

# Xerostomia – an Overview of Current and Evolving Therapies



by Linda M. Douglas, RDH

## Educational objectives

Upon completion of this course, participants should be able to achieve the following:

- Discuss the functions of saliva and the factors that influence salivary output.
- Pro-actively assess patients for risk of Salivary Gland Hypofunction (SGH).
- Discuss diagnostic techniques for SGH and related pathologies.
- Describe evidence-based components of a clinical maintenance protocol and self-care regimen that would be beneficial for xerostomic patients.
- Discuss current research on treatment of salivary gland hypofunction and xerostomia.

## Introduction

Xerostomia is a subjective complaint of dry mouth usually associated with Salivary Gland Hypofunction;<sup>1</sup> it affects at least one in 10 adults. In those older than 65 years of age, prevalence approaches 25 percent, while rates in institution-ized elders can be as high as 50 percent.<sup>2</sup> However, xerostomia is not a normal part of aging;<sup>3</sup> the number of medical conditions present or prescription medications being taken increases prevalence. The symptom of dry mouth can occur without an actual reduction in salivary flow: for example, using certain nasal sprays cause the mouth to *feel* dry, although salivary gland output is unaffected. Salivary Gland Hypofunction (SGH) is objective evidence of reduced saliva output.<sup>4</sup> SGH generates xerostomia when salivary flow is not sufficient to compensate for loss of fluid from the mouth; oral fluid is consumed by swallowing, absorption by the oral mucosa, and evaporation from the mouth. A 50 percent reduction in salivary flow can occur before xerostomia is noted.<sup>5</sup> Xerostomia is often called ‘the symptom which acts like a disease.’

## Saliva

The major salivary glands are the parotid, submandibular and sublingual glands; accessory glands are situated throughout the oral mucosa.<sup>6</sup> Salivary glands are regulated by the autonomic central nervous system; sympathetic response generally produces a low volume of viscous saliva, while parasympathetic stimulation produces watery saliva that is high in volume and ions. Saliva production is also affected by overall body fluid balance,<sup>5</sup> blood flow through salivary gland tissues, hormones, circadian cycles, body posture, and lighting; antidiuretic hormone decreases salivary output, while estrogen and testosterone increase resting salivary flow.<sup>7</sup> Salivary flow peaks in the late afternoon, diminishing to almost zero during sleep. Salivary output is higher when we are standing, than when lying down, and is reduced by approximately 40 percent in individuals who are blindfolded, or in the dark. Physical exercise produces sympathetic stimulation which diminishes salivary output, while olfactory stimulation temporarily increases salivation.

Whole saliva is the total output from the major and minor salivary glands; we produce about 500-600ml/day. Stimulated saliva contributes approximately 80-90

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### Salivary flow rates<sup>13</sup>

**Normal**

Unstimulated	0.3-0.4 ml/minute
Stimulated	1-2 ml/minute

**Abnormal (very low)**

Unstimulated	less than 0.1 ml/minute
Stimulated	less than 0.7 ml/minute

percent of daily salivary production.<sup>8</sup> Residual salivary volume is saliva left in the mouth after swallowing; it forms a thin, protective, lubricating film covering the oral surfaces. There are site-specific differences in the thickness of the salivary film, from 70-100 microns; diminished salivary films on the hard palate are associated with complaints of dry mouth.<sup>9</sup>

“Salivary lubrication, repair, lavage, antimicrobial and buffering properties contribute significantly to the maintenance of the integrity of the hard and soft oral tissue.”<sup>10</sup>

Research by Jensdottir, et. al., has found that salivary proteins reduce the erosive potential of cola drinks by up to 50 percent.<sup>11</sup>

Salivary flow (SF) is classified by the SF Index parameters as normal, low, or very low.<sup>12</sup>

### Etiology

Many oral and systemic conditions cause changes in the flow and composition of saliva. Prescription medications are implicated in 64 percent of xerostomia cases;<sup>14</sup> more than four hundred current medications have been reported to cause xerostomia. Xerogenic medications can be found in 42 drug categories; the major xerogenic drug groups are antihypertensives, and antidepressants, others include analgesics, statins, and antihistamines.

