivary function will cause any or all of the following symptoms:<sup>6,8,9</sup>

- Viscous saliva
- Sticky saliva
- Difficulty in speaking
- Difficulty swallowing
- Halitosis
- Altered sense of smell
- Altered taste
- Complaint of dryness
- Complaint of burning mouth, lips or tongue
- Impaired retention of full upper denture
- Impaired lubrication of lower denture
- Mucosal irritation from foods and dental home care products

Within a short period, without adequate saliva, the patient will begin to experience soft and hard tissue changes in the oral cavity. These are the complications of xerostomia, which can have very serious impacts on the patient's health and quality of life. Looking for these changes can also aid in diagnosis.

The visible soft tissue changes include:<sup>9</sup>

- Dryness of the vermilion border of the lip
- Loss of filiform papillae of the tongue

in females, especially at menopause)

- Diurnal rhythms (flow is highest during the mid afternoon)
- Circadian rhythms (flow decreases in the fall and increases in the spring)

Xerostomia is a common side effect of taking medication. There are more than 400 commonly used drugs that can induce dry mouth.<sup>9</sup> (Table 1) Many of these products are over-the-counter and this side-effect is not always listed on product packaging. The salivary dysfunction is magnified with multiple medication usage in the elderly and medically compromised patients.<sup>9</sup>

Sjogren's syndrome is an autoimmune inflammatory disease with multisystem manifestations. There is a progressive loss of lacrimal and salivary function.<sup>10</sup> Primary Sjogren's syndrome is confined to dry eyes and a dry mouth. Secondary Sjogren's syndrome is associated with connective tissue disorders. The most common connective tissue disorder associated with Sjogren's is

rheumatoid arthritis.<sup>11</sup>

**SYMPTOMS AND DIAGNOSIS**

Diagnosis of salivary hypofunction (Table 2) is difficult because normal flow rates vary widely.<sup>12, 13,14</sup> Furthermore, it has been estimated that a 50% reduction in salivary secretion is required for the patient to become aware of xerostomia.<sup>13</sup>

A quick set of five questions can help with diagnosis. A yes to at least one of these questions has been shown to correlate with salivary hypofunction:<sup>15-17</sup>

1. Does your mouth usually feel dry?
2. Does your mouth feel dry when eating a meal?
3. Do you have difficulty swallowing dry foods?
4. Do you need to sip liquids in order to swallow dry food?
5. Is the amount of saliva in your mouth inadequate most of the time?

Salivary diagnostic tests to check the quality and effective function of the patient's saliva are available. The Saliva Check Buf-



**FIGURE 1**—Saliva Check Buffer (GC America) is a comprehensive evaluation system for saliva.



**FIGURE 2**—Chewing xylitol flavoured gum stimulates saliva and inhibits *Streptococcus mutans*.



**FIGURE 3**—Biotene (GSK) salivary substitution products provide relief from the discomfort of xerostomia.

- Cracking and fissuring of the tongue
- Increased plaque formation on the tongue
- Absence of saliva in response to gland palpation
- Oral candidiasis
- Ulceration of the oral mucosa

The hard tissue changes include:<sup>9</sup>

- Increased caries rate (especially in the cervical third)
- Increased non-carious loss of tooth structure by dental erosion
- Cervical dentinal hypersensitivity
- Increased plaque accumulation on teeth and appliances

These soft and hard oral tissue changes are serious complications of xerostomia and must be considered in the comprehensive treatment plan.

## MANAGEMENT

Management of the condition of xerostomia must include strategies to restore salivary flow and function as well as treatment of the soft and hard tissue complications.

Four basic strategies are followed:

1. Salivary stimulation
2. Salivary substitution
3. At-home strategies for patient comfort and oral disease prevention
4. In-office intervention to pre-

vent further complications of oral disease

## SALIVARY STIMULATION

Saliva can be stimulated by various means. The easiest and least invasive method is mechanical, or chewing, stimulation.<sup>18</sup> Chewing sugarless gum is beneficial in that it stimulates salivary flow as well as aiding in the clearing of food debris from the oral cavity. This is not only through the chewing action but also through the fact that all sweeteners increase salivary flow.<sup>19</sup> The increased flow rate enhances the antibacterial, buffering and lubricating qualities of saliva.<sup>9</sup> Chewing xylitol sweetened gum is particularly advantageous due to its damaging effect on *Streptococcus mutans*, the major bacterium implicated in caries development. (Figure 2) Xylitol is not easily digested by *Streptococcus mutans*. Thus, the presence of xylitol inhibits the growth of *Streptococcus mutans* and limits its ability to produce plaque.<sup>20,21</sup>