### How drugs cause SGH:

Alterations in fluid and electrolyte balance such as occurs with diuretics,<sup>15</sup> vasoconstriction of the salivary glands, or by affecting neural pathways.<sup>16</sup> Sympathomimetic drugs cause reduced volume of saliva, with increased viscosity, anticholinergic drugs reduce production of serious saliva. Chemotherapy drugs for cancer such as Cisplatin, cause tissue damage.<sup>17</sup>

### How diseases & conditions cause SGH:

Local factors include aplasia of the salivary glands, tumours, sialoliths, abnormalities of the salivary ducts, and radiation damage.<sup>17</sup>

Systemic factors include dehydration, sympathetic response, nerve damage, hormonal imbalances, and inflammatory response due to infection, or autoimmune disease. Xerogenic diseases and conditions include, anxiety, bulimia<sup>18</sup>, depression, diabetes,<sup>19</sup> thyroid disease, amyloidosis, scleroderma,<sup>20</sup> and Graft Versus Host disease.<sup>21</sup>

### Signs of SGH<sup>7, 10</sup>

- Dry, cracked lips and corners of the mouth.
- Thicker, “frothy” or “ropey” whole saliva (high salivary *Spinnbarkeit*).
- Lack of pooled saliva in the floor of the mouth.
- Difficulty expressing saliva during palpation of the major salivary glands.
- Dry thin, pale oral mucosa, loss of the moist, glistening appearance.
- Mouth mirror sticks to the tissue.

Complications include caries on roots and cusp tips,<sup>22</sup> a reddened, fissured, lobulated tongue, with atrophied papillae, and opportunistic infections, such as viral infections. Reduced salivary flow predisposes to overgrowth of *Candida Albicans*, causing candidiasis or angular cheilitis, particularly if dentures are worn.<sup>23</sup> Also, gingivitis, apthous ulcers, and cracked, bleeding, friable tissues. Mucositis occurs after radiation therapy or chemotherapy. Xerostomia accompanied by chronic salivary gland enlargement is associated with Sjögren’s syndrome,<sup>24</sup> sarcoidosis, HIV-associated salivary gland disease, chronic Hepatitis C infection, bulimia nervosa,<sup>18</sup> or lymphoma.



Lobulated tongue and root caries.

Image courtesy of Dr. Andy Wolff

### Oral Symptoms

- Halitosis.<sup>25</sup>
- Impaired taste.
- A sticky, dry or burning feeling in the mouth.
- Dysphagia, impaired chewing and speech.
- Food sticking to the teeth.
- Dental hypersensitivity.
- Dry, irritated tongue.
- Difficulty wearing dentures.
- Dry lips.

### Non-oral Symptoms

- Sleep disturbance.
- Limited food choices compromise nutrition
- Impaired compliance with a medication regimen due to difficulty swallowing pills, or delayed dissolution of sublingual tablets.
- Dry throat.
- Dry nose, changes in sense of smell.
- Dry, burning eyes, blurred vision.
- Dry skin and scalp.
- Heartburn, constipation.
- Vaginal itching, dryness and fungal infections.



Chronic salivary gland enlargement.

Image courtesy of Dr. Andy Wolff

**Risk assessment and diagnosis** starts with a thorough medical history review. This Xerostomia Screening Questionnaire might be used for risk assessment; it addresses the most common complaints associated with reduced salivary flow.<sup>4</sup>

1. Does the amount of saliva in your mouth seem too little?
2. Do you have any difficulties swallowing?
3. Does your mouth feel dry when eating a meal?
4. Do you sip liquids to aid in swallowing dry food?

If someone answers “yes” to any of these questions, they are at risk of abnormal salivary gland function. The Xerostomia Inventory (XI) is a more detailed questionnaire, which is often used for research.<sup>26</sup>

**Saliva testing aids a definitive diagnosis of SGH;**<sup>7</sup> commercially available kits can be used, like Orion Diagnostica, or Saliva-Check from GC America. To check minor salivary glands; dry inside the lower lip with gauze, and observe the time taken for droplets of saliva to form on the labial mucosa; it should not take more than one minute. Also, check for pooled saliva in the floor of the mouth, and its consistency.

To test unstimulated SF, the patient should fast, and avoid brushing and flossing for one hour prior to testing. The patient allows saliva to flow into a cup for five minutes, and the volume, color and consistency of saliva collected is noted. An abnormally low resting SF rate necessitates testing stimulated SF; before doing so, unflavored paraffin wax is chewed for five minutes, or one percent citric acid is applied to the tongue. To assist in diagnosing Sjögren’s Syndrome, parotid saliva is collected using a Lashley cup placed over Stensen’s duct.

An abnormally low stimulated SF rate indicates SGH; a stimulated SF rate less than 0.7ml/min is a predictor of caries activity. The pH and buffering ability of unstimulated and stimulated saliva might also be tested: 5.5 is the critical pH at which demineralization occurs; salivary pH should be 7.0-7.5. To test for cariogenic bacteria, the saliva collected is incubated at 37 degrees Celsius for 48 hours, and then checked for levels of colony-forming units per milliliter (CFU/ml); a new alternative to this is immunochromatography, which detects mutans streptococci (MS) levels within 15 minutes. MS Levels of greater than 100,000 CFU indicate high caries risk; Lactobacillus and MS levels should be less than 10,000 CFU/ml.

Diagnostic techniques used to detect pathologies associated with SGH<sup>27</sup> include blood testing and immunologic testing for autoimmune diseases or viruses, biopsy, and diagnostic imaging<sup>28</sup> to assess chronic salivary gland enlargement. In Magnetic Resonance Imaging,<sup>29</sup> a large magnet polarizes hydrogen atoms in the tissues; normal and abnormal tissue respond differently to this alteration in their magnetic field, giving differing signals, which are transferred to images. Computed Axial Tomography<sup>30</sup> uses a computer to assimilate multiple X-ray images into a 3D cross-sectional image. In Sialography,<sup>31</sup> a radiopaque contrast medium is injected into the duct, to visualize the anatomy of the gland and duct. For Scintiscanning,<sup>32</sup> a gamma emitting radionuclide, namely Technetium Perchnetate (Tc), is administered intravenously; if the salivary glands are functional, they take up Tc, and secrete it into the mouth. Ultrasound might also be used.

### Treatment

The Commission on Oral Health, Research and Epidemiology has established the following Principles for Xerostomia Treatment:<sup>33</sup> stimulation of secretion has the advantage of providing the benefits of natural saliva; most SGH cases retain a stimuable, albeit reduced salivary function; xerostomia usually remains a chronic condition, therefore sustained-acting preparations are ideal for longer-term management.

## Management of Xerostomia and SGH can be divided into seven main goals:

- Hydration.
- Stimulation of salivary flow.
- Saliva substitution.
- Slow/reduce the loss of functional salivary gland tissue.
- Prevent caries, promote remineralization.
- Prevent soft tissue injury and infections.
- Improve comfort.

Adequate hydration<sup>5</sup> is crucial for salivary secretion. If not contraindicated by any medical condition, increase water intake to eight to 10 eight-ounce glasses per day, use an air humidifier,<sup>34</sup> and keep water close by at nighttime.

Salivary glands are highly responsive to stimulation<sup>16</sup> of taste, masticatory muscles, and sensory nerves of the oral mucosa; a regular chewing gum habit also causes a prolonged increase in unstimulated SF rate.<sup>7</sup> Gustatory stimulation is achieved using flavourings, sugar substitutes and buffered fruit acids. Sonic brushing,<sup>35</sup> acupuncture,<sup>36</sup> electronic stimulation,<sup>37</sup> and systemic sialogogues<sup>38</sup> also increase salivation.

Saliva substitutes include dry mouth rinses, moisturizing oral gels, sprays and lozenges. MI paste with Recaldent is also an effective saliva substitute,<sup>39</sup> it moisturizes the oral tissues, and stimulates SF. MI paste is safe for individuals with lactose intolerance, but is contraindicated for those with allergies to benzoate (a preservative), or milk protein. Systemic sialogogues like Cevimeline, and Pilocarpine,<sup>38</sup> chemoprotective drugs like Amifostine,<sup>40</sup> and Targeted,<sup>17</sup> or Intensity Modulated Radiation Therapy,<sup>41</sup> reduce the loss of functional salivary gland tissue.

To prevent caries and promote remineralization, minimize sugar intake, apply fluoride varnish every three months, and apply MI paste nightly: casein phosphopeptides in Recaldent stabilize and localize amorphous calcium phosphate<sup>42</sup> at the tooth surface, reducing the adherence of bacteria, buffering pH, and enhancing fluoride uptake and remineralization (MI Plus also contains fluoride). Use neutral self-applied fluorides, such as gel in trays for five minutes once per day, or rinses, and brush three to four times a day with a 5000ppm fluoride dentifrice such as Omni ControlRx or PreviDent. Clean interproximally daily, and use a tongue scraper.<sup>43</sup> Xylitol<sup>44</sup> products include gum, mints, lozenges, dry mouth sprays and rinses: recommended dosage of xylitol is six to 10g per day; the gum is chewed for five minutes, three to four times daily. Chlorhexidine rinses reduce the oral population of cariogenic bacteria, pathogens and opportunistic micro-organisms: this is used daily, one week per month for six months. Sunstar Americas and Oral Dent Pharma make alcohol-free 0.12 percent chlorhexidine rinses. A one-minute rinse with 10 percent Betadine reduces the oral lactobacillus population for three to four months.<sup>45</sup>

Measures to improve comfort, and prevent soft tissue injury and infection include chlorhexidine rinses, eating moist foods, moisturizing lips with lanolin products, and using saliva stimulants and substitutes, (up to 15ml of Biotène rinse can also be sipped and swallowed for dry throat relief). Dry mouth gels can be used under dentures. Using paste with Recaldent or potassium nitrate relieves dental hypersensitivity.