Chemical stimulation can also increase salivary flow. Sugar-free lozenges containing citric acid are often used. The downside of this approach is that it may shift the oral pH (normally between pH 6 and 7) into the critical acidic zone below pH 5.5 where enamel erosion begins.<sup>1,8</sup>

Some medications decrease salivary flow; others increase sali-

vary flow and can be used to treat xerostomia. The most established pharmacologic agent is pilocarpine. This drug is used in the treatment of glaucoma where one of its major side-effects is excessive salivation.<sup>22</sup> The downside of this approach includes other significant side effects such as sweating, chills, dizziness, nausea, diarrhea or constipation.<sup>23</sup>

Other treatment options such as acupuncture,<sup>24</sup> and the electrical stimulation of the major salivary glands<sup>25</sup> have been explored, but have not become mainstream.

## SALIVARY SUBSTITUTION

Saliva substitutes and oral lubricants are over the counter products that are formulated as solutions, sprays or gels. They contain glycerin and various forms of cellulose (carboxymethyl or hydroxymethylcellulose) that create a pleasant mouth feel. The relief provided is for a limited time.<sup>26</sup> The most effective treatment is through multiple delivery systems during the day and especially prior to bed.

Many patients with profound xerostomia suffer from mucosal irritation. Alcohol based rinses amplify these symptoms<sup>9</sup> and must be ruled out. The lubricating products should have a neutral pH range to keep oral irritation at a minimum and to

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**FIGURE 4**—The Water Flosser (Water Pik) enables the dry mouth patient to effectively flush out accumulated food debris.

**FIGURE 5**—Stannous and Sodium Fluoride gels especially in combination with xylitol help decrease the high caries risk in severe xerostomia.



**FIGURE 6**—The remineralization product Novamin is in XPUR toothpaste (Oral Science).

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control the high dental erosion risk in xerostomia patients. GC Dry Mouth Gel (GC America) was developed to stabilize oral pH in the neutral range.

Sodium lauryl sulfate (SLS) is an ingredient which must be avoided in patients experiencing xerostomia since it increases dryness and mucosal irritation.<sup>27</sup> SLS is included in many toothpastes for its foaming action, a feature that has come to be associated with a more effective cleaning experience. Foaming is not essential for cleaning and xerostomic patients should not use SLS containing products. Foaming toothpastes, without the SLS ingredient (Aquafresh and Sensodyne isoactive formulations, GSK), have been developed for patients who insist on this particular mouth feel when brushing their teeth.

Biotene (GSK) has salivary

substitution products in gel, spray and moisturizing liquid form. (Figure 3) They can be used throughout the day depending on the patient's needs and preferences. Biotene Oral Balance Gel provides longer relief, especially at night, while the moisturizing liquid is for daytime symptoms. The spray is portable but its effect is of shorter duration. These products contain a unique salivary enzyme-protein system that supplements the missing salivary enzymes that are lost in hyposalivation.

The Biotene system includes one protein and two enzymes, both naturally present in saliva, that have antimicrobial properties. The protein is lactoferrin, a substance which removes iron from bacteria, a material that is necessary for microorganism growth. The two enzymes are lysozyme and lactoperoxidase. Lysozyme splits bacterial cell walls, thereby killing the microorganisms. Lactoperoxidase is an

enzyme that is essential in the synthesis of hypothiocyanite, another potent antimicrobial agent. Studies have shown definitive improvement in oral dryness and discomfort with the use of the Biotene system.<sup>27,28</sup>

#### AT-HOME STRATEGIES FOR PATIENT COMFORT AND ORAL DISEASE PREVENTION

The following strategies should be incorporated into the patient's at-home regimen to improve comfort and prevent disease. They include some of the systems already discussed.