## Patients with cancer

Salivation might be reduced by as much as 93 percent, when all of the major salivary glands are irradiated,<sup>46</sup> and there can be a lifelong risk of rampant caries, beginning as soon as three months after completing radiation treatment. A study by Lockhart and Clark found that 76 percent of patients attending a head and neck tumor clinic were *not* compliant with their dental care regimen;<sup>47</sup> these individuals really need our sup-

## General Tips

- Dental recare visits every three months for continuing care and support.
- Treatment of infections as required.
- If xerostomia is caused by medication, the physician might change the drug or adjust the dose.
- Treat the causes of mouth-breathing.
- Maintain meticulous oral hygiene; remove and clean dentures nightly.
- Rinse with water before eating.
- Drink liquids with meals and use broth or mayonnaise, etc., to make food easier to swallow.
- Take frequent sips of water.

## Exacerbating Factors

- Smoking is a local irritant; nicotine causes severe functional alterations in the salivary glands.
- Alcohol-based mouthwash, whitening toothpaste and tartar control products.
- Sodium lauryl sulphate.
- Hard, dry or salty foods.
- Chewable vitamin C, acidic, sugared lozenges.
- Carbonated, citrus and caffeinated drinks.
- Alcohol consumption reduces stimulated SF.

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Acupuncture points.

Image created by Danielle L. Douglas



Saliwell GenNarino.

Image courtesy of Dr. Andy Wolff

port; they should be monitored very closely, and commence a daily remineralization protocol before radiation therapy, continuing during and after therapy.

### Ingredients in dry mouth preparations, and rationale for their use

Water-based preparations are best, as natural saliva is 99 percent water. Amino acids, milk proteins, betaine,<sup>48</sup> and cottonseed oil lubricate, protect and retain moisture; as do olive oil, glycerin, linseed extract, and mucin-based preparations. Folic acid aids healing of trauma, and aphthous ulcers; hyaluronic acid might also be beneficial for aphthous ulcers.<sup>49</sup> Bicarbonate, calcium and phosphate buffer acids, while Recaldent works with fluoride to promote remineralization, and desensitize teeth; potassium nitrate also desensitizes. Xylitol<sup>44</sup> reduces the oral population of mutans streptococci (and porphyromonas gingivalis),<sup>50</sup> and provides gustatory stimulation of SF. Sodium citrate, buffered citric acid, anhydrous crystalline maltose<sup>51</sup> and various flavourings also provide gustatory stimulation, as does sorbitol, a sweetener with humectant properties. Aloe vera, slippery elm bark, xanthan gum, carboxymethylcellulose, hydroxyethylcellulose and carrageenan are hydrophilic; they add moisture, form a protective coating on the oral mucosa, and have a “slippery” feel, which replicates the viscosity of saliva. Lysozyme, lactoperoxidase and lactoferrin replicate antimicrobial enzymes found naturally in saliva.

### Innovative Therapies

**Acupuncture**<sup>36</sup> stimulates salivation by increasing blood flow over the parotid gland, releasing neuropeptides, which stimulate the autonomic nervous system. Three points are treated in each ear: these points affect the salivary glands, producing parasympathetic stimulation, and homeostasis; one needle is also inserted in the radial aspect of each index finger.

**Saliwell** is an intraoral, remote-controlled electronic saliva stimulator.<sup>37</sup> Saliwell devices demonstrate a three- to four-fold increase in SF, and relief from xerostomia in patients with severe SGH; neural stimulation improved with prolonged use. There are two options: Saliwell GenNarino, a removable device, and the Saliwell crown, which is attached to a dental implant.

### Interesting Research

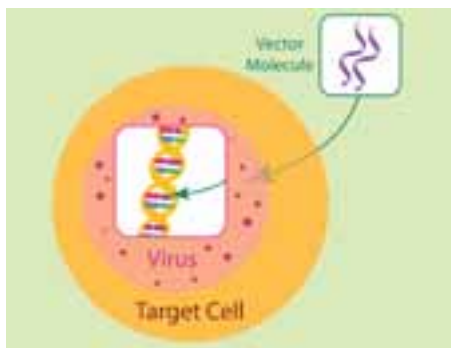
Some studies implicate Coxsackie Virus,<sup>52</sup> or Epstein-Barr Virus<sup>53</sup> in the pathogenesis of Sjögren’s syndrome.

One evolving therapy is gene therapy;<sup>54</sup> it regenerates damaged cells using a carrier molecule, (vector) to deliver a therapeutic gene to the target cells of the patient. The vector is usually a genetically altered virus carrying normal human DNA, it enters target cells to unload the therapeutic gene. There has also been research on immunotherapy for Sjögren’s Syndrome; a prototype vaccine was able to stop disease progression in mice.<sup>55</sup>

The findings of Hiroto’s study suggest that low SF rate, and high salivary spinnbarkeit, could constitute a high risk for periodontal disease in the elderly.<sup>56</sup>

### Conclusion

In the future we are likely to encounter increasing numbers of xerostomic individuals, who will need our support to maintain optimal oral health and quality of life. Xerostomia management also ties in with the new paradigm, Minimal Intervention Dentistry, and its emphasis on promotion of healthy saliva. ■



Viral Method of Gene Transfer.

Image created by Danielle L. Douglas

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## Author's Bio

Linda M. Douglas, RDH, graduated in 1982 from the Royal Dental Hospital School of Dental Hygiene in London, England. She also studied dental assisting at the Eastman Dental Institute. After working in Periodontology at The Royal Dental Hospital and University College Hospital in London, Linda moved to Toronto, Canada, where she has worked in general and periodontal private practice since 1990.

Her interest in xerostomia management has grown since encountering an increasing number of patients with this condition. Reading the literature on salivary function and the new paradigm, Minimal Intervention Dentistry, has raised her awareness of the significance of healthy saliva for optimal oral and general health.

**Disclosure:** Linda Douglas declares that neither she nor any member of her family have a financial arrangement or affiliation with any corporate organization offering financial support or grant monies for this continuing dental education program, nor does she have a financial interest in any commercial product(s) or service(s) she will discuss in the presentation.



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- Which is the most prevalent etiological factor in xerostomia?
  - Mouth breathing.
  - Prescription drugs.
  - Sjögrens syndrome.
  - Age.
- A normal unstimulated salivary flow rate is
  - 0.3-0.4ml/minute.
  - 1.0-1.7ml/minute.
  - 1-2ml/minute.
  - 0.1ml/minute.
- All of the following are mechanisms by which drugs reduce salivary flow except:
  - Sympathomimetic action.
  - Alteration of fluid and electrolyte balance.
  - Vasoconstriction.
  - Cholinergic action.
- The critical pH at which demineralization occurs is
  - 4.5
  - 5.5
  - 6.0
  - 6.5
- Which of the following do individuals with xerostomia commonly experience?
  - Halitosis.
  - Impaired taste.
  - Dental hypersensitivity.
  - Sleep disturbance.
  - All of the above.
- Which stimulated salivary flow rate is a predictor of caries activity?
  - Less than 0.7 ml/minute.
  - Less than 1.0 ml/minute.
  - Less than 1.7 ml/minute.
  - Less than 1.5 ml/minute.
- According to Lockhart and Clark's study, what percentage of patients visiting a Head and Neck Tumor Clinic were compliant with their dental care regimen?
  - 24 percent
  - 76 percent
  - 40 percent
  - 60 percent
- Acupuncture stimulates salivary flow by:
  - Stimulating the anticholinergic receptors in the salivary acini.
  - Increasing blood flow over the trigeminal nerve, releasing neurotransmitters, causing a sympathomimetic response.
  - Increasing blood flow over the parotid glands, releasing neuropeptides which stimulate the parasympathetic division of the autonomic nervous system.
  - Stimulating the neuropeptides in the acini of the accessory salivary glands to compensate for hypofunction of the parotid glands.
- The recommended daily dose of Xylitol for reduction of the oral Mutans Streptococci population is:
  - 3 g
  - 6-10 mg
  - 60 mg
  - 6-10 g
- According to Jensdottir et al, salivary proteins have been found to reduce the erosive potential of cola drinks by up to:
  - 25 percent
  - 50 percent
  - 15 percent
  - 75 percent

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# Continuing Education Answer Sheet

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## Xerostomia – an Overview of Current and Evolving Therapies

by Linda M. Douglas, RDH

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For questions, contact Rita Zakher, DMD, MBA, director of continuing education at [rita@dentaltown.com](mailto:rita@dentaltown.com)

### CE Post-test

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| 6.  | a | b | c | d |
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