The following list of "do's and don'ts" is focused on restoring comfort for the patient.<sup>26,9,6,29</sup> (Table 3):

1. Chew xylitol flavoured gum for enhanced salivary output. If not a gum chewer, use xylitol candies
2. Use saliva substitute products (liquids, gels and sprays) to moisturize and lubricate oral tissues throughout the



**FIGURE 7**—The remineralization product Recaldent is in MI Paste (GC America).



**FIGURE 8**—The remineralization product Tri-calcium phosphate is in Clinpro 5000 (3M ESPE).

- day as needed
- 3. Ensure adequate water intake
- 4. Limit intake of caffeine, alcohol and other diuretics
- 5. Avoid alcohol-containing mouth rinses which further dry out oral tissues
- 6. Avoid toothpastes with the detergent sodium lauryl sulfate (SLS) that can cause mucosal burning in dry mouth patients
- 7. Use the Water Flosser by Water Pik before bed for complete flushing of accumulated food debris (Figure 4)
- 8. Apply lip balm regularly
- 9. Use a humidifier at night
- 10. Sleep on the side to avoid mouth breathing at night

The following at-home strategies counteract the complication of high caries risk in the xerostomia patient<sup>29,9,27</sup> (Table 4):

- 1. Chew xylitol gum. (The minimum effective anticariogenic dose is 5-7 g/day with a consumption frequency of at least 3 times per day<sup>30</sup>)
- 2. Limit consumption of acidic foods and drinks
- 3. Avoid using any liquid with an acidic pH as a mouth moisturizer
- 4. Avoid using items containing sugar to stimulate salivary flow (gum, candies, etc)

- 5. Avoid frequent between-meal snacks especially those high in carbohydrates
- 6. Brush teeth after every meal
- 7. Floss at least once a day
- 8. For high risk patients, use a fluoride rinse or gel daily (1.0% sodium fluoride OR .4 % stannous fluoride). The over the counter products found in the pharmacy are less effective than the dentist dispensed prescription products. (The dental team must be educated on the relative merits of various fluoride products and their efficacy. Stannous fluoride has the enhanced benefit of reducing gingivitis and plaque when compared to other fluorides.<sup>31</sup> Xylitol and fluoride work synergistically to decrease caries incidence<sup>32</sup> (Figure 5)
- 9. Use a fluoride toothpaste (1000 or 5000 ppm depending on the severity of the demineralization) to promote remineralization of the teeth
- 10. Use products with remineralization properties like Novamin (XPUR toothpaste, Oral Science) Recaldent (MI Paste, GC America) or Tri-calcium phosphate (Clinpro 5000, 3M ESPE) to help remineralize affected areas (Figures 6,7,8)
- 11. Apply chlorhexidine if experiencing gingivitis
- 12. Have more frequent den-

tal examinations (every 3 months for the first year and from 3 to 6 months thereafter depending on the oral conditions)

**IN-OFFICE INTERVENTION TO PREVENT FURTHER COMPLICATIONS OF ORAL DISEASE**

Proactive intervention therapies in the dental office are necessary to prevent the further complications of oral disease that occur with xerostomia. These strategies vary depending on the severity of the symptoms. Patients with Sjogren’s syndrome and those with head and neck radiation will experience the most severe effects. The following therapies may be necessary in the more extreme cases<sup>29,9,27</sup> (Table 5):

- 1. Eliminate all caries through minimally invasive restorative procedures
- 2. If permanent restorations are not possible due to time constraints, use glass ionomers to restore the lesions and for caries control
- 3. Apply fluoride varnish to all the teeth
- 4. For patients with candidiasis, a prescription may be necessary for antifungal rinses, ointments or lozenges.

Edentulous patients with low salivary flow also face challenges. Dentures do not adhere well to

dry tissues and may slide around. Lack of lubrication increases frictional forces between the dentures and the oral mucosa causing sores. Denture wearers are also prone to bacterial and, in particular, fungal infections which cause inflammation (denture stomatitis). The dentist should check for correct fit of the dentures. Soft and hard tissue relines may be necessary. The patient may also require the use of denture adhesives and should be counseled to apply oral lubricants prior to eating.<sup>29,27</sup>

## CONCLUSION

Dry mouth is a common condition that affects many dental patients. Since it is defined as a subjective feeling of dryness, many contributing conditions are lumped together. It is important to determine and understand the specific causative factor or factors for the particular patient so that appropriate management protocols can be instituted.

Xerostomia sufferers range from patients who simply "feel dryness" to patients who have pronounced hyposalivation due to Sjogren's syndrome or head and neck radiation. The predominant cause of dry mouth is the effect of medications on the salivary glands.

After the cause is determined, the treatment follows step-by-step strategies. First, the lack of saliva is addressed through stimulation and /or saliva substitution to enhance patient comfort. Then the oral complications are managed by easy-to-follow protocols.

The dry mouth patient is part of our everyday practice. We must be able to recognize the condition and follow the management strategies. With this knowledge we will achieve greater success in treatment, and most importantly

have happier, more comfortable patients. **OH**

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*Oral Health welcomes this original article.*

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